



Data Quality Objectives

In its 2000 session, the Wyoming Legislature created new opportunities, procedures, and standards for voluntary remediation of contaminated sites. These provisions, enacted as Articles 16, 17, and 18 of the Wyoming Environmental Quality Act and implemented by the Wyoming Department of Environmental Quality (DEQ), will govern future environmental cleanups in Wyoming.

This Fact Sheet provides general guidelines for developing data quality objectives. This Fact Sheet is not intended to identify data quality objectives for any specific situation, but instead is intended to describe the process for developing data quality objectives that are site specific.

1. What are data quality objectives?

Data quality objectives (DQOs) are qualitative and quantitative statements that clarify the objectives of a site investigation, define the appropriate type of data to be collected, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data to support risk assessment, if needed, and site remediation decisions. DQOs are developed based on the current knowledge of the site (i.e., the current site conceptual model) and on the current phase of the project (i.e., the initial site assessment, initial sample collection, risk assessment, or remediation).

2. What is the purpose of DQOs?

The DQO development process provides a systematic planning approach for collecting environmental data. During DQO development, the intended use of the environmental data to be collected is determined and the quantity and quality of the data required is identified. A site characterization work plan (discussed in Fact Sheet #8 *Site Characterization*), consistent with the DQOs and the site conceptual model, is prepared and implemented. In the assessment phase, the results of the sampling, analysis, and other physical measurements obtained during the site characterization investigation are evaluated to determine whether the DQOs were met.

3. What is the advantage of developing DQOs?

The primary benefit of the DQO process is that it provides Volunteers with a method for clarifying how site decisions will be supported by environmental data and for establishing criteria for these decisions. In addition, development of DQOs establishes the nature of the problem prior to obtaining additional information, provides a higher likelihood that the quality of the data collected is consistent with its intended use, and optimizes the design for the sampling and analysis program. Development of DQOs also provides a planned approach to data collection and evaluation.

4. Is a single set of DQOs adequate for a project or is it necessary to have more than one set?

It is preferable to develop separate DQOs for different phases of an investigation. For example, DQOs may be developed during the early assessment of a site and also prior to sample collection, in support of a risk assessment, and for remedial activities. Additionally, objectives may need to be re-evaluated and modified as information related to the level of data quality is gained and assessed, and as the site conceptual model is refined.

5. How are DQOs developed?

The United States Environmental Protection Agency (EPA) has developed a seven-step systematic documented planning approach to prepare plans for environmental data collection activities. The results of the first six steps of the process are the qualitative and quantitative statements that become the DQOs for an investigation or for a specific phase of an investigation. The seventh step of the process is development of a work plan that is expected to satisfy the DQOs. The first six steps are addressed in question 7.

6. Can the DQO process be streamlined for simple sites?

It is necessary to complete each of the six steps of the DQO development process for all sites (simple or complex). However, each step of the DQO process is likely to require significantly less time for simpler sites than for complex sites. Also, the outputs (or DQOs) are likely to be shorter and simpler and are likely to rely less on statistical analyses for a simple site than for a complex site.

7. What are the six steps for developing DQOs?

Step One: State the Problem

The problem is the situation that needs to be investigated or investigated further. The problem is determined based on the site conceptual model developed at the beginning of the site characterization using known information about the site. As discussed in Fact Sheet #8 *Site Characterization*, the conceptual site model may include the location of known contaminants or potential contaminant sources; types of contaminants expected; types of media potentially contaminated (e.g., groundwater, surface water, soil, air, etc.); potential migration pathways; and potential human and ecological targets or receptors.

The output from step one may be a simple statement that describes the contamination problem or potential contamination problem that may present a potential threat or unacceptable risk to human health and the environment. Step one should be repeated and new outputs developed as the site enters into different phases of the site characterization or as the site enters into cleanup.

Example Output:

Subsurface soil and groundwater may be contaminated with gasoline-range petroleum hydrocarbons and related constituents [e.g., volatile organic compounds] due to a release in the northwest corner of the site.

Step Two: Identify the Decision

Identifying the decision is primarily a matter of stating the possible decision(s) that will address the problem. Several decisions may be necessary to address the problem; therefore, more than one statement may be included in this step.

Example Outputs:

- 1. Determine whether the concentrations of contaminants, if present, are a risk to human health and the environment.*
2. Determine whether or not contamination in groundwater has migrated offsite.

Step Three: Identify Inputs to the Decision

This step identifies the information that will be needed to support the decision(s) identified in step two. Types of information that may be required will depend on the site and the information already available. Some types of information that may be needed include physical soil and groundwater data, chemical data, historical data, and cleanup levels and/or action levels based on state and/or federal regulations. The output from step 3 is a list of information inputs required to resolve the decision statement.

Example Output:

Information needed includes concentrations of gasoline-range petroleum hydrocarbons and volatile organic compounds in site soil and in site and downgradient groundwater; screening levels for these constituents for each media; groundwater flow direction; and potential human and environmental receptors.

