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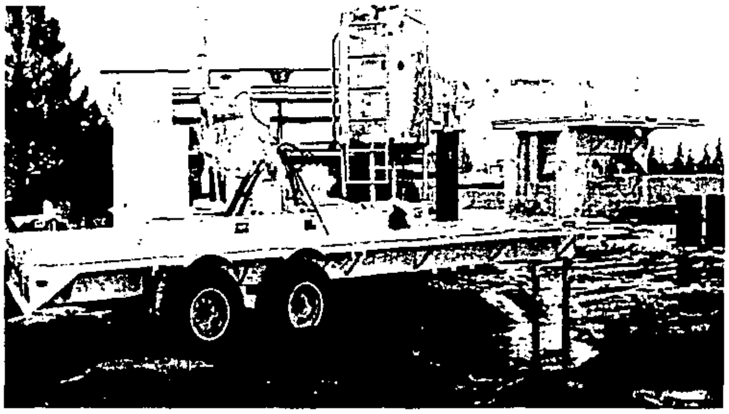
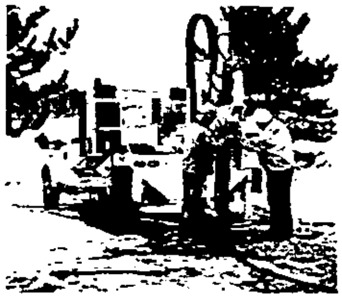
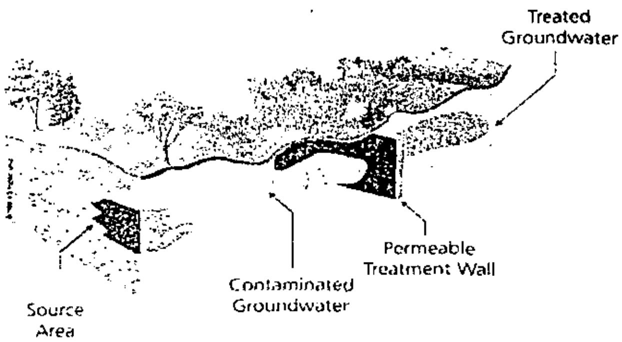
URS proposal for Install of
PRB system. pdf

Proposal for Installation of a Permeable Reactive Barrier (PRB) System
Volney, New York

Prepared for
Miller Brewing Company







URS

April 26, 2002

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URS

April 26, 2002

Mr. John Wettengel
Miller Brewing Company
3939 W. Highland Blvd.
P.O. Box 482
Milwaukee, WI 53201

Subject: **Proposal for Installation of Permeable Reactive Barrier System**
Former Miller Container Plant - Volney, New York

Dear Mr. Wettengel:

URS Corporation (URS) is pleased to present our proposal for the installation of a Permeable Reactive Barrier (PRB) System at the Former Miller Container Site in Volney, New York. This proposal is based on the work scope defined in the March 2002 Request for Proposal, a review of available site information, discussions with MBCo, and our previous experience at the site.

URS's turnkey approach offers significant cost savings over traditional subcontracting and a higher level of quality. We will self-perform this project utilizing our own construction personnel and equipment. The URS Team will also utilize technical personnel from our Albany office, who are very familiar with the New York State Department of Environmental Conservation (NYSDEC) standards and procedures. The local URS Team of professionals will draw technical and specialty resources from members of our national PRB Focus Group at other URS offices as needed.

URS has extensive experience in the application of PRBs to treat organic contaminants in-situ. Additionally, URS owns a fleet of direct push rigs equipped with our innovative injection/pumping system, enabling delivery of zero-valent iron into deep subsurface environments. Our proprietary system allows for PRB construction without site disturbances associated with conventional excavation techniques. It does not require benching down and generating spoils. URS is the industry leader in the design and construction of deep PRBs. Summaries of some of our most recent PRB projects are included in Appendix B.

Our approach focuses on minimizing project cost. In order to accomplish this goal, we propose completing PRB construction by the end of November 2002. This will allow MBCo to shut down the existing groundwater treatment system at the earliest opportunity, minimizing the costly O&M of the existing system. In addition, we will rely on monitored natural attenuation in conjunction with the PRB system, to achieve site closure as quickly as possible.

The outline of our proposal is as follows:

Section 1. *Project Understanding*

Section 2. *Proposed Project Team*. Qualifications of key project personnel are summarized in this section, and complete resumes are included in the Appendix A.

Section 3. *Work Plan for PRB System Installation*. Includes a description of all services and remedial activities to be performed for each area, in addition to a summary all of the assumption made to develop estimated costs.

Section 4. *Proposed Project Schedule*, based on the work scope defined in the RFP.

Section 5. *Summary of Project Costs*.

URS Corporation
122 South Michigan Avenue, Suite 1920
Chicago, IL 60603
(312) 939-1000
(312) 939-4198 FAX

Section 1. Project Understanding

Based upon our review of the background site information, and our previous work at the site, URS has developed the following site understanding.

The project site is situated on approximately 40 acres in the Town of Volney, New York. The facility was formerly an MBCo container plant that began operations in 1976. The property was purchased by Reynolds Metals (Reynolds) and continued operations as a container plant. Crysteel Manufacturing subsequently purchased the facility from Reynolds, and currently uses the facility for truck body production.

The work scope defined in the March 2002 Request for Proposal is in response Millers desire to update the existing groundwater remediation system in the Northern and Southern Operable Units (NOU and SOU) at the subject site. Miller and The New York State Department of Environmental Conservation (NYSDEC) negotiated a Consent Order for an Interim Remedial Measure (IRM), and installed a groundwater treatment system at the site in 1987. A second Consent Decree and Record of Decision were entered for the site in March 1995. Based on the ROD, Earth Tech developed a remedial design for an expanded groundwater recovery and treatment system for the site. The expanded system became operational in 1997. To date, Miller has operated the pump and treat for about 12 years. In addition, Miller also operates a groundwater treatment system for water produced by the City of Fulton municipal well field.

Miller requested that URS Corporation (URS) evaluate alternatives for groundwater remediation of the subject site in 1999. URS identified Permeable Reactive Barriers (PRBs) as a viable remediation approach through site-specific treatability tests and a full-scale pilot test. The bench and full-scale pilot tests were successful.

It is our understanding that the purpose of the RFP is for Miller Brewing Company (MBCo) to select and contract with an environmental services firm to design and construct a PRB system that will replace the existing groundwater treatment system at the subject site. Advances in remediation technologies, such as PRBs, provide Miller with the opportunity to implement a more cost effective remedial approach at the site, that meets the same objectives as the remediation option selected in the ROD, while significantly reducing overall life cycle costs.

Section 2. Proposed Project Team

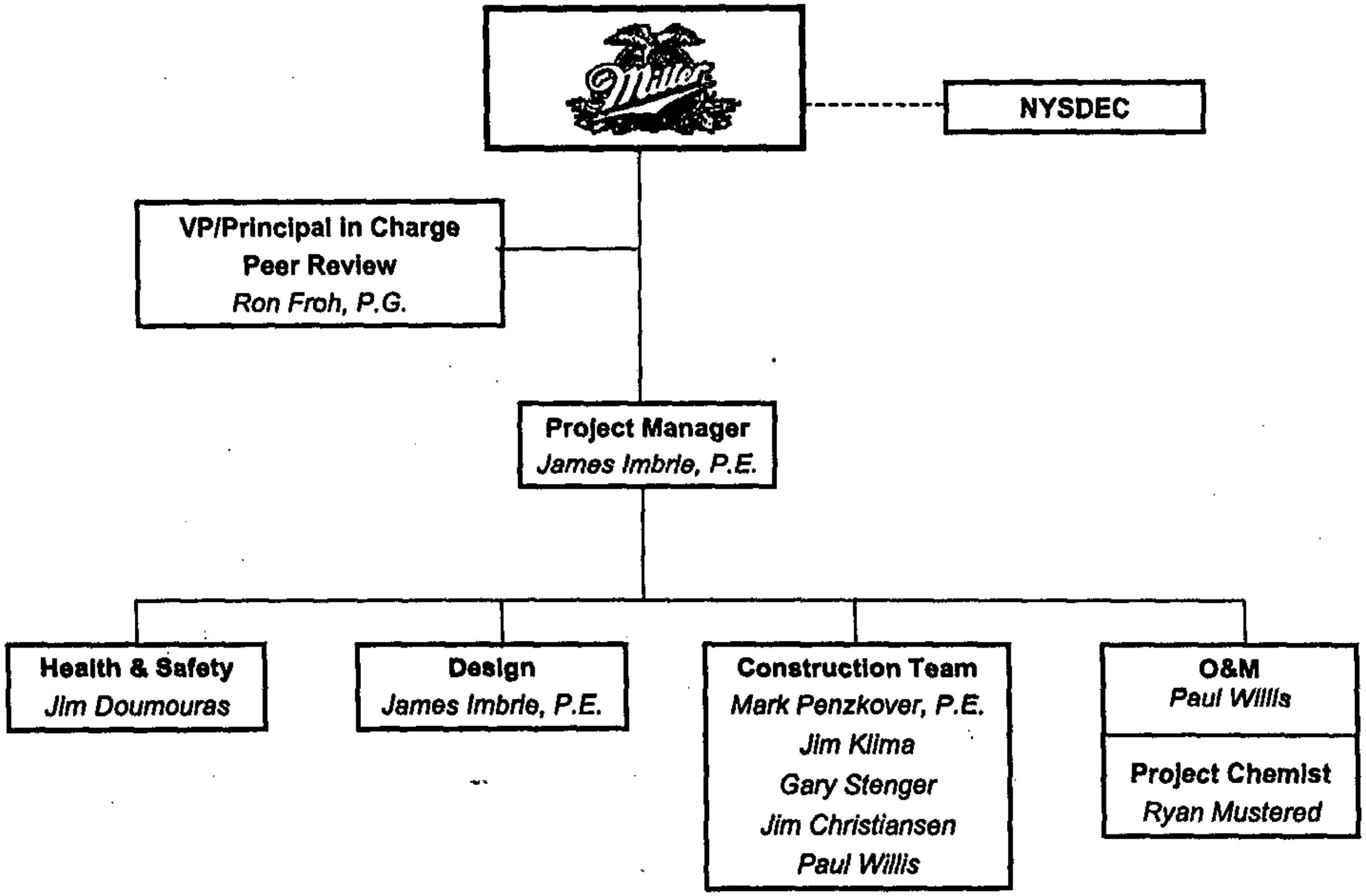
URS will lead this design build effort from our Regional office in Milwaukee, Wisconsin. URS operates professional offices in Albany, New York, and Milwaukee, Wisconsin. We will also utilize the professional staff in our local offices, including regulatory compliance specialists, geotechnical/civil/environmental engineers, geologists, hydrogeologists, scientists, construction managers, operators, laborers, and environmental technicians. Our local regulatory compliance specialists are very familiar with the New York State Department of Environmental Conservation (NYSDEC) standards and procedures.

As one of the few "true" design/build engineering firms, we design and perform the construction using our own proprietary construction equipment to provide complete "turn key" services.

The qualifications of key URS Team members that will be working on this project are summarized below. Figure 1 shows the responsibilities of our proposed project team. Appendix A contains complete resumes of these key team members, as well as other important project personnel.

FIGURE 1

MILLER PROJECT ORGANIZATION CHART



4/25/02

VP/Principal in Charge-Ron Froh As Vice President, Mr. Froh is responsible for the Construction and Remediation Services. In this capacity, Mr. Froh has used his background in development and application of innovative remedial technologies as a basis for saving money. Particular areas of expertise include in situ chemical oxidation, biodegradation, and developing innovative direct push delivery systems for the subsurface placement. With considerable experience developing low cost construction methods for the placement of zero-valent iron, Mr. Froh has successfully installed five permeable reactive walls using these injection techniques. These installations include bench scale and pilot study applications. Mr. Froh has been especially successful with developing technical relationships with numerous state regulatory agencies. He has shown through research that abiotic applications like zero-valent iron can be used to reductively dehalogenate chlorinated solvents. Mr. Froh is applying the permeable reactive wall technology to replace outdated technologies such as pump & treat. He has documented operation and maintenance cost reductions with passive in-situ applications for large commercial chemical and manufacturing clients.

Project Manager-James Imbrie, P.E. Mr. Imbrie is presently working as a Project Manager. His principal responsibilities relate to the management of remediation projects for the design, installation and operation of remediation systems for the cleanup of hazardous waste sites. Mr. Imbrie sits on a committee at an oil refinery that is responsible for overseeing the design, construction and operation of remediation systems. The facility currently has 32 remediation systems in operation. Mr. Imbrie also manages construction services for the permeable reactive wall team. He leads a team of construction engineers for all aspects of bench scale pilot study, and full scale PRW installation. Mr. Imbrie is also a member of URS's national focus groups for PRBs. Each focus group includes about 25 of URS's best technical experts. He has additional experience in feasibility studies, pilot studies, cost estimating, plans and specifications, and site assessments. He designed pilot scale applications of permeable reactive walls at several sites for chlorinated groundwater contamination in deep alluvial aquifers. Mr. Imbrie designed and managed the installation of the pilot scale in situ jet grout permeable reactive wall for Miller Brewing Company site in Volney, NY. He was responsible for the bench scale study and detailed design of an in-house injection system using a proprietary direct push rig and abiotic amendment pumping system. This system successfully placed 54 tons of zero valent iron with a guar slurry to 80-foot depths at the MBCo Volney, NY site. For another project, Mr. Imbrie designed and managed the pilot installation of an in situ 907015 permeable reactive wall in Jamestown, NY. He also managed the design of a PRB made of granular activated carbon for BTEX remediation at a site in Muskegon, Michigan.

Construction Manger-Mark J.K. Penzkover, P.E. Mr. Penzkover possesses over ten years of experience in environmental engineering, construction management, and operations supervision in the petrochemical and hazardous waste industries. His current responsibilities include the evaluation, design, specification, installation, construction supervision, and implementation of a wide range of civil and environmental engineering projects. His experience includes design of remedial systems, and construction project management on remediation projects throughout the Midwest. Other related experience includes hazardous waste management, permitting, pilot studies, cost estimating, operations management, and preparation of plans & specifications.

Construction Manager-James S. Klima Mr. Klima currently serves as a Construction Manger for URS. His responsibilities include project management, engineering design, hydrogeologic investigation, and design/ management for construction and remediation projects. He has participated in projects involving EPA, RCRA, NPDES, and OSHA regulatory compliance issues. In addition to project management of large remediation projects, his responsibilities include evaluation of existing remedial systems, design of innovative remedial technologies to achieve accelerated closure of contaminated sites, and construction for a wide range of civil and environmental engineering projects.

