Optimization of Groundwater LTM Programs

Larry Jeffers and Carla Schultz
ADI Technology Corporation, 1800 N. Beauregard Street, Suite 200, Alexandria, VA 22311

Abstract – Each year, DoD spends millions of dollars on groundwater Long-Term Monitoring (LTM) programs. As LTM program costs become a significant portion of the Environmental Restoration Program (ERP) budget, it becomes increasingly important to evaluate these programs in terms of cost-effectiveness. The primary reasons for optimizing monitoring programs are to reduce monitoring costs and expedite site close-outs without compromising program quality. For new programs, a systematic planning process should first be employed to define the site-specific project goals and data quality objectives (DQOs). For existing programs, periodic LTM assessments must be conducted to allow for course corrections.

The data considered during the optimization process would typically include

- The LTM objectives
- the number and locations of monitoring points;
- frequency and duration of monitoring;
- target analyte list
- usefulness of field quality assurance/quality control (QA/QC) samples;
- the sampling procedures; and
- the documentation, data evaluation, data management, and reporting procedures.

Monitoring objectives will typically fall into one or more of the following categories:

- Validation of conclusions of a remedial investigation/feasibility study (RI/FS);
- Determination whether contamination is migrating off site or off base;
- Determination whether contamination will reach a receptor (such as a drinking water supply well);
- Tracking of contaminants exceeding some standard;
- Tracking of changes of shape, size, or movement of a contaminant plume;
- Assessment of the performance of a remedial system (including monitored natural attenuation [MNA]);
- Assessment of the practicality of achieving complete remediation; and
- Fulfillment of regulatory requirements (such as those for landfill closure).

A conceptual site model (CSM) is often used at this stage, as it can provide an initial description of all parameters relevant to contamination at a site. As a modeling tool, the CSM can be updated periodically with performance monitoring data to show progress toward goals and reevaluate corrective measures and monitoring strategies.

After the LTM objectives have been defined, they are described and documented in the Groundwater Monitoring Plan (GMP). The GMP is an essential tool for conducting an efficient program, as it provides overall guidance and contains the decision criteria for reducing and eventually ceasing monitoring altogether. Ideally, the GMP should be approved by the regulators before the monitoring program is initiated.

Every GMP should include the following components: a statement of program goals; a description of the current monitoring network; the list of target analytes; the frequency and anticipated duration of monitoring; specific field procedures to be used (e.g., purging, sampling, documentation, record keeping, etc.); analytical methods, sampling handling requirements (e.g., containers, preservation), and quality assurance/quality control (QA/QC) sample collection rates; data handling and reporting procedures; decision criteria (including exit strategies); and a periodic review process to reevaluate and optimize all of the above. Annual and 5-year reviews provide an opportunity to make any necessary changes to the monitoring program or the GMP.

The GMP should contain specific decision criteria for reducing the scope of the monitoring program over time. Streamlining the analyte list is a significant way to reduce the cost of a monitoring program. After the first year of sampling, it is often possible to reduce the list of analytes for which monitoring is needed. Using the decision criteria in the GMP, a recommendation could be made, for example, to eliminate SVOCs, pesticides/PCBs, and/or individual VOC compounds from an initial, comprehensive, analyte list (e.g. total compound list (TCL) organics and total analyte list (TAL) metals). These changes would result in a 46% decrease in the analytical budget, based on cost savings of $466/sample.

Applying appropriate data evaluation tools can provide an objective way to make specific decisions based on the data generated during the course of the LTM program. For instance, the Kriging geostatistical method can be applied to optimize sampling frequency and to define the network of essential sampling locations. This statistical tool will also identify areas where additional well may be needed to fill data gaps. The Mann-Kendall test or regressive analysis is used identify trends to support a recommendation to stop monitoring a well or site, if contaminant concentrations are found to be stable over long period of time. Other statistical methods, such as the Shapio-Wilks test and the single sample student's T test can be used to identify well concentrations that exceed regulatory standards. Other data analysis tools such as geographical information systems (GIS) increase the visual impact and aid in the comprehension of large amounts of data. GIS can be used to identify and track contaminant plumes and to create other over-area maps. GIS can also be used to compare monitoring data to decision criteria; this can expedite regulator buy-in regarding which wells to sample, which wells can be abandoned, and when to close out a site.

Considerable cost savings can be achieved by ending unneeded sampling. Example: If, after the first year, it were determined that half the wells in a 50-well monitoring network could be decreased to semiannual sampling and the other half decreased to annual sampling, over 60 percent of the analytical cost could be saved in the second sampling year. Based on analytical cost of $1,000/sample for 50 samples per round, an annual savings of $125,000 could be realized in analytical cost alone. In addition, the field sampling cost would be cut in half by eliminating two quarterly sampling rounds per year.

Several sampling tools are now available that can be used to improve sample quality while reducing the cost of the monitoring program. These tools include micro-purging techniques, diffusion samplers, and dedicated equipment. An evaluation should be made on a site-by-site basis to determine if one or more of these sampling tools is appropriate for a particular monitoring program.

Finally, cost savings can be realized by streamlining the Groundwater Monitoring Reports (GMRs). For example, quarterly and semiannual reports could be submitted electronically in tabular formats with little or no text. This will eliminate the need for comment resolution and revisions to the report. The annual GMRs would contain data presented in graphical and tabular formats, along with recommendations for optimizing the monitoring program, status of the decision criteria, changes to monitoring goals, and changes in the site conditions. In addition, the information contained in the annual GMR could be presented as a GIS package to the regulators in a data visualization type meeting. During such a meeting, real-time decisions could be made regarding specific recommendations made in the GMR. In summary, the most important tool in conducing an efficient monitoring program is having a flexible regulator approved GMP that contains decision criteria for decreasing and eventually ceasing the monitoring program.

References

NFESC, *Guide to Optimal Groundwater Monitoring*, January 2000.