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Capstone Report on the Application, Monitoring, and Performance of Permeable Reactive Barriers for Ground-Water Remediation:

Volume 2

Long-Term Monitoring of PRBs: Soil and Ground Water Sampling



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Volume 2 - Long-Term Monitoring of PRBs: Soil and Ground Water Sampling

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Notice

The U.S. Environmental Protection Agency through its Office of Research and Development funded the research described here. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

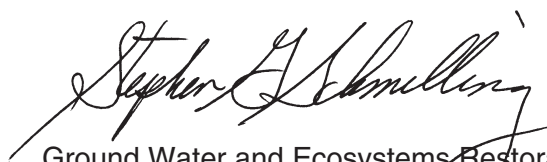
All research projects making conclusions or recommendations based on environmentally related measurements and funded by the Environmental Protection Agency are required to participate in the Agency Quality Assurance Program. This project was conducted under an approved Quality Assurance Project Plan. The procedures specified in this plan were used without exception. Information on the plan and documentation of the quality assurance activities and results are available from the Principal Investigator.

Foreword

The U.S. Environmental Protection Agency (EPA) is charged by Congress with protecting the Nation's land, air, and water resources. Under a mandate of national environmental laws, the Agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. To meet this mandate, EPA's research program is providing data and technical support for solving environmental problems today and building a science knowledge base necessary to manage our ecological resources wisely, understand how pollutants affect our health, and prevent or reduce environmental risks in the future.

The National Risk Management Research Laboratory (NRMRL) is the Agency's center for investigation of technological and management approaches for preventing and reducing risks from pollution that threatens human health and the environment. The focus of the Laboratory's research program is on methods and their cost-effectiveness for prevention and control of pollution to air, land, water, and subsurface resources; protection of water quality in public water systems; remediation of contaminated sites, sediments, and ground water; prevention and control of indoor air pollution; and restoration of ecosystems. NRMRL collaborates with both public and private sector partners to foster technologies that reduce the cost of compliance and to anticipate emerging problems. NRMRL's research provides solutions to environmental problems by developing and promoting technologies that protect and improve the environment; advancing scientific and engineering information to support regulatory and policy decisions; and providing the technical support and information transfer to ensure implementation of environmental regulations and strategies at the national, state, and community levels.

This publication has been produced as part of the Laboratory's strategic long-term research plan. It is published and made available by EPA's Office of Research and Development (ORD) to assist the user community and to link researchers with their clients. The purpose of this document is to provide detailed sampling methods and procedures used to collect soil and ground-water samples in order to evaluate the long-term performance of full-scale permeable reactive barriers (PRBs) installed to treat contaminated ground water at two different sites. This report provides methods to obtain representative ground-water samples and to evaluate geochemical parameters within and around a PRB. Proper analytical and quality control procedures, both in the field and in the laboratory, are also discussed for obtaining accurate and representative data for PRB evaluation and site assessment. The information provided in this document will be of use to stakeholders such as state and federal regulators, Native American tribes, consultants, contractors, and other interested parties.



Ground Water and Ecosystems Restoration Division
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Abstract

This report discusses soil and ground-water sampling methods and procedures used to evaluate the long-term performance of permeable reactive barriers (PRBs) at two sites, Elizabeth City, NC, and the Denver Federal Center near Lakewood, CO. Both PRBs were installed in 1996 and have been monitored and studied since installation to determine their continued effectiveness for removing contaminants from ground water. An effective monitoring program requires appropriate soil and ground-water sampling techniques.

For ground-water sampling, water quality indicator parameters must be monitored to determine when formation water has been accessed. Geochemical parameters include oxidation-reduction potential (ORP), pH, specific conductance, dissolved oxygen (DO), and turbidity. Field analytical methods are discussed along with interferences and issues which may arise when using certain electrodes or instruments in the field. Detailed field analytical procedures for hexavalent chromium, ferrous iron, alkalinity, hydrogen sulfide, and dissolved oxygen are described. Also included are laboratory methods for sample analyses for organics, cations, anions, and carbon. Sample collection methods, sample containers, preservation methods, and sample storage techniques are also discussed.

An effective soil sampling program also depends on methods employed to collect, preserve, and characterize solid materials. Core samples from the PRBs were collected to assess the distribution of mineral and biomass concentrations. Proper use of a conductivity probe to verify the exact position of the iron/aquifer interface prior to collecting core material is described, along with core collection methods. Laboratory methods for core processing prior to analyses are also detailed. Procedures for inorganic carbon, sulfur, and X-ray diffraction analyses, electron microscopy, and microbial characterization are discussed in detail.

In order to properly evaluate PRBs for long term performance, proper sampling methods and procedures must be employed, both in the field and in the laboratory, to provide accurate and representative soil and ground water data. Proper analytical and quality control (QC) procedures are also necessary to ensure accurate and representative data for PRB evaluation and site assessment.

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