Health & Safety-James W. Doumouras Mr. Doumouras has 18 years experience in Health & Safety development and monitoring. His experience includes health and safety management in the consulting and utility fields. Mr. Doumouras has been involved in all aspects of safety and industrial hygiene compliance relative to confined space entry management, indoor air quality surveys, emergency response planning and management, company safety regulations development, accident record keeping, incident investigations, safety training, and repository fit testing and training. Mr. Doumouras will perform field safety audits, involvement in safety committee meetings, and development of the project Health and Safety Plan.

Site Supervisor-Gary E. Stenger Mr. Stenger has more than fourteen (14) years experience in heavy equipment operating, construction management at the foreman level, and specialized equipment (i.e. in-situ solidification) operation and maintenance at hazardous, non-hazardous, and radiological contaminated sties.

Site Supervisor-Jim Christiansen Mr. Christiansen is the manager in charge of the URS fleet of specialty probing and subsurface injection systems. His experience includes construction and operations management. Mr. Christiansen has been involved on the majority of innovative in-situ injections were applied. His extensive background provides the expertise required to develop and implement innovative site-specific delivery techniques (direct push, injection, jetting, horizontal, etc.) for the introduction of in-situ treatment media.

Site Engineer-Paul J. Willis Mr. Willis has experience in site and design engineering, subcontractor oversight, schedule tracking, remediation construction, survey control, and quality control of hazardous and non-hazardous waste projects. His expertise focuses on construction management, subcontractor management and field engineering.

Project Chemist-Ryan R. Mustered Mr. Mustered has experience in the areas of sampling program development, budgeting, and oversight; treatment system evaluation and monitoring and support; groundwater remediation system operation; quality assurance/quality control; laboratory services procurement and oversight; industrial hygiene; hazardous materials emergency response; waste management; permitting; site assessments; and training.

Section 3: Work Plan for PRB Installation

This section includes a description of all tasks to be performed, in addition to key assumptions made to develop estimated costs. The tasks detailed for each location are based on the work plan outlined in the Request for Proposal (RFP) and Remedial Action Work Plan (RAP).

Task 1 - Scoping, Planning, and Final Design (assuming a design/build approach)

URS will prepare a final design for the PRB system, and ancillary documentation including a Quality Assurance Project Plan (QAPP), and Health and Safety Plan (HASP). URS will request site access agreements at this time. URS will assist MBCo in making all arrangements to obtain site access agreements, should they become necessary.

Concurrent with final design activities, URS will support MBCo negotiations with NYSDEC for modification of the ROD for the proposed PRB system. URS has allowed up to 40 hours for negotiation with NYSDEC, preparation of submittals, and two meetings with NYSDEC in Albany, New York, including travel. Expedited negotiations are critical for maintaining the project schedule. Costs for this task do not include legal services for ROD negotiations or changes.

URS will communicate site activities to MBCo, and ultimately to Crysteel Manufacturing. All communications will have prior approval from MBCo.

Task 2 - Site Preparation and Well Installation: All PRB Locations

The PRB injection locations and monitoring wells will be staked, and temporary roads will be laid out by a surveyor licensed in the State of New York. The proposed PRB system will consist of three PRBs (PRB-1, PRB-2, and PRB-3) placed down gradient of the primary source areas at the site. PRB 1 will be installed at the NOU Taylor Property Location to treat water moving toward the municipal well field. PRB 2 and PRB 3 will be installed to treat groundwater moving from the two source areas at the NOU and SOU Crysteel Locations respectively. Figure 2 shows the proposed PRB, monitoring well, and temporary road locations.

Based on our experience at the site, under wet conditions surficial soils at the site can become quite unstable. To allow PRB construction to proceed efficiently we propose constructing gravel access roads. Gravel access roads will be constructed at each PRB location. The gravel access road at PRB 1 will be about 325 feet long and 15 feet wide. The access road at PRB2 will be about 300 feet long and 15 feet wide. The access road at PRB 3 will be about 400 feet long and 15 feet wide. The access road will be consist of a 6-inchs of compacted gravel fill. The access road will be constructed by URS construction crews.

incorrect, copied

Field support trailer and portable rest room facilities will be staged on the Crysteel property in a non-disruptive area (Figure 2). Electrical and phone service will be extended to the trailer.

The groundwater monitoring network (Figure 2) will be installed prior to the installation of the PRBs to allow for sampling to confirm design conditions. The monitoring well network will consist of one well nest at each end of each PRB, and one well nest down gradient of each PRB. There will be two wells per nest, 18 wells total. In addition, one well nest, (two wells) will be installed south of PRB 1 to confirm target constituents are not migrating towards the well field in that area. URS will install a total of fourteen (14) 1-inch diameter wells to complete the groundwater-monitoring network, and use three existing well nests. The wells will be screened in the deep and shallow zones to allow for an evaluation of hydraulic control and treatment over the vertical depth of the proposed PRBs. URS will also construct two temporary monitoring wells along the alignment of PRB 1 and PRB 3. These wells will be used to confirm influent concentrations to PRB 1 and PRB 3. In addition, URS will construct two temporary monitoring wells down gradient of the pilot test PRB. These wells will be used to confirm iron reducing bacteria do not pose a risk to the City of Fulton municipal well field. The wells will be installed using direct push technology (DPT). URS will provide all drilling, development, and permitting services associated with the installation of the the wells.

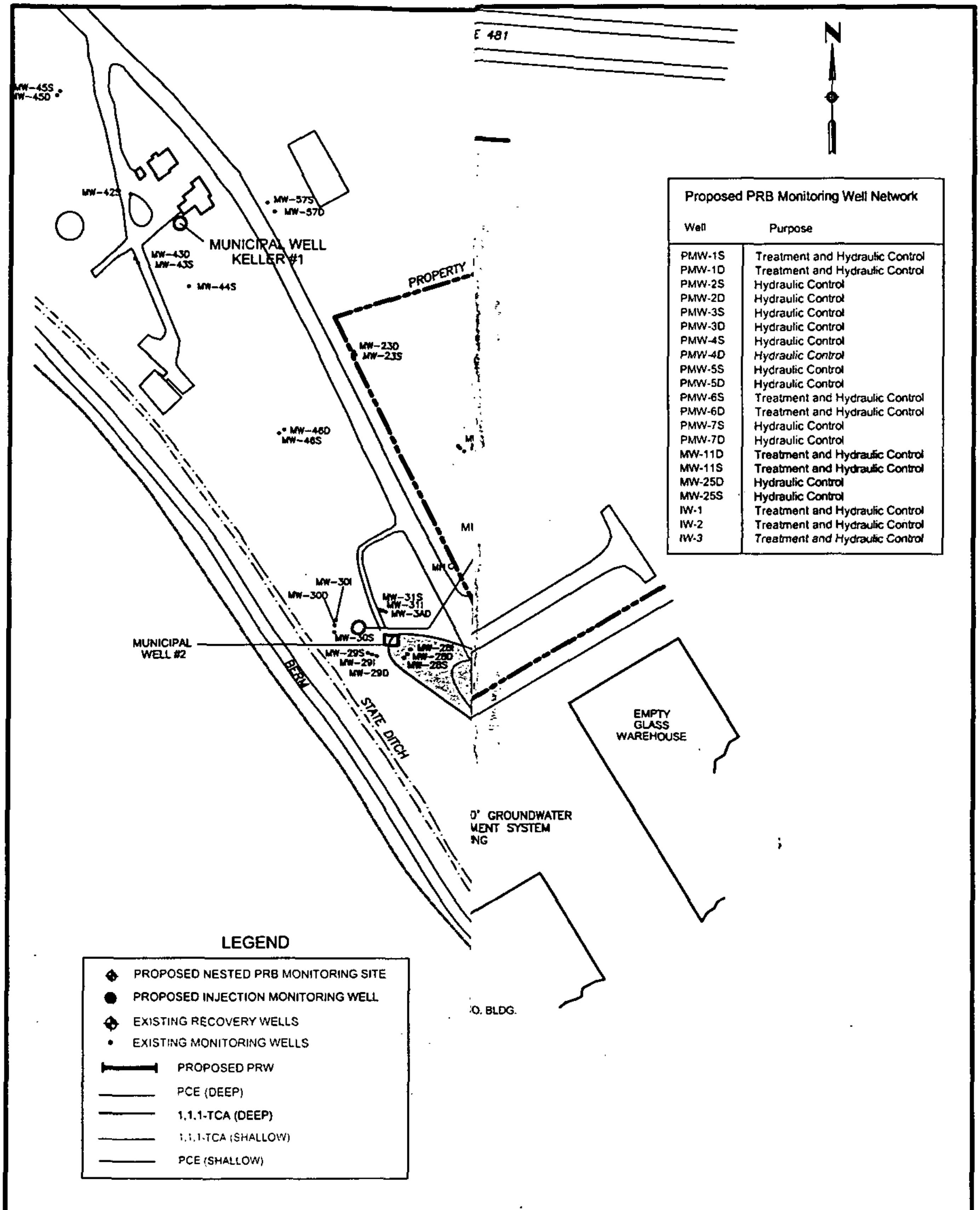
Design condition confirmation sampling will be conducted prior to installation of the proposed PRBs. The results of this sampling event will be used to confirm design conditions prior to PRB installation, and to establish baseline conditions. The wells will be sampled using diffusive samplers. Diffusive samplers are an innovative approach for sample collection that significantly reduces sampling costs. One sample per well will be collected and analyzed for VOCs following SW 846 Method 8021. Up to three samples per well will be collected in the temporary wells along the PRB alignments. One sample each will be collected and analyzed for iron reducing bacteria in the temporary wells down gradient of the pilot wall. The results will be included in the Maintenance and Monitoring Performance Report (M&M).

Task 3 - PRB Installation

The specific details on the PRBs are provided below.

PRB 1- NOU Taylor Property Location

PRB 1 will be constructed in this area to the dimensions (45' X 165') indicated on Figure 2. URS will obtain all required permits, and will self-perform all tasks associated with construction of the PRB. URS will advance fifteen (15) injections from about 24 to 68 feet bgs, and place approximately 260 tons of iron. We do not anticipate the generation of any spoils during the construction of the PRB.



Proposed PRB Monitoring Well Network

Well	Purpose
PMW-1S	Treatment and Hydraulic Control
PMW-1D	Treatment and Hydraulic Control
PMW-2S	Hydraulic Control
PMW-2D	Hydraulic Control
PMW-3S	Hydraulic Control
PMW-3D	Hydraulic Control
PMW-4S	Hydraulic Control
PMW-4D	Hydraulic Control
PMW-5S	Hydraulic Control
PMW-5D	Hydraulic Control
PMW-6S	Treatment and Hydraulic Control
PMW-6D	Treatment and Hydraulic Control
PMW-7S	Hydraulic Control
PMW-7D	Hydraulic Control
MW-11D	Treatment and Hydraulic Control
MW-11S	Treatment and Hydraulic Control
MW-25D	Hydraulic Control
MW-25S	Hydraulic Control
IW-1	Treatment and Hydraulic Control
IW-2	Treatment and Hydraulic Control
IW-3	Treatment and Hydraulic Control

NOTE: CONCENTRATIONS SHOWN ARE A COMPOSITE OF THE MOST RECENT SAMPLING EVENTS AND SUMMARIZED TO ESTABLISH CONDITIONS.

FIGURE 2

URS

MILWAUKEE, WISCONSIN 53226

PROPOSED PRB SYSTEM
FORMER MILLER CONTAINER PLANT
VOLNEY, NEW YORK

CAD DRAWING FILE: MILLER\B16

CONTRACT NO.	DRAWING NO.	REV.
261584.0125	B-16	

What's the H_2O level?

PRB 2: NOU Crysteel Location

Two extensions to the pilot test PRB will be constructed in this area. One extension will have the dimensions (15' X 105') the other extension will have the dimensions (15' X 70') indicated on Figure 2. URS will obtain required permits, and will self-perform all tasks associated with construction of the PRB. URS will advance sixteen (16) injections from 65 to 80 feet bgs, and place approximately 96 tons of iron.

PRB 3: SOU Crysteel Location

PRB 3 will be constructed in this area to the dimensions (50' X 245') indicated on Figure 2. URS will obtain all required permits, and will self-perform all tasks associated with construction of the PRB. URS will advance twenty-three (23) injections from about 26 to 76 feet bgs, and place approximately 337 tons of iron.

In addition to the PRB system, we propose relying on monitored natural attenuation (MNA) down gradient of PRB-1 and PRB-2 (Figure 2) to minimize project costs. Site data show a generally decreasing trend in these areas suggesting MNA will be effective. The application of MNA will depend on the outcome of MBCo negotiations with NYSDEC on changing the ROD.

Task 4 - Site Restoration and Demobilization

Site restoration will consist of sloping/tapering from the ground surface in the area of the access road and PRB injections to the nearby existing grade using topsoil, and re-seeding the area. URS will self perform site restoration. Our price for this item is based on the restoration of an area of approximately 14,000 sf. All URS field equipment will be mobilized from the site after restoration is complete.

Task 5 - Construction Documentation Report

A construction documentation report will be prepared. The report will contain injection records, and show the injection and monitoring well locations. As built drawings in Microstation format will be provided within three weeks of system installation and be incorporated as part of this document.

Task 6 - Maintenance and Monitoring

URS will prepare a Maintenance & Monitoring (M&M) Plan for post PRB installation. The PRB systems are passive treatment systems so there is no ongoing operation required. However, the systems may require limited maintenance should natural plugging of the PRB system occur over time. As part of the design, a flushing system will be designed for the PRBs to address this potential plugging. The flushing system would consist of dedicated 1-inch diameter piezometers placed near every other injection point to provide a means for flushing of the PRB with a mildly acidic solution. This system will not be a part of the installation described in this proposal. It would be installed, should it be necessary.

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To document the performance of the PRBs, monitoring will be performed on three (3) monitoring well nests at each of the three PRBs, and the well nest south of PRB-1. The monitoring well locations are shown in Figure 2. Samples will be collected using diffusive bag samplers for VOCs. Other parameters will rely on one composite sample per well at the middle of the well screen.

Samples will be analyzed for:

- VOCs (SW846 Method 8021)
- Alkalinity
- Metals (Ca, Mg, Fe)
- PH, temperature, conductivity
- Iron reducing bacteria
- Water levels

DO?
Alkalinity (OH^-)?
Redox pot (Eh)? (ORP)
Sulfate?

URS

Where? to determine what?

Sampling for VOCs will be conducted quarterly for 1-year. Geochemical parameters to evaluate PRB plugging will be collected semiannually for 1-year. The analytical results will be reported in a brief semi-annual report, and an annual maintenance and monitoring (M&M) report. Quarterly and semiannual sampling will be performed by Certified Environmental Services, out of Syracuse, New York.

