US Army Corps of Engineers Focus on Long Term Monitoring

Douglas B. Taggart, David E. Splichal, * Laura J. Percifield, and Denise K. MacMillan

Engineer Research and Development Center, Environmental Laboratory, Environmental Chemistry Branch, 420 S 18th Street, Omaha, NE 68102

Long term monitoring of groundwater prior to site closure is a necessary but costly endeavor. The costs associated with sampling and laboratory analysis over 10 years of monitoring on the more than 1300 unique Army sites will be nearly $500M.[1] The Department of Energy estimates spending $100M per year over the next 70 years, and the Navy estimates spending $80M per year.[2] Expenses for sample collection and laboratory analysis can contribute up to seventy percent of the total cost of groundwater monitoring and fifty percent of the total cost of a site investigation. In an effort to significantly reduce capital outlays and operational monitoring costs, the Engineer Research and Development Center (ERDC) of the US Army Corps of Engineers has initiated a program to develop processes and technologies for more effective monitoring which will be both acceptable to the regulatory community and meet the compliance and expense needs of the Army. Program requirements are detailed in the Army Environmental Requirements and Technologies Assessments available on Denix and were refined during an LTM workshop held in Vicksburg, MS from Jan 14-16, 2003 and sponsored by the Corps and the Army Environmental Center. Briefly, the requirements dictate that field analytical techniques be developed that provide quick turn-around time for results (less than 4 hours), produce data that are acceptable to regulatory agencies, result in a 30% cost reduction compared to laboratory analysis, and are applicable to a wide variety of military unique chemicals (MUCs), including HMX, RDX, TNB, 1,3-DNB, tetryl, 2,4-DNT, 2,6-DNT, 2-NT, 3-NT, 4-NT, ammonium perchlorate, propellants, volatile organics (TCE, BTEX), and degradation products. The technologies also must be user friendly and able to be hand carried to the sampling site. The program goals will be addressed in three major work areas: 1) deployment of currently available commercial technologies that will reduce present operational costs; 2) development and implementation of new protocols for acquiring definitive data outside the analytical laboratory; and 3) development and deployment of new and emerging technologies for a near-real-time *in situ* monitoring system (RTISMS) for detection of volatile organics and MUCs.

Initial steps for reducing LTM costs will include identifying innovative sampling techniques and surveying commercially available technologies (COTs) for analytical monitoring. In a separate effort, the USACE recently performed a comprehensive study of five discrete interval-type groundwater sampling devices.[3] According to the study, the passive diffusion bag sampler (PDBS) appeared to be well suited for volatile organics such as trichloroethylene, which is a common contaminant at DoD sites. Expansion of the effective use of PDBS for non-volatile analytes such as explosives will be studied under the LTM program as a cost-saving measure. The Diffusion Sampler team of the Interstate Technology Regulatory Council (ITRC) will also soon start preliminary testing of new bags for use with semi-volatile analytes and metals.[4] Environmental field-testing technologies are also currently available,[5] but have not received wide use. In some instances, high detection limits, the need for highly trained personnel, and incompatibility with variable field conditions have restricted use of the technologies. After surveying COTS, technologies that appear to have potential for successfully meeting project data quality objectives will undergo limited laboratory and field evaluation as part of the LTM program. Findings from the surveys and evaluations will be published, and also be made on the program web site that is currently being developed. LTM program personnel will also provide training to Corps customers in use of field technologies for reducing analytical costs.

Environmental testing laboratories are able to generate data of known quality by following quality assurance protocols that include procedural documentation, training, audits, quality control sample evaluation, and data review. For field analytical methods to gain acceptance for producing more than screening data, similar quality assurance parameters need to be incorporated. Most quality assurance activities will translate directly to use in field work, however use of quality control samples presents an obstacle, especially for systems that are automated systems. Quality control samples such as blanks, laboratory control samples, matrix spikes and use of surrogates will be evaluated for technologies selected for further study by the LTM program. In addition, we are using historical laboratory data from long term monitoring sites to investigate appropriate sampling intervals and monitoring designs. Lengthening time between sampling intervals or limiting the target analyte list may be worthwhile cost savings approaches to monitoring in the interim before near-real-time *in situ* technologies are available.

Development and deployment of the RTISMS is the primary focus of the LTM program. We are currently surveying sensors, lab-on-a-chip devices and miniaturized detectors such as ion trap mass spectrometers. Our intent is to select devices that are still in development and with promise for cost-effective and scientifically valid monitoring, and optimize them for those purposes. Biofouling, lack of reproducibility, high detection limits, tendencies towards false negatives and false positives, matrix interferences, power supply incompatibilities, and inability to withstand environmental conditions are all problems that have been cited in the literature related to sensor research. After optimization to minimize such barriers followed by laboratory testing of a device, we will perform a limited field demonstration of the new technology at a typical long term monitoring site. The field demonstration will incorporate quality assurance protocols developed specifically for near-real-time, *in situ* monitoring of military unique chemicals and volatile organics.

Traditional LTM sampling and laboratory analysis are expensive, and costs avoided by use of alternative, *in situ* technologies could be substantial. The Corps LTM program must overcome several barriers before these savings can be realized, however. New sampling techniques, such as PDBS, in conjunction with optimized quality assurance protocols, and innovative on site technologies are likely to require higher initial operational costs due to training and installation of equipment. Regulatory acceptance of new technologies will require demonstration and validation of the techniques, and coordination with multiple agencies. User acceptance will require wide dissemination of the findings of the program, and continued support through District briefings, ERDC Technical Reports, journal publications, conference presentations, and web-based support. The program is scheduled to continue through FY09.

REFERENCES

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