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by T.K. Boguski

Collecting Environmental Information Using the Data Quality Objectives Process

Introduction

The Data Quality Objectives (DQO) process is a planning tool. Using this process to plan data collection activities has many benefits, including time and money savings and improved sampling designs. The DQO process helps you determine when enough data of sufficient quality has been collected to enable you to make accurate decisions.

There are seven steps to the DQO process:

1. State the problem
2. Identify the decision
3. Identify inputs
4. Define boundaries
5. Develop a decision rule
6. Specify limits on decision errors
7. Optimize the design

Each of these seven steps is discussed below and a simple example of each step is given.

Step 1: State the Problem

This step includes developing or refining a conceptual model of the site. A conceptual site model shows the locations of sources of contamination; the types and expected concentrations of contaminants; possible movement of the contaminants in the soil, water or air; and the location of people (or sensitive ecological receptors, such as plants or animals) who may be exposed to the contaminants.

This step also includes identifying the approximate amount of money that can be spent on sampling and analysis activities; people who will be involved; and other resources.

Example:
A certain property is the site of a former auto repair shop. A review of historical records and interviews with nearby residents indicate that barrels of used oil were improperly stored on the property for many years. Residents living on nearby properties have private drinking water wells and they are complaining of odors in their drinking water. Further investigation is needed to determine if contaminants from this property are affecting the private wells. The map below shows the area of concern.

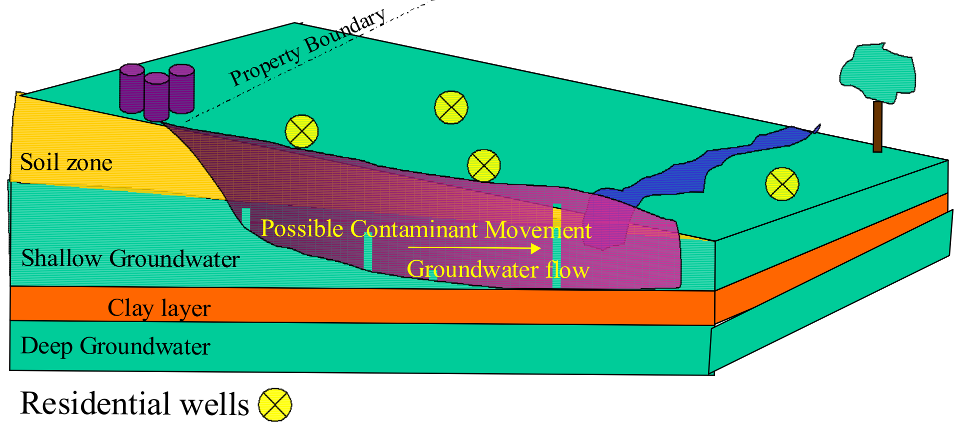

Figure 1. Site conceptual model.

Step 2: Identify the Decision

This step involves stating the problem and the alternative actions that could be taken to solve the problem.. Often the problem is stated in terms of one or more questions which must be answered. Then, different actions are identified depending on the answers to the questions. Identifying the decision allows the investigation to be more focussed which may save time and money.

Example:
The problem for the former auto repair shop is to find out if contaminants from the site are moving into residential water wells. The alternative actions depend on the answers to two questions:

1. Are contaminants migrating from the auto repair shop and polluting residential wells?
2. Are contaminant levels in the wells high enough to cause harm to human health?

If the answer to both questions is yes, then the action alternative may be to provide a different source of drinking water to affected residents and to further investigate the site and develop a cleanup plan. If the answer to question 1 is yes and the answer to question 2 is no, then the action alternative may be to further investigate the site and develop a cleanup plan. If the answer to question 1 is no and the answer to question 2 is yes, then the action alternative may be to provide a different source of drinking water to affected residents and to further investigate possible sources of the contamination. If the answer to both questions is no, then the action alternative may be to recommend that no further action is necessary. The decision based on possible answers to questions 1 and 2 are illustrated in Table 1.