Section 4: Proposed Project Schedule

URS has prepared a project schedule (Figure 3) which follows our work plan. The schedule is based on initializing the project in May 2002. Depending on regulatory negotiations and modification of the ROD, design would be completed during the late spring and early summer of 2002. Installation of the PRB system could be implemented during the summer and fall of 2002, as long as we are able to obtain access agreements in a timely manner. We anticipate completing construction of the PRB system before December 2002. Groundwater monitoring will be performed on a quarterly basis for one year following system construction.

Section 5: Summary of Project Costs

URS has prepared project costs based on the proposed PRB system (Appendix C). URS will perform this work under our existing contract with MBCo. The prices are for time and materials based on unit rates and fees in the existing contract. Labor rates and markups remain the same. We propose updating our existing contract with Miller to reflect the construction nature of this project. URS will make every attempt to execute this project ahead of schedule and under budget.

The key assumptions for costing are:

ROD changes and access agreements will be complete per our schedule. Delays in schedule may increase project cost, due to unfavorable weather conditions in the late fall and early winter.

PRB thickness is based on the results of bench-scale tests. At PRW-3, the concentration of target constituents is higher than the concentrations tested in the bench tests. Additional testing may change degradation rates and iron requirements at PRW-3.

no, but conditions may

PRB thickness and iron requirements are based on existing site information. Our understanding of site conditions may change based on our proposed groundwater sampling to confirm design conditions. Changes in our understanding of site conditions may change iron and injection requirements, and project costs.

Costs for air travel are based on $370 RT for Saturday travel. Changes in airfares may change project cost.

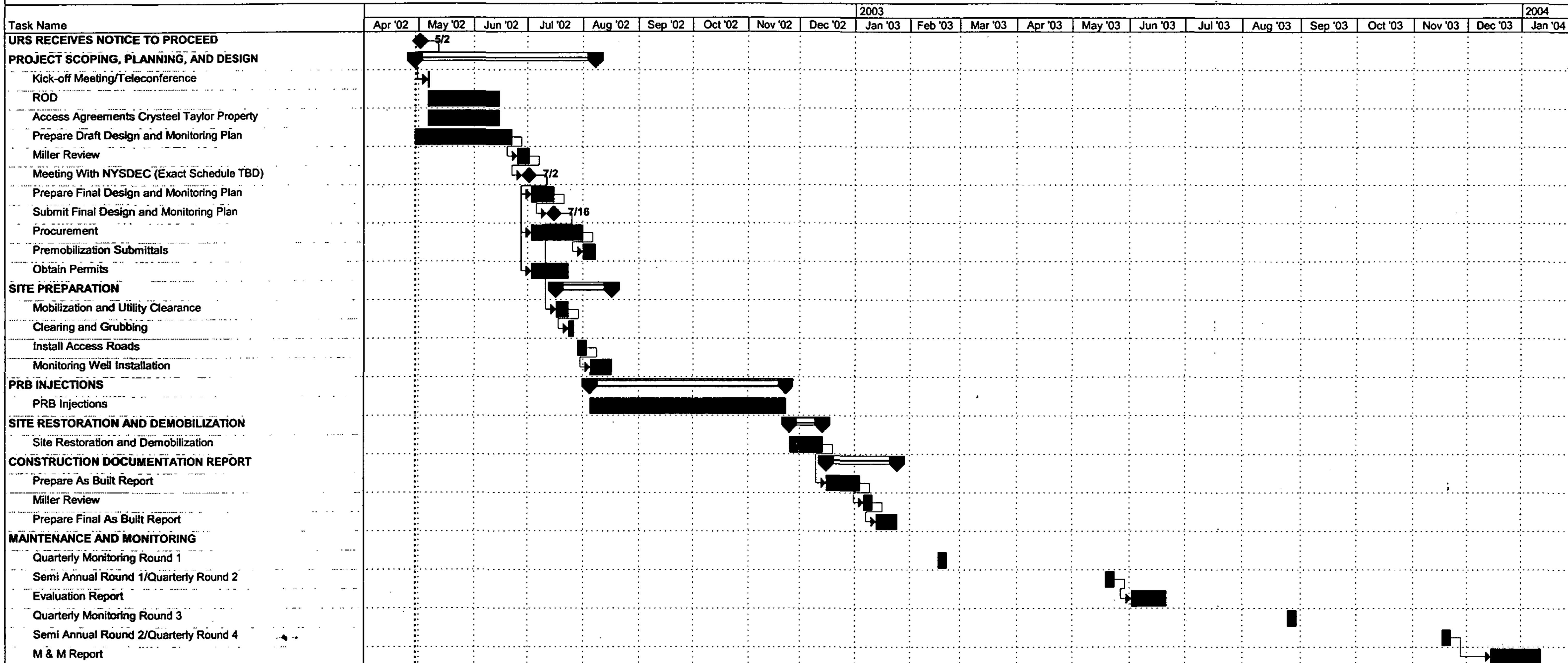
The costs presented are developed before completing the final design, and negotiated ROD changes with NYSDEC. Changes in design such as PRB placement, size, or acceptance of MNA approach by NYSDEC will change costs.

Costs for injections assume water from fire hydrants on-site will be available in quantities suitable for injection purposes.
Patent fees for the PRBs will be negotiated based on the final design. These fees may vary from the amount we anticipate in this proposal.

URS

Figure 3

Proposed Project Schedule
PRB System Installation
Former Miller Container Plant
Volney, NY



Diff. btwn task + Rolled up task?

Project: Schedule (4.25.02) Date: Mon 4/29/02	Task	Progress	Milestone	Summary	Rolled up Task

Monitored Natural Attenuation (MNA) monitoring is not included in project cost.

Costs assume drilling and injecting in fair weather, and do not take into consideration delays caused by excessive rain, subfreezing temperatures, or other unforeseen circumstances.

A copy of our certificate of insurance is contained in Appendix D. A list of subcontractors we will utilize during this project is contained in Appendix E.

Closure

URS appreciates the opportunity to provide a proposal for design build environmental services to MBCo for the Volney site. If MBCo has any questions, or requires additional information, please fell free to contact James Imbrie (414) 831-4115 or jamie_imbrie@urscorp.com). Thank you again for the opportunity to provide professional services to MBCo.

Sincerely,

James Imbrie

James Imbrie, P.E.
Senior Engineer

Ron Froh

Ron Froh
Vice President

Appendix A

URS Staff Experience

Ronald D. Froh

VP/Principal in Charge

AREAS OF EXPERTISE

- Project Management
- In-situ Remediation
- Design/Build/ Operate/Maintain
- Supervision of Large Complex Sites
- Construction Management
- Unique Business Solutions

EDUCATION

Michigan Technological University: BS, Geology-1981

PROFESSIONAL HISTORY

URS Corporation
Regional V.P. 1997-Present

GEO Environmental
President
1986-1997

Environmental Auditing Services
Vice President 1992-1996

TRAINING

- ITRC Monitored Natural Attenuation Courses
- Permeable Reactive Barrier Courses
- Intrinsic Bioremediation Courses
- ACS Abiotic and Biotic Technology Seminars
- Miller Heiman Sales Training Courses

REPRESENTATIVE EXPERIENCE

Mr. Froh is VP/Principal in Charge for remedial construction services. He has over 21 years of experience managing complex projects using innovative technologies and unique business solutions. His responsibilities include developing strategies that efficiently address end-focused solutions based on the lowest life-cycle cost. As a Vice President of URS, Mr. Froh has structured many contracts that deal with innovative pricing structures. Much of his experience stems from owning several national environmental construction companies and innovative niche service companies.

PROJECT MANAGEMENT

- Account Manager of a large industrial site in Northern Chicago. Innovative in-situ remediation of groundwater was completed using a zero-valent iron and guar gum slurry. The amendment was injected using direct push technology and high-pressure injection. The contaminant treated was chromium.

- Project Manager of a large Petroleum refinery in the upper Midwest responsible for the demolition and remediation of the site. Utilized innovative cost cap insurance mechanisms to manage liabilities of the site.

- Project Manager of a large Petroleum bulk terminal remedial cleanup in the upper Midwest. Innovative in-situ remedial technologies were utilized to reduce cost. Also, O & M costs were reduced by optimizing existing systems and using innovative technology.

- Account Manager of a new Industrial 500,000-gallon per day wastewater treatment plant. Innovative technology was utilized to meet stringent effluent treatment standards at the lowest life-cycle cost.

- Account Manager for a PCB sediment removal project in the Midwest for a major Industrial client. Project was completed under close scrutiny and expedited schedule of EPA Region V.

- Account Manager for a 44-acre lime pond capping project in Michigan. Significant costs were saved utilizing 60% design and real-time construction management communication. Project was a success coming in ahead of schedule with no OSHA recordables.

- Project manager responsible for an innovative in situ bioremediation solution for a chlorinated solvent plume in a shallow flowing sand aquifer. The remedial design was a low cost non-intrusive application at a manufacturing facility in the upper Midwest.
- Project manager for bioaugmentation of a gasoline plume in a car dealership site in Denver, CO. TPH concentrations were reduced to non-detect in three months using live cultured bacteria, nutrients, and ORC®.
- Project manager of an in situ biostimulation project in Salt Lake city, UT. Guar gum and zero valent iron filings were used to remediate a chloroform plume in a shallow high saline groundwater environment.
- Project manager at a pipeline release site in Colorado. An oxygen barrier wall was injected around the perimeter of a condensate plume in order to stop plume advance and promote microbial activity.
- Project manager at a site where 70 injection points were used to remediate a large diesel plume. ORC was injected in a high-energy alluvium sand zone to rapidly degrade diesel to non-detect at a site in Denver, CO.
- Designed a remedial solution for vinyl chloride in groundwater using ORC and nutrients. the application was designed to treat daughter products of a;biodegraded TCE plume.
- Designed a zero valent iron filings and guar gum treatment curtain at a manufacturing facility in the Northeast US. This application was coupled with monitored natural attenuation.
- Designed an in situ remediation alternative for hydrocarbon contaminated soils in a tight access application at a gas plant site in North Texas. A bioventing approach was utilized to liberate hydrocarbons from a shallow vadose soil plume under building and surface lines. A Radian Direct push rig was used to install shallow, one-inch PVC bioventing wells. Multiple small diameter wells were installed at a 60% cost savings over traditional large diameter wells. No soil waste was generated utilizing the ATV Scorpion probe
- Designed and participated in a totally in situ remediation

project using cross technologies. Free product thickness and extent was determined as well as groundwater flow direction. The free product was then removed using a "slurping" technique. The downgradient extent was surrounded by multiple Direct push injections of Oxygen Releasing Compounds. Additional injections of the time release oxygen were delivered in the heart of the plume after 3 to 6 months once concentration levels decreased from the enhancement of bacteria in the groundwater.

- Directed an emergency response condensate site characterization and immediate cleanup at a pipeline break in south Texas. A mobile lab and direct push rig were mobilized to determine the real-time subsurface condensate migration. Once the downgradient plume edge was determined, Oxygen Releasing Compound was injected to create a barrier wall of oxygen. This passive technique was successful in stopping the condensate from impacting a third- party landowner. The immediate public safety was addressed in one mobilization.

- Completed a due diligence project on a 26-mile-long pipeline project. Soil samples were taken at 3 to 5 feet every mile along the pipeline and at areas of visual surface staining. A mobile lab and direct push rig were utilized to delineate the extent of contamination on a quick turnaround. This approach was unique since the pipeline was in a remote area.

AREAS OF EXPERTISE

- Project Management
- Innovative Remediation Technologies
- Groundwater Remediation
- Design/Construct
- Soil Vapor Extraction (SVE)
- Groundwater Extraction
- Air Sparging
- Superfund Sites
- Management
- Operation and Maintenance (O&M)

EDUCATION

University of Wisconsin: MS, Civil & Environmental Engineering-1995

University of Wisconsin: BS, Civil & Environmental Engineering-1990

REGISTRATION

Professional Engineer, Environmental Engineer, Wisconsin--1997

PROFESSIONAL HISTORY

URS Corporation
Project Manager/Senior Engineer, 1999-Present

Advent Environmental Services, Inc.
Project Manager, 1996-1999

REPRESENTATIVE EXPERIENCE

Mr. Imbrie has more than 12 years of experience as an Environmental Engineer. Mr. Imbrie is presently working in URS's Milwaukee office as a Project Manager. His principal responsibilities focus on the management of projects that include the evaluation, design, installation and operation of remediation systems for the cleanup of hazardous waste sites. Mr. Imbrie also has experience in project management, feasibility studies, pilot studies, cost estimating, plans & specifications, and site assessments.

GROUNDWATER REMEDIATION

- Managed a number of remediation projects from the feasibility study through site closure. Responsible for all client, regulator and contractor contact, budgets, billings, reports, and all correspondence.
- Managed a design project for a groundwater treatment system that included wetlands treatment for a superfund site and managed the preliminary design report. The innovative design saved the client two to three million dollars.
- Managed an innovative groundwater remediation project with the Electronic Power Research Institute (EPRI) to apply permeable reactive barriers (PRBs) at two manufactured gas plant (MGP) demonstration sites. A full scale PRB will be installed this summer at one of the sites.
- Managed a pilot project that included bench tests and the installation of a 70-ft. long zero-valent iron PRB from 65-80 ft. below ground surface at an industrial facility. The PRB will address chlorinated compounds in the groundwater. this site
- Conducted a treatability study to determine the feasibility of a PRB constructed of granular activated carbon (GAC) to treat impacted groundwater. Designed the innovative PRB system based on the bench test and pilot study results.
- Managed a zero-valent iron pilot test for source control of chlorinated compounds at a major chemical company facility.
- Member of a committee that oversees remediation at a major petroleum refinery.

CH2M Hill
Project Manager, 1995-1996

Environmental Engineer, 1992-1995

University of Wisconsin-Madison
Research Assistant, 1990-1992

U.S. Geological Survey
Hydrologic Technician, 1985-1990

TRAINING

40-Hour HAZWOPER Training (OSHA)

- Member of URS's national focus group for NAPL and PRBs. Focus group consists of 25 of URS's top technical experts.
- Managed construction services for PRB team.
- Technical Manager for innovative remedial technologies group.
- Managed system installation and conducted system startup. Responsible for regulatory compliance of remediation systems, including city ordinances, zoning, all environmental permits and notifications. Responsible for system operation, maintenance and monitoring.
- Managed project consisting of 80 Phase 1 Site Assessments (PSIAs) and 15 potentially contaminated properties for a Wisconsin Department of Transportation (WisDOT) study.
- Performed a detailed evaluation of twelve groundwater and soil remediation alternatives for a major oil company site. Evaluated state regulations for both reinjection of process effluent and discharge to surface water.
- Conducted a detailed evaluation of eight alternatives to remediate soil and groundwater at four different sites at a USAF base. Wrote the engineering evaluation/cost assessment (EE/CA) report and reviewed state cleanup regulations for compliance.
- Conducted pilot studies to determine if soil vapor extraction (SVE), groundwater extraction, and air sparging would effectively remediate contaminated soil and groundwater. Collected and analyzed pilot study data, and wrote pilot study reports.
- Designed full scale SVE, groundwater extraction, and air sparging systems based on pilot studies. Modeled SVE capture zones using GASSOLVE, and Chevron criteria. Analyzed groundwater pump test data to determine capture zones using VMODFLOW, and WHPA.
- Conducted Phase I and Phase II Site Assessments for two industrial facilities. Managed the Phase II investigations, wrote the work plans, and reports.

