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Technical and Regulatory Guidance for Using Polyethylene Diffusion Bag Samplers to Monitor Volatile Organic Compounds in Groundwater (DSP-3)

EXECUTIVE SUMMARY

Polyethylene diffusion bag (PDB) samplers are low-density polyethylene bags containing deionized water, used to collect water samples in groundwater wells for laboratory analyses of volatile organic compounds (VOCs). PDB samplers are passive devices, relying on the movement of groundwater from the aquifer or water-bearing zone through the screen or open interval of a well. VOCs in groundwater diffuse across the bag material until concentrations within the bag reach equilibrium with those in the surrounding groundwater. The technical basis for use of PDB samplers is presented in the U.S. Geological Survey Water Resources Investigations Report *User's Guide for Polyethylene-Based Passive Diffusion Bag Samplers to Obtain Volatile Organic Compound Concentrations in Wells* (Vroblesky 2001a, 2001b). The document in hand should be used in conjunction with the technical guidance in that report.

PDB samplers cannot be used to sample for all contaminants; metals and other inorganic compounds will not diffuse across the membrane. However, many VOCs have shown good diffusion characteristics in laboratory tests and are recommended for sampling with PDBs. For these common contaminants (listed in Section 1), PDB sampling is as valid as low-flow and other conventional methodologies and is often substantially less expensive over the life of a long-term monitoring (LTM) program. Cost savings in the range of 40%–70% have been achieved by replacing other sampling methods with PDB sampling. PDB samplers can also be an effective tool to characterize vertical VOC stratification in the screened or open intervals of wells and have been used to identify and delineate groundwater flow into surface waters.

This document provides a guide for regulators, technology users, and stakeholders to facilitate the use of PDB sampling, particularly for LTM. The technical guidelines for implementation in Section 2 are a consensus of the Interstate Technology & Regulatory Council (ITRC) Diffusion Sampler Team, which includes participants from nine different state regulatory agencies, as well as representatives from federal agencies, academia, and the private sector. Section 3 contains a set of sequenced questions to provide a quick preliminary screening of a site's potential for PDB sampling. Section 4 discusses regulatory issues related to PDB use, considers potential regulatory impediments to the implementation of PDB sampling, provides suggestions for expediting the process, and reports on a survey of state regulators' acceptance of the technology. No regulatory issues were identified that would restrict the application of PDBs in technically appropriate situations. The final sections provide a cost model to estimate the potential savings associated with conversion to PDB monitoring and present some case histories of the technology's implementation.

Groundwater sampling is performed to collect a sample that is representative of conditions in the

aquifer. Inherent differences between various sampling techniques may produce results that generate different representations of the aquifer, but no single sampling technique is the correct methodology—each has advantages and limitations. It is important to understand the conceptual basis and differences in sampling techniques when interpreting sampling results. PDBs may indicate contaminant concentrations higher or lower than those indicated using other sample collection methods. Therefore, it is essential that all parties involved in the implementation of PDBs for LTM at regulated sites identify and agree on data quality objectives (DQOs), data evaluation techniques, and data end use before actual PDB deployment takes place.

Regulatory guidance documents and permits, consent orders, other agreements, and sampling and analysis plans may specify or state a preference for a specific sampling methodology. Discussions with regulators should be held before deciding to deploy PDB samplers to determine whether alternative technologies will be acceptable. Negotiations may be needed to modify or amend permits, orders, and sampling plans; in some instances, public meetings may be required. Side-by-side comparisons of sampling technologies may be necessary to establish the applicability of PDB sampling to a well; however, for wells where there has historically been little variation in contaminant concentration and groundwater elevation, comparison of PDB sampler results to the historical record may provide enough information to determine whether PDB sampling is appropriate.

Potential vertical variations in VOC concentrations (stratification) should be considered when determining placement of PDBs in a well for LTM. The deployment of a single PDB sampler should include consideration of site-specific DQOs. Deployment of a single PDB may or may not be at the depth with the highest contaminant concentration. Reprofiling wells or changing the vertical location of an established PDB monitoring point is not necessary unless evidence suggests that there have been changes in contaminant transport, hydrodynamics, or well characteristics since the initial profile was obtained. The recommended minimum equilibration period for PDBs is two weeks for water temperatures above 10ºC. No maximum deployment period has been identified, but PDBs have been successfully left in wells for three months and longer. Concentrations of VOCs in the PDB reflect the aquifer conditions one to four days prior to the recovery of the PDB.

In general, when PDBs are used to investigate vertical concentration stratification, an 18-inch-long PDB should represent no more than 5 feet of a saturated screened interval or borehole. PDB sampling may be used for compliance purposes, including sentinel well monitoring and site closeout. If PDBs are used in sentinel wells with saturated screen or borehole lengths greater than 5 feet, multiple PDB monitoring points are recommended.

The ITRC Diffusion Sampler Team conducted a survey of state regulators in May 2003, primarily to identify any rules or regulations that would impede the implementation of PDB sampling. None were identified. The survey also sought the regulators' familiarity with PDBs and their views on specific applications for the technology. Based on the 54 responses received from 23 states, there is widespread regulatory support for using PDB sampling technology, particularly for LTM. Acceptance has been gained as more professionals become aware of its advantages. At the same time, awareness of its limitations justifiably results in "conditional" approval by many regulators. The application of PDBs should always be governed by site characteristics and DQOs.

This guidance document will help reduce regulatory barriers to the implementation of PDB sampling by educating regulators on the correct use, applications, and limitations of the technology; discussing issues of common concern to regulators; and providing tools (e.g., the

decision tree and cost model) to aid in evaluating the potential for PDB sampling at a site.