Step Four: Define the Boundaries of the Study

This step defines spatial (physical and geographical), temporal (time periods), demographic, regulatory, and political boundaries for the investigation. Identified during this process are the area and depth to be investigated, the media to be investigated (e.g., surface soil, subsurface soil, groundwater, surface water, air), the timeframe of the investigation, and the potential population (human, plant, animal) that could be affected. This step also defines the practical constraints that could interfere with the investigation. For sites where little to no environmental information is already available, the boundaries of the study may not be easy to define. The boundaries of the study may therefore either expand or reduce as more information about the site is obtained.

Example Outputs:

1. *Surface soil and subsurface soil to a depth of 12 ft below ground surface will be investigated within 50 feet of the release. Groundwater monitoring will be conducted quarterly at the property boundary and within the vicinity of the release. Human, animal, and plant receptors may be affected by the contamination if the contamination is present in soil or in groundwater.*
2. *Potential receptors for this site include residents and terrestrial plants and wildlife if soil is contaminated. Potential receptors also include fish and freshwater biota if groundwater is contaminated, because groundwater below the site discharges to a nearby lake.*

Step Five: Develop a Decision Rule

The decision rule is a logical “if...then” statement that describes the rule for taking certain actions in response to the findings of the investigation. The rule is most commonly applied to action and/or cleanup levels and the action taken if the action levels are exceeded.

Example Output:

If gasoline-range petroleum hydrocarbons in soil are greater than the action level, then the soil will be remediated. If gasoline-range petroleum hydrocarbons are present in groundwater at concentrations above the action level, the source of the contamination will be removed or treated and groundwater will be remediated.

Step Six: Specify Tolerable Limits on Decision Errors

This step establishes the degree of uncertainty (decision errors) that is acceptable to the decision-makers. Because it is impossible to sample all of a media being investigated, the samples collected and the corresponding analytical results must represent the media. The larger the area or volume that a sample represents, the larger the potential for error. For example, if a sample represents a large area of soil and the soil sample has contaminant concentrations exceeding the cleanup levels, the entire area represented by the sample will be considered contaminated. If not all of the soil represented by the sample is contaminated, some soil may be unnecessarily remediated. If no contaminants are detected in a sample, the entire area represented by the sample will be considered clean and a decision to not remediate that area may be made. If some soil represented by the sample is actually contaminated, contamination that should be remediated may be left in place. The more samples that are collected, each representing a smaller area, the more likely that the sample accurately represents conditions in the area, and the less likely that an incorrect decision will be made. The limit of uncertainty that is acceptable, therefore, may be driven by the risks to human health and the environment and the potential remediation cost. The limit of uncertainty that is decided to be acceptable will provide a framework for the sampling design.

Example Outputs:

1. *If a potential area of soil with contaminant concentrations exceeding regulatory criteria protective of groundwater is not identified and remediated, groundwater contamination may occur in the future. Because the groundwater at the site and within the vicinity of the site is a source of drinking water, the risk of not identifying potential groundwater contaminant sources is*

high; therefore, enough soil samples will be collected to statistically confirm a false negative rate of 10 percent.

- 2. The site is primarily covered with buildings. The soil beneath the buildings is not accessible; therefore, soil sampling will initially be conducted in accessible areas adjacent to the buildings. Results for this soil investigation and the groundwater investigation will be used to determine the need to perform soil samples in the less accessible areas.*

8. How can I get more information about the VRP?

To learn about VRP sites that may exist in your community, obtain copies of other VRP Fact Sheets/ guidance documents, get answers to your questions, or volunteer for the program, contact DEQ at (307) 777-7752 or through the VRP web site at: <http://deq.state.wy.us/volremedi/index.asp>.

The VRP web site includes all of the Fact Sheets and other guidance documents for the VRP. This web site is updated frequently and includes the latest information about DEQ's progress in developing guidance, policy, and other supporting documents for the VRP.

9. References

For additional information regarding development of DQOs, the Volunteer is referred to the following documents.

EPA. 2002. *Guidance on Choosing a Sampling Design for Environmental Data Collection, for Use in Developing a Quality Assurance Project Plan*. EPA QA/G-5S Final. U.S. Environmental Protection Agency. EPA/240/R-02/005. December. Available at: <http://www.epa.gov/QUALITY/qs-docs/g5s-final.pdf>

EPA. 2006. *Guidance on Systematic Planning using the Data Quality Objectives Process*. U.S. Environmental Protection Agency. EPA/240/B-06/001; QA/G4. February. Available at: <http://www.epa.gov/QUALITY/qs-docs/g4-final.pdf>

EPA. 2000. *Data Quality Objectives Process for Hazardous Waste Site Investigations*. EPA QA/G-4HW Final. U.S. Environmental Protection Agency. EPA/600/R-00/007. January. Available at: <http://www.epa.gov/QUALITY/qs-docs/g4hw-final.pdf>