AREAS OF EXPERTISE

- Project Management
- Construction Management
- Civil Design/Build
- Remediation System Design
- Industrial/Commercial Decommissioning & Decontamination

EDUCATION

Purdue University: BS, Civil Engineering-1989

PROFESSIONAL REGISTRATIONS

Professional Engineer (WI) License # 34455

PROFESSIONAL HISTORY

URS Corporation
Project Manager/Senior Engineer, 2000-Present

Superior Services, Inc.
Operations Manager/ Senior Project Engineer, 1999-2000

U.S. Oil Co., Inc.
Divisional Operations Manager/Environmental Coordinator, 1992-1999

Miller Engineers
Environmental/Civil Engineer, 1990-1992

TRAINING

40-Hr Hazardous Waste Operations & Emergency Response (HAZWOPER) training, Timeline™ and

REPRESENTATIVE EXPERIENCE

Mr. Penzkover possesses over ten years of experience in environmental engineering, construction management, and operations supervision in the petrochemical and hazardous waste industries. His current responsibilities include the evaluation, design, specification, installation, construction supervision, and implementation of a wide range of civil and environmental engineering projects. His experience includes design of remedial systems, and construction project management on remediation projects throughout the Midwest. Other related experience includes hazardous waste management, permitting, asbestos & lead abatement, pilot studies, cost estimating, operations management, and preparation of plans & specifications.

PROJECT AND CONSTRUCTION MANAGEMENT

- Project Manager for plating line decommissioning and remediation. Decontaminated an entire unused plating line, dismantled, and segregated for disposal or recycling. Excavated heavily-impacted soils and installation of a remediation system that would not impact future use of the area.
- Project Manager for a hazardous soil stabilization project. Approximately 124,000 cubic yards of hazardous lead-contaminated soil was excavated, treated with a stabilizing compound, and then disposed as a non-hazardous waste.
- Design and construction management of a petroleum bulk storage and fueling terminal. Duties included demolition of several buildings, remediation of contaminated soil, installation of a groundwater treatment system, and construction of the new fueling terminal (loading rack, containment dikes, storage tanks, and office/maintenance building).
- Design and implementation of a wastewater treatment system upgrade. Enhanced system to improve efficiency and significantly reduce waste products for the wastewater treatment system at a waste oil recycling plant.
- Conducted remedial investigations at over fifty sites throughout Wisconsin. Responsibilities included collection and analysis of hydrogeologic information, supervision of drilling and installation of groundwater

Project™ scheduling software, Continuous Improvement Process (CIP) training, Frontline Leadership training, DOT Hazmat training

monitoring wells, performance of aquifer testing, management of monitoring program, interpretation of site data, and composition of remedial investigation report.

- Designed over thirty full-scale remediation systems, including: groundwater extraction/treatment, soil vapor extraction, dual-phase extraction, air sparge, and soil stabilization. Responsibilities included performance of field pilot studies, site specific design modeling and calculations, selection of remediation equipment, preparation of detailed plan & specification bid documents, submission of bid request proposals, award of contracts, and project administration.
- Performed construction project management on over 150 remediation projects throughout the Midwest. Responsibilities included site health and safety plan preparation, project scheduling, subcontractor selection and management, equipment submittals, equipment and parts acquisition, labor and resource allocation, site construction and documentation, continuous interaction with regulating agencies and municipalities, remediation system startup, verification and preparation of as-built construction plans, invoice preparation, and payment review and approval.

James S. Klima
Staff Engineer/Project Manager

AREAS OF EXPERTISE

- Design/Construct
- Remediation Design
- Project Management
- Construction Management
- Subsurface Investigation
- Site Assessments
- Hydrogeology
- Geo-Engineering
- Geophysics
- Relational Database Management
- GIS
- Data Warehousing

EDUCATION

Univ. of Wisconsin-Madison: MS, Geological Engineering-1996

Colorado School of Mines: MS, Geophysics-1991

Univ. of Illinois-Champaign: BS, Geology-1988

PROFESSIONAL HISTORY

URS Corporation
Staff Engineer, 1997-Present

TRAINING

40-hr HAZWOPER, NUCA Competent Person, CPR and First Aid Certified

REPRESENTATIVE EXPERIENCE

Mr. Klima currently serves as a Staff Engineer for URS. His responsibilities include project management, engineering design, construction management, hydrogeologic investigation, and relational database design/ management for remediation projects throughout the Midwest. He has participated in projects involving EPA, RCRA, NPDES, and OSHA regulatory compliance issues. He has interfaced with clients from the utility, manufacturing, industrial, and governmental sectors, and with state regulatory officials primarily in Illinois, Michigan, and Wisconsin.

DESIGN AND CONSTRUCTION MANAGEMENT

- Prepared and reviewed design and cost estimate for permeable reactive wall (PRW) projects for various industrial clients, performed groundwater modeling to model capture zones for various PRW configurations (VMODFLOW), and developed PRW QA/QC methodology utilizing geophysical techniques.
- PRW designs include plume capture and source control. Installation methods include in situ injection and trenching.
- 2-PHASE extraction system design, construction, and operation and maintenance (O&M) for RCRA corrective measures at a major industrial site. Key project elements included developing an integrated subsurface interpretation (hydrogeology and extensive buried utilities), plans and specifications, regulatory reviews, and detailed budgetary cost estimates. Developed detailed Waste Management, Performance Monitoring, (O & M) Plans in accordance with regulatory requirements.
- Design engineer and site construction manager/inspector for remediation of a former manufactured gas plant (MGP) in the Illinois Site Remediation Program (SRP).
- Designed soil excavation, storm water drainage system, and bituminous cap and oversaw construction.
- Developed 100% design documents for Corps of Engineers (COE) project at an Army Air Force Station. Activities included development of remedial design plans and specifications for COE bid advertisement and preparation of a budgetary cost estimate.

- Design elements included several small excavations, removal of former filter bed sands, removal of an above ground storage tank, and removal of an existing hardfill landfill. Plans included a contingency for removal, handling, and disposal of suspect ACM.
- Developed work plans and was onsite engineer for RCRA landfill closure at an industrial facility (construction / excavation work), which included installation and operation of a dewatering and pre-treatment system for extracted groundwater.
- Development and execution of material segregation procedures, and operating procedures for handling buried suspect ACM (required air monitoring and level C PPE).
- Obtained permits from Federal, State, and local agencies including those involving work in the general floodplain overlay (GFO) and in a wetland.
- Developed bid specifications/drawings and was involved in subcontractor evaluation and selection.
- Field task leader for site investigation and remedial action along a former main railway yard. Investigation work included well installation, soil and groundwater sampling, managing analytical test results, and assisting in development of a site investigation report and an interim remedial action plan.
- Remedial actions included subcontractor procurement, excavation of impacted soil, and removal large debris area.

SITE ASSESSMENTS

- Project manager for site assessment at large industrial facility involving delineation of a listed hazardous waste and other compounds exceeding state groundwater enforcement standards.
- Supported Phase II efforts for project in central Illinois. Responsible for subcontractor procurement (drilling and analytical testing), overseeing site drilling, collecting samples for analysis, and managing analytical test results.
- Supported data collection and analysis of hydrogeologic conditions at a landfill to assess its current effectiveness and recommend potential improvements.

- Directed site investigation and collected soil samples for an agricultural chemical site (unknown contaminant source). Recommended for remedial design alternatives.
- Prepared a geotechnical soils report outlining the suitability of soil for loading dock and parking lot construction. Activities included supervising the data collection effort, providing geotechnical support, and coordinating report preparation.
- Performed field development of ultrasonic, nondestructive testing device for evaluation of annular seal integrity in monitoring and groundwater wells.

GIS / DATABASE MANAGEMENT

- Developed Geographic Information System (GIS) deliverable for EPA superfund site. Project included over 75,000 records from 1971 through 2000 and included extensive 2D and some 3D maps. Trained GIS staff.
- Developed GIS database for a large industrial client that included over 10 years of RCRA investigation data. Designed relational database structure and managed GIS team.

AREAS OF EXPERTISE

- Multidisciplinary Safety, Industrial Hygiene and Environmental Management
- Indoor Air Quality Surveys and Noise Pollution Studies
- Ergonomic Evaluations
- Phase I and II Environmental Site Assessments
- Regulatory Compliance Management: RCRA, CERCLA, SARA Title III, NFPA and DOT
- Emergency Response Planning and Management

EDUCATION

Northeastern Illinois University: Master of Arts, Environmental Planning, 1990

Bradley University: BS, Geography & Environmental Studies, 1983

PROFESSIONAL HISTORY

Commonwealth Edison
Safety & Industrial Hygiene Advisor/Manager, 1997-Present

OHM Remediation Services Corp.
Health and Safety Manager, 1996-1997

Roy F. Weston, Inc.
Environmental Scientist/Field Safety Manager, 1994-1996

REPRESENTATIVE EXPERIENCE

Mr. Doumouras has 18 years experience in Health & Safety development and monitoring. His experience includes health and safety management in the consulting and utility fields. Mr. Doumouras, within the last 6 years, was employed with a major public utility company based out of the Chicago Region managing and monitoring the health and safety program for an employee base of 800 individuals. Mr. Doumouras has been involved in all aspects of safety and industrial hygiene compliance relative to confined space entry management, indoor air quality surveys, emergency response planning and management, company safety regulations development, accident record keeping, incident investigations, safety training, and repository fit-testing and training. New duties for Mr. Doumouras will consist of weekly field safety audits to project sites, involvement safety committee meetings, and development of project Health and Safety Plans. He will also maintain involvement with other URS Regional offices and divisions on Health and Safety concerns.

RELEVANT PROJECT EXPERIENCE

- Coordinated emergency response management and cleanup procedures during major power outages within the city of Chicago, IL.
- Management and monitoring indoor air quality projects as warranted
- Conducted field safety audits at project sites on a daily basis.
- Established nuclear safety certification to support nuclear health and safety personnel during scheduled steam generator replacement projects.
- Managed and monitored safety and industrial hygiene protocols during large scale asbestos abatement projects.
- Conducted major building surveys for state owned property within Illinois for materials containing asbestos.
- Managed and monitored confined space entry programs.
- Managed and monitored hearing conservation programs.

Environmental Consultants, Inc.
Industrial Hygiene and Safety Consultant (Self Employed), 1987-1994

Particle Data Labs
Environmental Technician, 1983-1987

AFFILIATIONS

Air Sampling Professional
Asbestos Building Inspector

TRAINING

Confine Space Entry Program Development and Monitoring

Respiratory Fit Testing and Training

Construction Safety, Hazwoper, Asbestos, Blood Borne Pathogens, and Defensive Driving Training

AREAS OF EXPERTISE

- Construction Management
- Site Management & Oversight
- Heavy Equipment Operation
- Health & Safety Officer
- Hazardous Waste Disposal
- Soil/Water Stabilization

PROFESSIONAL HISTORY

URS Corporation
Construction Manager/ Operator, 1996-Present

WM. J. Lang Clearing, Inc.
Equipment Operator, 1990-1996

Midland Environmental Services, Inc.
Equipment Operator, 1992-1994

TRAINING

40-Hour HAZWOPER, 8-Hour Refresher, CPR-First Aid, Radworker I & II

Confined Space

OSHA Hazard Supervision Training

REPRESENTATIVE EXPERIENCE

Mr. Stenger has more than fourteen (14) years experience in heavy equipment operating, construction management at the foreman level, and specialized equipment (i.e. in-situ solidification) operation and maintenance at hazardous, non-hazardous, and radiological contaminated sties.

PROJECT AND SITE MANAGEMENT EXPERIENCE

- Construction Manager for demolition and remediation of a small chemical plant in Waukegan, Illinois. Responsibilities included state and local permitting activities, oversight of asbestos abatement, support of small demolition/excavation crew (3 operators/laborers), bidding and subcontract management, direction of bench testing of chemical stabilization agents, material procurement, and waste characterization/profiling. Also an active participant of the groundwater remediation team responsible for groundwater sampling, analysis of present and historical groundwater chemical analytical data, negotiation with regulatory officials and selection/implementation of a remediation technology designed to close the site.

- Construction Manager/Operator at The Dow Chemical Company's Sixth Street Pond Closure in Ludington, MI. Responsible for mobilization, access road construction, clearing of areas, construction of temporary and permanent erosion and stormwater control structure, general filling with subgrade soils over non-hazardous lime solids, capping with an impermeable liner, placing drainage layer and topsoil layer, establishing revegetation and landscaping, fencing, construction, and demobilization.

- Construction Manager/Operator for design/construction of an asphalt cap for Tyco Suppression Systems – Ansul in accordance with Wisconsin Department of Natural Resources regulations. The asphalt cap is approximately 5 acres and covers contaminated material in the 8th Street Slip, the Former Salt Vault and adjacent areas. Construction will be completed in two phases to allow for on-site treatment of contaminated surface water in the Slip. Phase I (late 2001) consists of the installation and maintenance of temporary and permanent erosion and sedimentation controls, access road paving, construction of a temporary dam and management of contaminated water, placement and compaction of off-site fill material for cap subgrade, drainage ditch construction, installation of a drainage culvert and partial installation of the asphalt cap. Phase II (mid 2002) consists of maintenance of temporary and permanent erosion and sedimentation controls, placement and compaction of remainder of cap subgrade material and completion of the asphalt cap. Final use of the site will be as a storage area. Supervised 5-6 people consisting of staff engineers, construction crew (non-union) and support staff.

- Lead Operator/Foreman for the excavation and rail operations for The Dow Chemicals Thorad Site in Bay City, MI. This project involved the remediation of two low level radiological waste storage sites containing approximately 140,000 cubic yards of Thorium impacted material within a 42-acre area. Project activities included waste delineation, excavation and transport (truck and rail) followed by verification sampling and analysis in accordance with USNRC, USACOE, and the State of Michigan requirements.

- Lead Operator/Stabilization Supervisor for a refinery in Buenos Aires, Argentina. Duties included remediation of acidic and alkaloid sludges and oil emissions. Supervised the in-situ additive and slurry plant mixtures and operated the in-situ mixer. Over 16,000 cubic yards of acid and nonacid refinery sludges, petroleum, metal contaminated soils, demolition debris, and municipal solid wastes were treated on-site by encapsulation/solidification. Supervised the construction of a compacted clay liner and vegetated cover system.