Table 1. Identifying the Decision: Alternative Actions

Question 1	Question 2	Action Alternatives
Yes	Yes	A. Supply drinking water and further investigation and cleanup plan for the site
Yes	No	B. Further investigation of the site
No	Yes	C. Supply drinking water and investigation of other possible sources of contamination
No	No	D. Recommend no further action

Step 3: Identify Inputs

In this step, the information that must be collected in order to make the decision described in Step 2 is identified using the conceptual site model. A plan is made for obtaining this information. The appropriate methods and techniques for collecting samples and analyzing them are described.

Example:
An initial site assessment and limited sampling of the soil at the former auto repair shop is needed to help answer question 1 from Step 2. This input would show whether or not contamination exists at the site of the former auto repair shop. Sampling and analysis of residential well water is needed to help answer both questions 1 and 2. This input will determine if the residential wells are contaminated and if the contaminants could possibly be from the former auto repair shop.

The step for identifying inputs should include more detailed sampling and analysis plans. For example, the plan may include information such as this for the former auto repair shop. For the initial site assessment, four soil borings will be taken to a depth of 25 feet below ground level at specific locations on the site. The borings will be done in the areas where buildings existed and areas where barrels were stored. Since only a few residential wells seem to be affected, one water sample will be taken from each residential well where residents have complained of odors in their drinking water. Appropriate EPA-approved sample collection, transport, storage, and laboratory techniques will be followed.

Step 4: Define Boundaries

In this step, time boundaries and geographic boundaries are defined.

Example:
The investigation for the former auto repair shop may include making models based on spills and contamination that could only have happened during the years of operation of the shop. The geographic boundaries for the purpose of the initial investigation may include only the soil within the property boundaries of the shop and an area of groundwater migration determined by studying groundwater movement for the area.

Step 5: Develop a Decision Rule

The decision rule helps you to use the information from the previous steps in the DQO process for making good decisions. The people who may be affected are described in this step. The levels of contaminants in the soil and/or water that would cause different decisions to be made are identified and detection limits for testing purposes are verified. The testing procedures must be able to detect the contaminants at levels lower than the levels being used to made alternative decisions.

The decision rule may be in the form of an "if, then" statement. For example, the decision rule for the former auto repair shop may include statements such as:

> If contaminant levels in the soil at the auto repair shop are greater than State Maximum Contaminant Levels(MCLs) then further investigation and cleanup of the site will be required.

> If residential well water is contaminated with chemicals or oil at concentrations above the State drinking water standards, then an alternate water supply must be found for residents.

Looking back to Step 2 in the DQO process, these action alternatives are shown as alternative action "A" in Table 1.

Step 6: Specify Limits on Decision Errors

Understanding and controlling the errors associated with the sampling and testing plan is an important part of information collection. Decisions are only as good as the information used to make them. The science of statistics is often used to specify limits on decision errors. Statistics is the study of how to collect, organize, analyze and interpret numerical information. For a complex site evaluation, statistics may be used to help determine the number of soil and water samples that should be collected over what geographic area. Statistics also helps determine how many duplicate tests should be done to make sure the test results are accurate enough for decision making.

Step 7: Optimize the Design

This step is the goal of the DQO process. It ends with the most effective field investigation design that makes good use of time and money and generates information that is useful in making decisions. The information from the previous six DQO steps is used to develop the field investigation design.

The field investigation design will describe the methods that will be used, the type of samples that will be collected, the sample size, and the number of laboratory tests that will be run for each sample. Costs and timing for different alternatives will be considered along with the decision errors for each alternative. Alternative actions based on the results of sampling and testing will be described.

It is important to involve stakeholders (all interested and affected persons) when developing the optimal design. Each person should be able to review any assumptions and question the sampling design during the DQO process. The result of using the DQO process and involving stakeholders early in the process is usually a more streamlined and cost effective investigation and cleanup.

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