- Site Supervisor for a USACOE Project in Boonton, NJ. Supervised the stabilization of a 3.5 acre landfill, soil excavation, and backfill operation. Other duties included geoprobe sampling, building demolition, and asbestos removal.

- Lead Operator for a USACOE Project in Belmar, NJ. Supervised building demolition and asbestos removal. Other project activities included excavation of contaminated soils, contaminant testing, and site restoration.

AREAS OF EXPERTISE

- Innovative subsurface delivery techniques of in-situ treatment media
- Application of innovative treatment technologies
- Project Management
- Geological Evaluations
- Hydrogeologic Investigations
- Surveillance
- Supervision

EDUCATION

University of California-Riverside: MS, Geology-1980

University of California-Riverside: BS, Geology 1976

PROFESSIONAL HISTORY

URS Corporation
Site Supervisor/Senior Hydrogeologist, 2000-Present

Advent Environmental
Senior Hydrogeologist, 1992-1999

Richmond Petroleum
Exploitation/Production Geologist, 1991-1992

Exxon USA
Senior Petroleum Geologist, 1981-1991

REGISTRATION

Licensed Professional Geologist-WI

REPRESENTATIVE EXPERIENCE

Mr. Christiansen is a Senior Hydrogeologist in the Milwaukee office, responsible for management and technical application of the URS fleet of specialty probing and subsurface injection systems. His experience includes hydrogeologic investigation, petroleum exploration, management of environmental projects, and geophysical evaluation.

Mr. Christiansen is a key team member on numerous projects in which innovative in-situ remedial technologies were applied. His extensive background provides the expertise required to develop innovative site-specific delivery techniques (direct push, injection, jetting, horizontal, etc.) for the introduction of in-situ treatment media.

RELEVANT PROJECT EXPERIENCE

- **In-situ Remedial Pilot Testing Services**, Confidential Industrial Client, New York. Releases of trichloroethene (TCE) and aromatic compounds in groundwater had migrated offsite. Groundwater pump-&-treat and vapor extraction systems had been in operation since 1998. Onsite cleanup was being limited by the suspected presence of Dense Non-Aqueous Phase Liquid (DNAPL). The client had sold the property, and as such the remediation was viewed as a financial drain on the company. URS reviewed the data and determined that DNAPL was likely present and the existing pump and treat system would not likely achieve the cleanup goals. URS performed bench scale testing for the use of Zero Valent Iron in a Permeable Reactive Barrier (PRB) and Chemical Oxidation in source areas. Pilot testing of the PRB and chemical oxidation source area treatment were performed in 1999, and have shown to be successful techniques. URS has successfully implemented full-scale in-situ chemical oxidation techniques to destroy residual aromatic compounds. Full-scale application of PRB is scheduled for 2002. Estimated overall project cost savings, relative to established reserves, are approximately 50%.
- **In-situ Injection of a Permeable Reactive Barrier,** Confidential Retail Center, Colorado. Tetrachloroethylene (PCE) contaminated groundwater was migrating offsite via a sanitary utility corridor. A remedial technology evaluation conducted by URS determined the most effective remedial solution would be the placement of a Permeable Reactive Barrier (PRB). The designed PRB consisted of a

combination of both Zero-Valent Iron (ZVI) and Hydrogen Release Compound (HRC®) injected into the utility corridor. A technical approach was developed for delivery of the in-situ treatment compounds into the narrow target zone, and the injections were performed utilizing URS's DPT probing rigs and high volume/high pressure pumps. Approximately 300 pounds of HRC® and over 900 pound of ZVI were injected in a series of four injections over a one-year period. Risk-based closure of this site was obtained in June of 2001.

- ***In-Situ Bioremediation Injection***, *Gasoline/Service Station* Clean-up, Colorado. Fuel hydrocarbon and waste oil was found in groundwater at a local car dealership (location of a former gasoline service station). The structure was razed, tanks were removed, and the excavation was backfilled to bring the site back to grade. The Phase II investigation identified a petroleum hydrocarbon plume approximately 150' wide by 300' long and 8 feet in thickness. A bio-baseline was completed for the site with results showing that the subsurface biocausm was dormant, microbes were almost nonexistent, nutrients were below active limits, and the dissolved oxygen levels were close to zero. A remedial design was developed to enhance microbe populations, increase nutrient and oxygen levels, and to maintain a healthy biocausm necessary to destroy the hydrocarbon contaminants. A DPT probing rig and high pressure pumping system were used to inject a mixture of microbes, nutrients and Oxygen Release Compound (ORC®) on a 15 foot grid across the full extent of the plume. Point of Compliance monitor wells were sampled at two week intervals to confirm hydrocarbon destruction and the health of the biocausm. The 5th sampling event, 72 days after the initial injection, provided information that all contaminants of concern were below maximum regulatory limits. The site was monitored quarterly for a year and closed.
- **Bench-scale testing and In-situ Neutralization**, Confidential Client, Baton Rouge, LA . Mr. Christiansen managed URS's technical and physical effort to neutralize a caustic release through the injection of a bio-acid into the subsurface at the site. Bench-scale testing and remediation design work utilizing three different acid types to treat soil, groundwater and a soil/groundwater mixture preceded on-site remedial activities. Results were used to determine which acid type would be most cost effective in neutralizing the low pH soils and groundwater. Bench-scale data resulted in a design for acid loading on a pounds per vertical foot

basis over the entire extent of the impacted area. The remediation design targeted pH concentrations greater than 10 (6.0 pH to 10.0 pH was the target concentration). The selected acid, (sulfamic acid), was injected into the impacted area using a DPT probing rig and a high volume / high pressure pumping system. Injections were made from the surface to approximately eight feet below ground surface based on pH data provided by the client. Less than one year after injection of the remedial amendment, the site is under review for closure by the state.

- **Accelerated In-Situ pH Neutralization**, Confidential Major Chemical Plant, Texas. Client was in the process of a major expansion and discovered a failed sulfuric acid line. URS was retained to find a solution so the plant could meet construction goals. Sampling and bench testing of soil and groundwater determined site chemistry. An inexpensive caustic was chosen to neutralize the acid in place. Calculations were completed to determine volumes and pressures for in-situ neutralization. Caustic was injected into the soil with a DPT rig and a high pressure pumping system. The site was completely neutralized within 3 weeks, allowing for minimal delay of plant expansion.
- **Bench-scale Testing and Full-Scale In-Situ Neutralization**, Confidential Chemical Manufacturer, Canada. The client decommissioned and razed an outdated process facility adjacent to an existing plant. A Phase II assessment identified caustic in the soil that had been released while the facility was active. URS was retained to determine if the release could be addressed in-situ instead of opting for a costly dig and haul. Upon completion of bench scale testing, an inexpensive acid was selected and volumes were calculated to bring the soil pH back to background levels. The in-situ neutralization cost was calculated at approximately 30% of dig and haul costs. A Direct Push Technology (DPT) drilling rig in conjunction with a high pressure pumping system was used to apply the selected compound. Soils and groundwater pH levels returned to background levels less than 3 weeks after application.

AREAS OF EXPERTISE

- River Channel Remediation
- Landfill Closure
- Construction Oversite
- Landscaping

EDUCATION

Michigan Technological University: BS, Civil Engineering-2000

PROFESSIONAL REGISTRATIONS

Engineer-In-Training, 2000

PROFESSIONAL HISTORY

URS Corporation
Associate Engineer, 2001-Present

Mountain States Engineering
Engineering Intern, 2000

Village of Howard
Engineering Intern/Inspector, 1999

TRAINING

40-hour HAZWOPER Training, Certified CPR and First Aid, Competent Person Training (Trenching Safety), Auto CAD Land Development Desktop/Civil Design Training, Troxler Nuclear Density Testing

REPRESENTATIVE EXPERIENCE

Mr. Willis has two (2) years of experience in design and field engineering, subcontractor oversight, schedule tracking, remediation construction, survey control and quality control of hazardous and non-hazardous waste projects. His expertise focuses on construction management, subcontractor management and field engineering.

RELEVANT PROJECT EXPERIENCE

- Resident Engineer for construction and remediation activities for a ¼ mile section of the Little Mississinewa River located in Union City, Indiana during the Summer, Fall and Winter of 2001. While on site his responsibilities included temporary site management of a 12-man construction crew, quality control inspection, subcontractor oversight, cost/material tracking, survey control, bench scale testing of stabilization material and documentation of construction activities.
- Resident Engineer for construction and remediation activities on a 44-acre lime pond-capping project located in Ludington, Michigan for the summer of 2001. Included in site duties were survey control, quality control inspection, subcontractor oversight, health and safety assistance and construction management assistance. Mr. Willis was also involved in bidding and subcontract awarding.
- Worked as an inspector for the Village of Howard. During his time with the village he oversaw road and suburb construction. He worked directly with the subcontractors and was public representative for the Village of Howard.
- Assisted in topographic, property line and construction surveying.

AREAS OF EXPERTISE

- Project Chemistry and Quality Control
- Water Treatment System Evaluation and Design Support
- Waste Management
- Site Assessments and
- Regulatory Compliance
- Emergency Response, Health and Safety
- Industrial Hygiene

EDUCATION

University of Illinois:
BS, Chemistry - 1995
University of Illinois:
Minor, Spanish - 1995

PROFESSIONAL REGISTRATIONS

Wastewater Treatment Plant Operator #31930, WI NR 114-active through 12/2001.

PROFESSIONAL HISTORY

URS Corporation
Staff Scientist, 1999-present.
Scientist, 1998-1999.
Associate Scientist, 1995-1997.

General Electric Plastics
Environment, Health, and Safety Department
Summer Employee, 1992-1993.

REPRESENTATIVE EXPERIENCE

Mr. Mustered serves as Task Leader for RCRA groundwater and remediation system performance monitoring tasks totaling $1MM+, with scopes of work from December 1996 through September 2001. Mr. Mustered also serves as Task Leader for a $200K wastewater compliance project for a major chemical manufacturer. Mr. Mustered has experience in the areas of sampling program development, budgeting, and oversight; water treatment system evaluation and design support; groundwater remediation system operation; quality assurance/quality control; laboratory services procurement and oversight; industrial hygiene; hazardous materials emergency response; waste management; permitting; site assessments; and training.

PROJECT CHEMISTRY AND QUALITY CONTROL

- Serves as Task Leader for a major groundwater monitoring and performance monitoring program; coordinating field work and reporting, as well as laboratory work, quality assurance/quality control, and data management. The client has experienced a significance savings on tasks completed to date.
- Procures analytical services, oversees laboratory performance, and develops successful sampling and analytical plans for a variety of water, soil, waste and air sampling programs.
- Assisted in the development of a quality assurance project plan (QAPP) for site monitoring and remediation activities for a major chemical manufacturer.
- Evaluated treatment options for a truck stop client experiencing difficulty in meeting NPDES permit requirements. Developed bench and pilot studies. Estimated annual treatment costs. Worked at four locations for this major truckstop chain, providing successful solutions to wastewater treatment concerns.
- Refined a test plan for an outboard motor testing facility. Assisted in the engineering and design of a water cooling/ treatment, and recirculation system.
- Provided technical guidance and support for groundwater remediation investigations for a detergent manufacturer in Mexico City. Bench tests successfully treated groundwater to an acceptable quality.

TRAINING

40-Hour Training for Hazardous Waste Operations (OSHA)

NUCA Competent Person Trenching/Excavation Certification, Confined Space Entry, CPR and First Aid

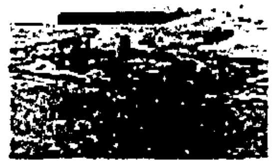
- Investigated treatment options for a client experiencing difficulties in meeting chromium TCLP limits in an industrial waste sludge.
- Investigated cost differences between dissolved air flotation and induced air flotation as treatment options for wastewater from railroad car washing operations. Estimated chemical, power, equipment, and labor costs to determine the most cost-effective solution.
- Instructed a truck stop manager in surface and groundwater sampling techniques to evaluate a treatment system's direct discharge to surface water. The client realized significant cost savings through self-performance of monitoring activities.
- Routinely collected wastewater sample for a local manufacturer in a confined space to evaluate treatment system effectiveness.
- Evaluated wastewater from endurance testing activities for an outboard motor manufacturer. The results were incorporated into the design of a multi-million dollar treatment, cooling, and recirculation system.
- Provided technical guidance and support for a truck stop experiencing high levels of zinc in a maintenance garage stream. Helped to draft a waste minimization program that was accepted by the local regulators.

Statement of Qualifications

Permeable Reactive Barrier Technology

URS





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URS—A LEADER IN PRB TECHNOLOGY

★ The PRB technology is especially desirable since its applications are passive and require no active operation or maintenance. The natural groundwater flow carries the contaminated groundwater to and through the reactive medium. A reactive medium is selected that will effectively either degrade the contaminant(s), cause the contaminant to sorb to the medium, or cause the contaminant to precipitate. Even though the concept is simple, there are critical factors involved in the selection of reactive materials for different contaminants and in the design, installation, and monitoring of these emplacements in the subsurface. Data requirements/ site characterization factors must be considered. These include: plume definition, contaminant concentrations, stratigraphic units and their properties, depth to lower confining layer, hydraulic conductivity of different units, flow direction and gradient, and historic range of water level elevations.

A great deal of money and effort has been spent on environmental restoration during the past 30 years. Among the more difficult and expensive environmental problems is contaminated groundwater. As the shortcomings of pump and treat have become more apparent, there has been an increasing need for innovative solutions to groundwater contamination. One of the most promising of these innovations is the use of permeable reactive barriers (PRB). URS Corporation (URS) brings our clients specialized PRB expertise in project management, pre-design data acquisition, design, construction, cost estimation, and performance monitoring. URS is a full service, design/build engineering corporation with hands-on experience designing and constructing PRBs plus a wide range of other remediation systems.

URS brings you:

☑ **Strong PRB Experience.** URS has successfully completed all phases of PRB projects—pilot studies, design, construction, and performance evaluation. We have worked with both chlorinated solvents and metals and multiple treatment media such as iron, compost, activated carbon, and air curtains. We have successfully constructed PRBs in many geologic settings. URS does not need to subcontract this service. We have the in-house expertise to provide turn-key services. This means smooth and efficient projects.

☑ **A Premier Design and Construction Firm.** URS performs all phases of design/build/operate projects in-house. Value engineering and constructability reviews are integral parts of our design process. The constructors have input into the design to help ensure a smooth, practical, and cost-effective design/build process.

☑ **Remediation Cost Reduction Programs.** With URS, you can project a true-closure endpoint for your remediation projects and significantly reduce your remediation costs.

☑ **Geotechnical Engineering Expertise.** URS is the pre-eminent geotechnical firm in the world and brings state-of-the-art experience in deep geotechnical construction techniques for the construction of barriers at great depths.

This SOQ demonstrates URS PRB's technical capabilities and experience.

☑ Proven experience on PRBs

☑ In-depth knowledge of remedial construction

☑ A successful track record of performance monitoring of PRBs and remedial systems

The URS Approach to PRBs

Remediation managers have recently concentrated their efforts on reducing environmental spending by focusing on accrued O&M costs from costly groundwater remediation systems. Because recent review has shown that most sites do not have true containment or treatment, experts have worked on how to get beyond interim remedial action and get to closure.

For years, pump and treat systems were installed in an effort to contain and treat groundwater plumes. After years of system performance reviews, we now know that pump and treat often isn't an effective removal technology, and does not provide a definite endpoint or closure.

URS has developed a new "end-focused" closure process. This program concentrates on applying new passive remedial approaches that can replace older outdated technologies like pump and treat. Unlike interim remedial approaches, this URS approach is designed to close sites. Two other essential components of the URS approach are: 1) our focus on developing a regulatory strategy that best meets our client's objectives and results in agency buy-in, and 2) a thorough financial analysis including: life cycle cost savings estimates comparing the current system with the URS solution, and determination of cash flow break-even points using the current annual O&M budget as a reference point.

The URS approach to reducing site remediation costs is to follow a systematic approach to evaluating and applying advanced remedial technologies as replacements to outdated remedial systems. Again, a key component of this process is a thorough life cycle cost analysis of the alternatives.

The URS approach is not just a review of assorted technologies. It is a systematic approach that focuses on four types of technologies that can help achieve passive, lower-cost cleanups. These include:

☑ **Monitored Natural Attenuation (MNA)**

Includes physical, chemical, or biological processes that act together to reduce contaminant concentrations in soil and groundwater. MNA is cost effective at sites where pump and treat systems are not achieving remedial action objectives. When coupled with long-term groundwater monitoring programs or incorporated with one of our other approaches, MNA can significantly reduce the costs of site closure.

☑ **In Situ Bioremediation**

Consists of enhancing biological processes by stimulating indigenous bacteria with nutrients, oxygen, or cometabolites.

WE WORK WITH OUR CLIENTS TO FIND OPPORTUNITIES TO:

- ☑ Lower full-scale costs
- ☑ Reduce O&M costs
- ☑ Close sites with a shorter life cycle
- ☑ Extinguish liability

Getting the right chemical mix is critical, and our broad-based project experience means that's just what we'll deliver.

☑ **In Situ Abiotic Systems**

Contaminated water is routed through reactive media, such as zero valent iron, for passive treatment. An in situ treatment wall that acts as a reducing environment serves as an abiotic system that dehalogenates chlorinated solvents to nontoxic compounds.

☑ **Phytoremediation**

An extensive vegetative root system that treats soil and groundwater contamination. Phytoremediation can provide a barrier for plume and groundwater flow, intercepts infiltrating water and runoff, and acts as a source control for contaminant removal at or near a spill.

Where changing remedial technologies may not be cost effective, URS also has extensive experience in optimizing existing treatment systems to help reduce O&M and monitoring costs. We employ process engineers, treatment system operators, and regulatory experts to improve existing systems and help negotiate appropriate modifications to monitoring requirements.

★ URS is working at a former canning plant in New York to remediate TCE contaminated groundwater using a PRB.

--Bench scale and pilot testing were sucessfully completed to get state approval for remediation approach

--URS is designing and installing the PRB in 2002

--Client will be able to shut down the ineffective pump and treat system

All treatment with PRB is passive and requires little or no O&M.

★ With the URS solution, a true closure endpoint can be projected, and significant life cycle cost reductions can be realized over a much shorter project life cycle.

PRB Design and Operation Issues

URS has an excellent experience base in the design, construction, and performance monitoring of PRBs. In partnership with a client in 1996, URS and the client visited the University of Waterloo, ETI, and the famous Borden Test Site to evaluate the feasibility of what was, at that time, a rather obscure developing technology. Since that time, we have designed both fully penetrating and hanging, full scale, full plume width, zero valent (ZV) iron PRBs. In addition, we also performed the one-year performance monitoring evaluation of one of these PRBs. This experience with all phases of PRB design and operation has allowed URS to develop the level of knowledge of design and operation issues illustrated below.

The reactive medium, groundwater chemistry, site geology, and site hydrogeology are all major factors in the design and operation of a successful PRB. These site factors determine how applicable a PRB system may be and affect the design, construction, and operation of a PRB.

Critical PRB Design considerations:

- ☑ Type of reactive barrier
- ☑ Need for pilot study
- ☑ Degree of aquifer penetration
- ☑ Residence time
- ☑ Method of barrier emplacement
- ☑ Method of excavation
- ☑ Size and location of reactive barrier
- ☑ Need to replace or treat barrier material
- ☑ Effect on plume flow pattern
- ☑ Effect on hydraulic conductivity
- ☑ Key into confining layer
- ☑ Presence of utilities
- ☑ Handling and disposal of excavated materials

Site Factors Affecting the Design of PRBs

Factors Influencing Design		Type of Reactive Barrier	Need for Pilot Study	Degree of Aquifer Penetration	Residence Time	Method of Barrier Implacement	Method of Excavation	Size & Location of Barrier	Need to Replace or Treat	Effect on Plume Flow Pattern	Effect on Hydraulic Conductivity	Key *into Confining* Layer	Handling Contaminated Soils	O&M Requirements	Funnel Elements
Groundwater Chemistry	Contaminants	●	●		●				●		●		●	●	
	Concentration	●	●		●				●		●		●	●	
	Distribution	●		●				●		●		●		●	●
	Continuing Source							●	●			●		●	●
Reaction Medium	Single or Multiple	●	●		●	●	●	●	●	●				●	
	Form	●	●		●	●	●	●	●	●	●	●		●	
	Passive or Active	●	●	●		●		●	●					●	
Site Geology	Stratigraphy	●	●	●		●	●	●		●		●		●	●
	Lateral Continuity	●	●			●	●	●		●				●	●
	Vertical Continuity	●	●	●				●		●		●		●	●
	Geotech Properties					●	●	●				●	●		●
	Nature of Confining Unit			●		●		●		●		●		●	●
	Config. Confirming Unit					●	●			●		●		●	●
	Depth Confining Unit	●	●	●		●	●	●		●		●		●	●
	Lithology of Aquifer	●	●		●	●	●				●		●	●	●
	Jointing & Fracturing	●	●	●	●							●		●	●
	Thickness of Contaminated Aquifer	●	●			●	●	●				●		●	●
	Thickness of Vadose Zone	●	●			●	●	●				●			
Hydrogeology	*High k Units*	●		●	●		●	●	●	●	●	●		●	●
	Hydraulic Conductivity	●	●	●	●	●	●	●	●	●		●		●	●
	Flow direction							●		●				●	●
	Gradient			●	●			●		●		●		●	●
	Confined or Unconfined	●	●	●		●	●	●	●	●				●	●
	Range of W.L.			●		●	●	●		●			●	●	●
Site Conditions	Utilities	●	●			●	●	●	●						●
	Buildings	●	●			●	●	●	●						●
	Topography	●	●			●	●	●		●			●		●
	Trans. Route	●	●			●	●	●	●				●		●

Type of Reactive Barrier

The contaminants to be treated determine the reactive agents to be used in the in situ reactive barrier. The final selection of the reactive agent to be used as well as the form of the agent will determine the required type of reactive barrier. The reactive agent may be available in either pure form or as a chemical compound and may be introduced into the subsurface as a solid, vapor, gas, or liquid. In some cases, the reactive agent may be introduced as a 100% replacement of a portion of the aquifer as done with zero valent iron and granular activated carbon. In other cases, some percentage of either the aquifer material or the pore water is replaced with reactive agent such as the introduction of sparged air or nutrients, diffusion from an implanted source, or solids addition by deep soil mixing or jet grouting methods. The design and construction of the reactive barrier are influenced by the geology and hydrogeology of the site, and the geologic and hydrogeologic factors must be considered in the remedy selection.

Need for a Pilot Study

Four major factors (reactive medium, groundwater chemistry, site geology, and site hydrogeology) should be evaluated in deciding whether to conduct a pilot study. A pilot study is often not needed if the chemical reaction required in the reactive barrier has been well demonstrated at other groundwater remediation sites with similar geochemistry. However, the geologic and hydrogeologic character of the site may still support a pilot study in order to optimize a cost-effective design. The more heterogeneous and anisotrophic the subsurface conditions are, the greater the need to complete a pilot study. The effectiveness and success of in situ remediation is very site dependent. Two important questions should be asked when determining the need for a pilot study. What is the level of confidence that a full-scale project will successfully capture and treat the contaminant plume? Are the consequences of failure of the system reasonable and manageable?

Degree of Aquifer Penetration

In most cases, the in situ reactive barrier will extend to the bottom of the aquifer; however, in some cases this may not be necessary. The degree of aquifer penetration is determined by contaminant distribution within the aquifer and by the flow regime. Consideration must be given to whether construction of the barrier will alter the groundwater flow pattern and force the contamination plume beneath a partially penetrating reactive barrier.

Residence Time

For reactive barriers that rely on the contaminated groundwater coming in contact with a reactive medium, a specific residence time (or time which the contaminated water must be exposed to the reactive agent in order for the contaminant to be degraded or removed) is required. The necessary residence time is usually determined from bench scale testing. The required residence time and the hydraulic conductivity, gradient, and porosity of the aquifer are used to determine the thickness of the reactive barrier normal to the direction of groundwater flow. High velocity zones associated with high hydraulic conductivity aquifer material must be recognized in that the residence time will be shortest opposite these zones, and the thickness of the reactive barrier will likely be controlled by these zones. In bedrock aquifers, the highest flow velocities and often the greatest volume of flow occur along open fractures and joints. In addition, the highly conductive zones within an aquifer also commonly carry the highest contaminant concentrations. Average hydraulic conductivity values obtained from pumping tests may not be sufficiently accurate for design in those cases where high conductivity zones exist.

★ Method of Barrier Emplacement

Both geologic and hydrogeologic factors are critical to the design and construction of the barrier. Each emplacement method will have a depth limitation, which is strongly influenced by both the surface and subsurface conditions at the site. Two or more reactive barrier technologies may be applicable to the site remediation. However, site geologic or hydrogeologic conditions and/or the depth to the plume might eliminate one or more of the technologies from further consideration. If barrier emplacement involves the addition of solids to the aquifer by means such as deep soil mixing or grouting techniques, the effects of the added material on the resulting conductivity within the barrier are very important. In these cases, a pilot test using the proposed addition method and in situ hydraulic conductivity tests in the treated zone are warranted to avoid diversion of the contaminant plume. The degree of aquifer anisotrophy will have a great influence on the distribution of sparged air or other gases introduced by means of a horizontal well.

★ Method of Excavation

When an excavation is chosen for barrier emplacement, stratigraphic detail, geotechnical properties, groundwater levels, aquifer hydraulic conductivity, and contaminant concentrations are vital for the design of the excavation, ground support, dewatering, and disposition of excavated soil and groundwater. If a permeable reactive barrier is to be constructed by excavation and backfilling, it is necessary that the backfill be at least as permeable as the aquifer. It is also necessary that the excavation and ground support system don't cause densification or disturbance of the aquifer adjacent to the back-fill, reducing permeability. For example, vibratory motions associated with driving sheetpiles with a vibratory hammer may densify loose saturated formation sands and reduce the hydraulic conductivity immediately upgradient and downgradient of the PRB.

Size and Location of Reactive Barrier

The length and location of the barrier normal to groundwater flow is determined by the width and location of the contaminant plume. The vertical dimension of the barrier must at least coincide with the vertical distribution of contaminated groundwater at the barrier location. The thickness along the direction of groundwater flow must provide the required residence time to allow treatment. In some cases, savings can be realized by utilizing the funnel and gate concept to reduce the width of the reactive barrier. The method utilizes subsurface impermeable barriers (funnel sections) to direct groundwater flow through a reduced width reactive barrier (gate). When the funnel and gate method is used, the potentiometric level will rise upgradient of the gate, and the groundwater velocity will increase and the residence time per unit of reactive barrier thickness will decrease as compared to unfunnelled flow. A good under-standing of groundwater contaminant distribution and concentration, subsurface geology, and hydrogeology are required for this method. Computer flow modeling is recommended if use of a funnel and gate is considered.

Need to Replace or Treat Barrier Material

The need to treat or replace the reactive agent during the projected life of the remediation must be considered in the design of the project. For example, if granular activated carbon is the reaction agent, it will require replacement after some period of time, and there is evidence that zero valent iron may require treatment to remove precipitates in some geochemical environments. If replacement is anticipated, it may be desirable to design and construct removable reaction agent modules. Treatment to remove precipitation might require a means to flush the reaction agent with a solution or to physically agitate the material to break up the precipitate. The need to maintain the hydraulic conductivity of the reactive barrier above that of the aquifer must always be a consideration.

Effect on the Plume Flow Pattern

The need to maintain plume flow through the reactive barrier cannot be over emphasized. Initially the site must be characterized sufficiently in terms of contaminant concentrations, geometry of the plume, flow direction(s), hydraulic conductivity, stratification, and hydraulic gradient to provide a sound basis for remedy evaluation and the conceptual design. Care must be taken to ascertain whether the flow direction may change seasonally. Such change might be due to water well pumping, operation of deep foundation drain systems, change in the stage of a nearby stream, etc. If the funnel and gate concept has been selected for remediation, the degree of capture and flow velocity through the gate must be evaluated for the full range of water levels and flow patterns expected to occur through the life of the project.

★ Effect on Hydraulic Conductivity

Maintaining plume flow through the reactive barrier is imperative, thus the designer must scrutinize each facet of the implementation to determine whether it may adversely affect hydraulic conductivity of the reactive barrier. In general, the hydraulic conductivity of the reactive barrier should be equal to or greater than the hydraulic conductivity of the aquifer. If it is known that the conductivity of the PRB will be less than that of the formation, the potential effects should be carefully evaluated. Special care should be exercised to avoid unintended reductions in hydraulic conductivity. Reductions in hydraulic conductivity can result from changes in gradation resulting from the addition of the reaction agent into the aquifer, formation of precipitates in the reactive barrier, and densification of aquifer sands resulting from driving sheetpile during construction.

★ Key into the Confining Layer

During the early design stages, the importance or need to key the reactive barrier into the confining layer should be determined. If a funnel and gate is proposed, it may be just as important to key the funnel sections into the confining layer than it is the gate. If a key is required or it is determined that the reactive barrier must at least be in intimate contact with the confining layer, important site factors include: depth to and configuration of the confining layer, hydraulic conductivity of the confining layer, and excavation characteristics of the confining layer. If excavation dewatering is required, knowledge of the hydrologic properties of the site is important to project success.

★ Presence of Above or Below Ground Utilities

Any subsurface construction requires careful consideration of utilities in the construction area. The evaluation will include resolution of such issues as: whether construction of the reactive barrier and associated impermeable barriers can be completed without relocating the utilities, is the cost of utility relocation possible or economically feasible, etc.

★ Handling and Disposal of Excavated Material

Consideration must be given to the handling and disposal of the material excavated from the trench. In nearly all cases, the groundwater at the PRB location is contaminated, however, the soil from the trench excavation may or may not be contaminated. The soil will be tested during the pre-design investigation as a means of esti-mating whether the spoils will require disposal as contaminated waste. In some cases, where a bench is excavated above the water table from which trenching is done, the potentially contaminated soil can be placed in the bench excavation upgradient of the PRB trench and covered with clean soil. URS has successfully utilized this approach in the past, and both the U.S. EPA and the State approved this design detail.

OPTIMIZING THE LOCATION OF THE PRB

Having successfully designed, supervised, installed, and monitored PRBs in a number of geographic locations involving a variety of hydrologic and contaminant conditions, URS is well aware of the potential problems faced by any newly applied remedial technology. One of the recurring problems for the owners of PRBs is the lack of sufficient hydrogeologic data prior to design. Even the best designs when based on insufficient data will be subject to failure. One technique now used by knowledgeable designers is to construct long and/or deep PRBs in stages, allowing time between stages to collect and evaluate actual performance data on in situ groundwater and contaminant conditions, and to determine whether the system will meet its performance objectives.

SELECTING THE PRB INSTALLATION METHOD

Several methods are available to install the PRB. The selection of installation method requires evaluation of site-specific conditions from the design criteria and constructability perspective developed from information provided in the RFP, availability of resources for the installation method, site access, health and safety, residual disposal, and cost of installation.

URS has evaluated the installation methods and prepared a matrix showing the advantages and disadvantages of each of the main installation methods.

★ **URS has applied its extensive remediation knowledge and expertise to the design and installation of more than half of all the PRBs worldwide.**

Advantages and Disadvantages of PRB Installation Methods

Construction Method	Advantages	Disadvantages
Hollow-stem augered holes (HSA)	• Low cost • Deep walls can be installed • No open trench.	• ZV Iron waste due to overlap for continuous walls • No visual guarantee of a continuous wall • Difficult to assure plumbness of the hollow-stem auger holes. This may result in windows in the PRB
Biopolymer Wall	• Low front-end cost • Conventional trench construction equipment can be used • Moderately deep walls can be installed • Use of the slurry to stabilize the trench eliminates the need for mechanical stabilization	• Off-site residual disposal • Liquid filled open trench can be a safety hazard • Repetitive swing/stop motion of the excavator causes top of trench instability in sandy soil • Objectionable odors from the degrading slurry will be a problem in this residential neighborhood
Continuous Trenching	• Moderate front-end cost • Trench is never open • Excavation and placement is performed in one step • Placement of iron is continuous and consistent	• Requires special equipment • Maximum depth is about 25 feet • Avoidance of utilities is time consuming • Multiple trenches are required for ZV Iron Walls over 24" thick • Low density of the placed iron often results in an iron-filled trench that is less than the width of the trench
Jetting	• Delivery system provides for better distribution of iron into the formation than HSA • Deep placement of ZV Iron	• Requires special equipment; higher cost than HSA • Numerous borings required • Verification of distribution of iron recommended. • May result in a reactive zone with a lower hydraulic conductivity than the formation
Sheet Pile Cofferdam	• Conserves ZV Iron: wall thickness can be varied at depth to meet design criteria • Open trench provides for thorough distribution of iron • Visual confirmation of iron placement	• High cost for cofferdam • Requires pile driving equipment, high vertical clearance • Compaction of adjacent low density sands due to vibrations from a vibratory drive hammer might reduce groundwater flow-through the PRB • Sheets must be pulled after completion
Trench Box	• Open trench provides for thorough distribution of iron • Visual confirmation of iron placement	• Requires high powered equipment to drag boxes through trench • Open trench can be a safety hazard.

PROJECT EXAMPLES

The URS Team has been involved in the design, construction, and performance monitoring of over 15 PRBs, and therefore, has state-of-the-art experience with the challenges PRBs present. URS has applied its extensive remediation knowledge and expertise to the design and installation of more than half of all the PRBs worldwide. No; there are ~ 80 now

URS PRB Experience

Project Name and Location	Date	Service Provided	Configuration	Dimensions	Installation Technique
DOE Kansas City Plant, MO	1998	Full Scale Installation	Continuous PRB	130 ft x 6 ft x 30 ft	Cofferdam
F.E. Warren AFB Spill Site 7; Cheyenne, WY	1999	Full Scale Installation	Continuous PRB *(iron/iron-sand)*	566 ft x 4 ft x 15 ft	Trench Box
Industrial Facility, IN	2001	Full-Scale Pilot Test	PRB using air sparged curtain with in situ bioreme- diation enhancements	50 ft. x 40 ft.	Sparge Ponds
Private Client, San Jose, CA	2000	Preliminary Design	Continuous Design	Anticipated 150 ft. long	NA
Private Client, Charleston, SC	2000	Pre-Design Investigation	Funnel & Gate or Continuous PRB	NA	NA
Private Client, Australia	1999	Pilot Scale Installation	Continuous PRB	20 ft x 5 ft x 25 ft	Cofferdam
Telefax Inc., Germany	2000	Conceptual Design	Funnel & Gate PRB	NA	NA
Beazer East, Inc., Salisbury, MD	2000	Full Scale Installation	Funnel & Gate with In-Situ Bioreactor	Gate-700 ft Funnel-5000 ft	Combination Bentonite & Waterloo Barrier
Private Client, Jamestown, NY	2000	Pilot Scale Installation	Continuous PRB	60 ft x 7 ft x 20 ft	Jetting
USACE – Baltimore District; Tacony Ware-house, Philadelphia, PA	2000	Full Scale Installation	In Situ Treatment with Zero Valent Iron	6 ft Zero Valent Iron Treatment Cell	Boring/Well
Lowry AFB, CO	1997	Pilot Scale Installation	Funnel & Gate PRB	10 ft x 5 ft x 17 ft	Cofferdam
Private Client, NY	2000	Pilot Scale Installation	Continuous PRB	150 ft x 7 ft x 20 ft **60-80 ft. Deep**	Jetting
Maxwell AFB, AL	1998	Pilot Scale Installation	Continuous PRB	40 ft x 0.3 ft x 75 ft **75 ft. Deep**	Vertical hydrofracturing
Travis AFB, CA	1999	Pilot Scale Installation	Continuous PRB	80 ft x 5 ft x 50 ft **50 ft. Deep**	Jetting
Aberdeen Proving Grounds, MD	1997	Preliminary Design	Above-Ground Treatment System	NA	NA

URS

Project Name and Location	Date	Service Provided	Configuration	Dimensions	Installation Technique
Rease AFB, NH	1999	Full Scale Installation	Continuous PRB	150 ft x 2.5 ft x 33 ft	Bio-polymer Trench
Somersworth Landfill, NH	1999	Pilot Scale Installation	Continuous PRB	Gate-8 ft Funnel-9 ft	Steel Caissons with Vibratory Hammer
Department of Energy, Oak Ridge, TN	1997	Full Scale Installation	Funnel & Gate PRB	Gate-30 ft x 2 ft x 26 Funnel-200 ft	Bio-polymer Trench
Private Client, Hileal, FL	1997	Pilot Scale Installation	In Situ Soil Treatment	Two 750 cubic ft plots	Deep Soil Mixing
Former Naval Ammunition Depot, NE	1998	Full Scale Installation	PRB using air sparged curtain with in situ bioremediation enhancements	200 ft x 150 ft	Horizontal Well

DEPARTMENT OF ENERGY KANSAS CITY PLANT, Kansas City, Missouri

Kansas City Plant PRB Construction

In 1995, the operating contractor for the DOE Kansas City Plant, AlliedSignal, invited URS to partner with them in evaluating the potential of a PRB to treat the Northeast Area Plume at the Kansas City Plant. URS and AlliedSignal made a joint trip to the University of Waterloo to explore the technology and methods of construction considered applicable at that time.

In 1996, DOE and AlliedSignal decided to proceed with the project design of two PRBs at the Kansas City Plant. AlliedSignal tasked URS with the project design. URS conducted pre-design investigations of the two PRB locations. In the Pre-design Investigation Report, URS recommended that design of the PRB at only the Northeast Area Plume proceed. We recommended against proceeding with design of the Southeast Parking Lot PRB. The recommendation was based on questions regarding the feasibility of successfully constructing a PRB at this location, the limited extent of the plume, and chemical and hydrogeologic data which indicated that the plume was possibly stable and naturally degrading. We conducted the pre-design investigation and designs, and provided engineering support during construction. The PRB was installed on time and within budget and is operating successfully.

URS also performed an evaluation of the performance of the first year of operation of the PRB. The performance data were collected by AlliedSignal in accordance with a Monitoring and Evaluation Plan prepared by URS.

Finished Site at the Kansas City Plant

Findings of the performance evaluation were:

- ☑ The PRB degraded the TCE, cis-1,2-DCE and vinyl chloride below their respective maximum contaminant limits (MCLs) and detection limits.
- ☑ The iron-filled trench acts as a small segment of high hydraulic conductivity aquifer within a larger confined aquifer of lower conductivity.
- ☑ There was no indication of reduced hydraulic conductivity with attendant flow bypass resulting from the construction of the PRB.
- ☑ Construction of the PRB caused a redistribution of the groundwater flow in the vicinity of the PRB.

PERTINENT DETAILS

★ 130-foot long full plume width PRB.

★ Completed in April 1998.

★ Constructed in the alluvium of the Blue River. The alluvium consists of approximately 3 feet of basal gravel with a design hydraulic conductivity of 34 feet/day overlain by approximately 27 feet of silty clay overbank material. The design hydraulic conductivity of the silty clay is 0.75 feet/day.

★ Contaminants of concern are 1,2-DCE and vinyl chloride with initial concentrations of 1,377 µg/L and 291 µg/L respectively.

★ The zero valent iron has a flow through thickness of 6 feet in the basal gravel interval and 2 feet opposite the silty clay.

★ Design studies included comparing the cost of funnel and gate configurations with the cost of the full plume width PRB.

★ The contaminants are degraded to below MCLs before the groundwater discharges from the downgradient edge of the barrier.

★ The PRB is a fully penetrating barrier keyed into the underlying shale bedrock.

★ Construction was accomplished by benching down to near the water table followed by trenching utilizing braced sheet pile.

★ EnviroMetals Technologies Inc. performed the column studies.

☑ As a result of the flow redistribution, contaminated groundwater flows around the south end of the PRB in a zone approximately 20 feet wide.

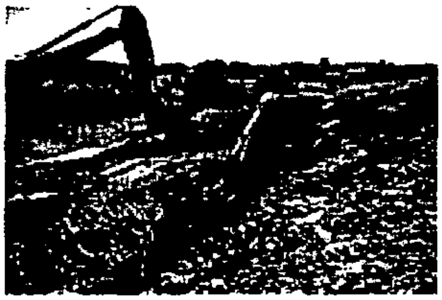
☑ The evaluation data indicate approximately 98% of the contaminant mass is being contained and treated.

As a result of the finding that some contaminated groundwater flow was bypassing the south end of the PRB, AlliedSignal and Oak Ridge National Laboratory conducted additional investigations, and URS prepared an addendum to the Performance Evaluation Report. The findings from the initial evaluation were confirmed, and the major additional findings from the additional investigation include:

☑ The PRB capture zone at the north end of the PRB is more extensive than before the PRB construction due to the flow redistribution effects.

☑ The redistributed flow pattern is due to a combination of a complex pre-construction flow field, the fact that the PRB was not placed precisely parallel to the potentiometric contours, the high hydraulic conductivity of the iron backfill, and the presence of a previously unknown zone of much higher hydraulic conductivity aquifer at the south end of the PRB.

> *"URS is to be commended for a outstanding effort in completing a comprehensive report on schedule when we were feeding them new data up to the last minute!"*
>
> Paul Dieckmann
> AlliedSignal, Sept. '99



Construction at F.E. Warren AFB

F. E. WARREN AIR FORCE BASE, Cheyenne, Wyoming

URS conducted the pre-design investigations and design of a PRB at Spill Site 7 at F. E. Warren AFB in 1998. The investigation and design were completed under an expedited schedule in order to meet the time requirements imposed by the Record of Decision (ROD). URS provided engineering and Title II oversight services during construction. Construction of the PRB was completed in October 1999. This project success was assured by the effective construction quality assurance/quality control (QA/QC) program that included participation from the Owner, the design/construction oversight contractor, and the construction contractor. This project was completed within a very short, strict timeframe and under budget.

PERTINENT DETAILS

- 566-foot long, full plume width PRB.
- Continuous hanging type barrier, i.e., not keyed into an aquitard.
- Designed to intercept and treat chlorinated hydrocarbon contaminants in the upper 15 feet of the saturated zone of the aquifer.
- Purpose is to prevent the contaminants from entering Diamond Creek.
- The aquifer is extremely heterogeneous. This allowed the barrier to be broken into segments based on maximum contaminant concentration and maximum hydraulic conductivity in the segment.
- EnviroMetals Technologies Inc. performed the column studies.
- Characterizing site geology and adjusting the design accordingly resulted in considerable cost savings.
- The design flow through thickness of segments are 4 feet, 1.5 feet, and 1 foot.
- TCE, cis-1,2-DCE, and vinyl chloride are the primary contaminants of concern.
- Construction was accomplished by benching down to near the water table followed by trenching using a trench box.
- The design provided for groundwater fluctuations of up to four feet above the top of the iron and the estimated permanent water table.
- Zero valent iron is the reactive medium.
- EnviroMetals Technologies Inc. did the column studies.

URS Awarded the
General Thomas D. White
Restoration Award for Team Excellence

F.E. Warren (FEW) AFB's 90th Space Wing Installation Restoration Management Team has recently received national recognition to a great extent as a result of the contribution of URS's professional services during the period May 1998 to December 1999. This recognition includes it's selection as the 1999 winner of the prestigious Air Force Space Command (AFSPC) General Thomas D. White Restoration Award for Team Excellence on 21 Dec 99. This award package was forwarded to compete at U.S. Air Force (USAF) level as a part of the 1999 USAF Civil Engineer Awards Program, and on 3 Jan 00 the FEW Installation Restoration Management Team was selected as the winner of the USAF General Thomas D. White Restoration Award for Team Excellence. This award was subsequently recognized by both the State of Wyoming Department of Environmental Quality (WDEQ) and United States Senator Thomas from Wyoming. Currently, the USAF award package is pending competition at Department of Defense (DOD) level for the Secretary of Defense Environmental Security Award.

The General Thomas D. White Restoration Award for Team Excellence is the most prestigious environmental award presented annually in the US Air Force, and it is fiercely competed. The FEW Chief of Environmental Restoration Management has made it clear that the URS Team has had a major role in the turn around and success of FEW's environmental restoration program.

CONFIDENTIAL CLIENT SITE, San Jose, California

URS performed a pre-design investigation and conceptual design of a PRB to remediate a chlorinated hydrocarbon plume in San Jose, California. We also conducted the pre-design investigation. URS will act as the general contractor for the construction of the PRB.

PERTINENT DETAILS

- ★ Approximately 150 foot long full plume width PRB.
- ★ The aquifer consists of multiple coalesced alluvial sand channel deposits surrounded by silty clays and clayey silts.
- ★ The barrier will fully penetrate the contaminated sand channels.
- ★ TCE is the primary contaminant of concern.
- ★ Zero valent iron will be the reactive medium.
- ★ The design is not yet finalized.
- ★ Historic water level fluctuations of more than 15 feet considered in the design.
- ★ Column studies are being done by EnviroMetals Technologies Inc.

PRIVATE CLIENT SITE, Charleston, South Carolina

URS is conducting column studies and has submitted the pre-design investigation work plan for this PRB. The scheduled design completion date is second quarter of 2000.

PERTINENT DETAILS

- ★ May be either a funnel and gate or a full plume width PRB.
- ★ The PRB will be constructed in sandy fill and silty sand coastal plain estuarine deposits.
- ★ The plume width may be as much as 500 feet.
- ★ Lead and arsenic are the contaminants of concern.
- ★ Various combinations of reactive media remained under consideration in the column studies.
- ★ Potential reactive media include: zero valent iron, compost, limestone, blast oxygen furnace slag, and calcium sulfide.
- ★ Column studies are being done by Dr. David Blowes at the University of Waterloo.

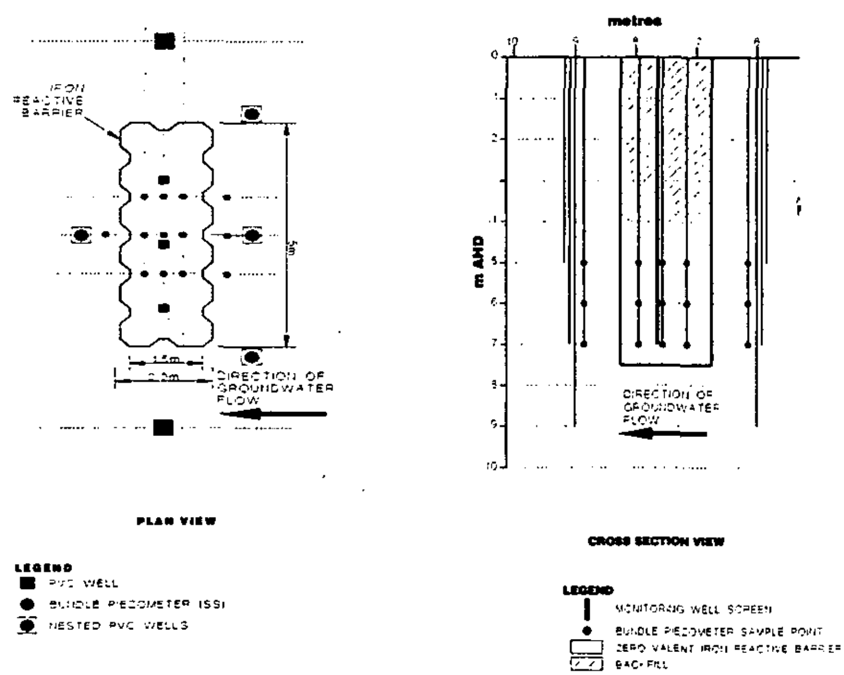
PERTINENT DETAILS

- ★ VOCs of concern include carbon tetra-chloride, PCE, TCE, chloroform, vinyl chloride, cis-1,2-DCE, 1,1,2 TCA, carbon disulfide. In addition, the groundwater also contains four semivolatile compounds.
- ★ A hanging barrier designed to intercept and treat shallow groundwater that discharges to a nearby ditch.
- ★ Constructed in a complex of beach, dune, and alluvial sands.
- ★ Zero valent iron is the reactive medium.
- ★ The test section is 5 meters long, iron is placed from 4 to 7.5 meters below the ground surface, and the flow through iron thickness varies from 1.5 to 2 meters.

PRIVATE CLIENT SITE, Australia

URS designed a pilot scale PRB to treat groundwater containing a complex mix of chlorinated hydrocarbons (CHCs). Extensive zones of DNAPL are present in the subsurface. Within the pilot test zone, the total dissolved phase concentration of CHCs ranges up to 220 mg/l. The site is underlain by unconsolidated sands, which are between 15 and 40 meters thick and are underlain by sandstone basement rock. The unconsolidated sands are a high yielding unconfined and semi-confined aquifer system, which is used locally for industrial water and turf irrigation supplies.

The pilot scale system was installed in February 1999 using a sheet pile trench box method. Monitoring of the system after 30 days revealed degradation of the volatile compounds ranged between 81 and 96%. Monitoring of the system is expected to be undertaken for at least 12 months to allow sufficient groundwater pore volumes to pass through the barrier to assess the long term feasibility of a full scale system. However, present monitoring data has demonstrated that even within a complex contaminant and geochemical environment, zero valent iron provides a relatively robust passive system for the remediation of a wide range of chlorinated solvents.



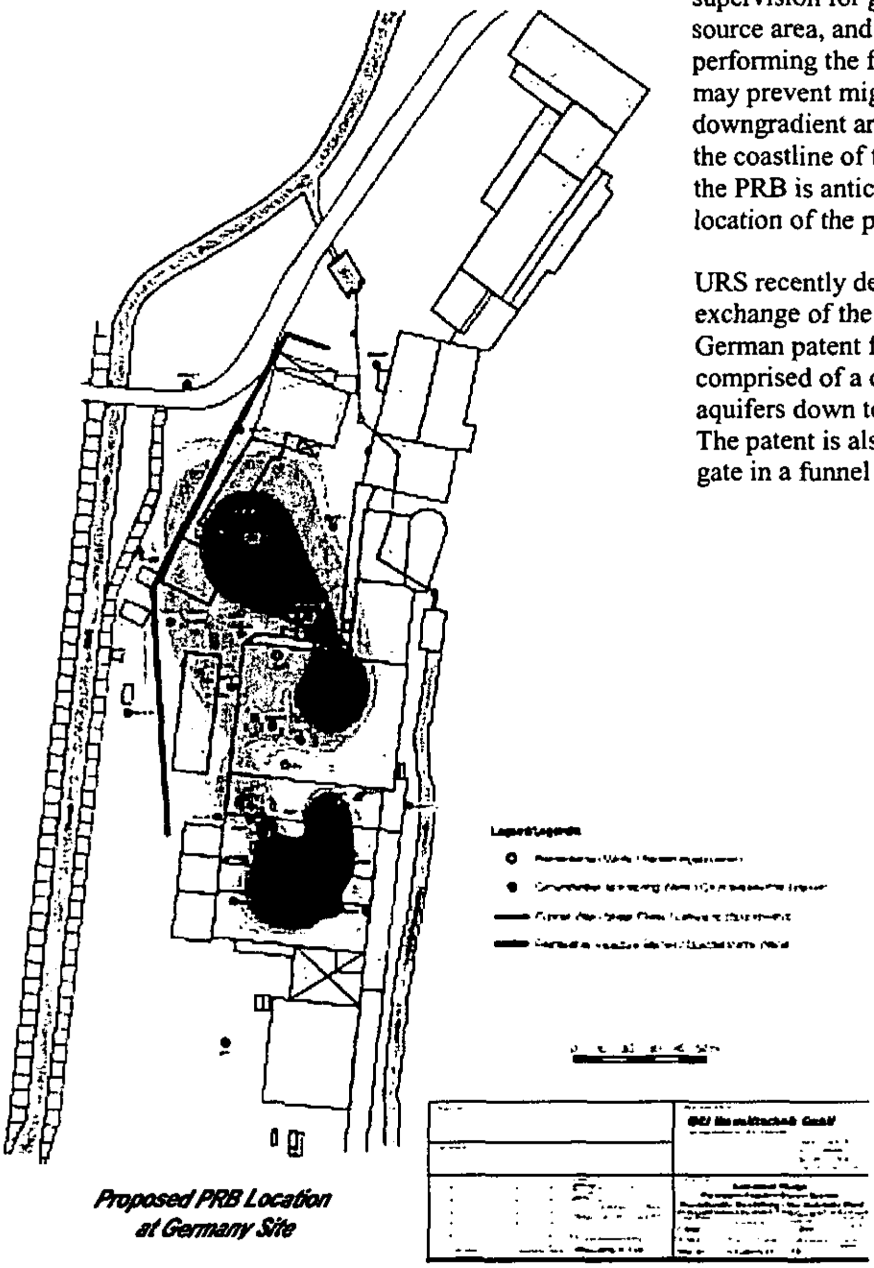
Plan and Cross Section of Pilot Scale Barrier

URS

PRB Projects in Germany

URS provided the conceptual design of a permeable reactive barrier system (funnel & gate) for in situ groundwater remediation in the downgradient area of a CHC-Plume at an industrial facility in northern Germany. The work included project management for the initial site investigation program, remedial design and supervision for groundwater remediation in the source area, and the conceptual PRB design. URS is performing the feasibility study to assess if a PRB may prevent migration of a contaminant plume in the downgradient area of a landfill, located directly along the coastline of the Baltic Sea. The implementation of the PRB is anticipated to happen by end of 2000. The location of the proposed PRB is shown on the figure.

URS recently developed a PRB system to allow exchange of the reactive materials and obtained a German patent for the system. The patent is comprised of a double-wall construction installed in aquifers down to a depth of approx. 6-8 meters bgs. The patent is also suitable to be implemented as a gate in a funnel & gate system.



Proposed PRB Location at Germany Site

PERTINENT DETAILS

- ★ 60 meter long gate to a depth of 4 meter bgs.
- ★ The gate will be divided into three sections; each section filled with a different reactive material (GAC, zero valent iron, and a mixture of iron and GAC.
- ★ One section will have a double wall configuration (upgradient wall filled with iron downgradient wall filled with GAC).
- ★ A total of 170 meter sheet pile walls for both funnel wings to a depth of 4.5 meter bgs.

INDUSTRIAL CLIENT, New York

Client had experienced a release of trichloroethene from its manufacturing operations, impacting groundwater and threatening the town's drinking water supply. A groundwater pump and treat system had been implemented that was requiring significant expenditures to maintain.

URS reviewed the data and determined that a series of permeable reactive barriers (PRBs) would be more effective in treating the trichloroethene, protecting the town's drinking water wells, and at a much lower cost than the existing system. Because the depth of treatment was beyond conventional methods for placing zero valent iron, a 70 foot long pilot scale PRB was installed using URS' specialized direct push/injection equipment to place the PRB at a depth of 60 to 80 feet beneath the ground surface to target a more permeable sand unit. Laboratory bench scale testing was performed at URS's treatability lab to facilitate design of a PRB. The pilot test conducted in 2001 confirmed that a permeable reactive barrier will successfully reduce TCE contamination. A full scale installation is proposed for 2002. The permeable reactive barrier will result in significant savings compared to the existing system.

PERTINENT DETAILS

- 70' long, 80 ft. deep PRB
- Used high-pressure injection to place "y" shaped panels for treatment
- Targeted high permeability zone for treatment
- Laboratory bench scale testing used to optimize design and lower material costs for full-scale installation.
- Pilot scale testing successful at reducing TCE concentration

INDUSTRIAL CLIENT, NEW YORK

Client had experienced a release to groundwater of trichloroethene (TCE) and aromatic compounds from a sump and underground storage tanks. The releases had migrated offsite. Groundwater pump and treat and vapor extraction systems had been in operation since 1998. Onsite cleanup was being limited by the suspected presence of Dense Non-Aqueous Phase Liquid (DNAPL). The client had sold the property, and as such the remediation was viewed as a financial drain on the company. URS reviewed the data and determined that DNAPL was likely present and the existing pump and treat system would not likely achieve the cleanup goals. URS performed bench scale testing for the use of zero valent iron in a permeable reactive barrier (PRB) and source area injections. URS is treating the underground storage tanks (which were filled with sand and abandoned in place) using in-situ chemical oxidation techniques to destroy residual aromatic compounds. Full-scale application of zero valent iron is scheduled for 2002. Estimated savings, relative to established reserves, are approximately 50%.

PERTINENT DETAILS

- Bench scale testing by URS
- Zero-valent iron used for both source treatment and PRB
- In-situ chemical oxidation also employed to reduce contamination

RETAIL CENTER, COLORADO

A Phase II Environmental Site Assessment detected tetrachloroethylene, commonly known as perchloroethylene (PCE), in groundwater. Sampling indicated that the PCE was primarily confined to the groundwater and was migrating offsite via a sanitary utility corridor. The remedial alternative selected combined both zero-valent iron (ZVI) and Hydrogen Release Compound (HRC®) injected into the utility corridor to form a Permeable Reactive Barrier (PRB). This in-situ combination was clearly the best option based on time required for clean up, total project costs, and because problems associated with groundwater recovery, treatment and disposal could be eliminated. In addition, this in-situ remedial method creates little long-term site disturbance and does not require capital investment in and operation/ maintenance costs for remediation equipment and buildings. HRC® remedial activities were performed at the site in a series of four injections, at seven injection points, within a two-year period. Approximately 915-pounds of ZVI and 300-pounds of HRC® were injected utilizing URS's DPT drilling rigs and high volume/high pressure pumps. Based on current analytical projections, risk-based closure of this site is scheduled for July of 2001.

PERTINENT DETAILS

- URS direct injection techniques used for source treatment
- Combined HRC® and zero-valent iron for treatment
- Minimal disturbance to surface

Appendix C

PRB System Costs

Table 1

Cost Summary for PRB Design/Build

Former Miller Container Plant, Fulton, NY

Design/Install PRB			
	Labor Cost	$	604,700.00
	Materials and Equipment	$	762,700.00
	Travel Expenses	$	61,300.00
	Total	$	1,428,700.00
Monitoring and Maintenance			
Well Installation			
	Labor Cost	$	13,800.00
	Materials and Equipment	$	15,900.00
	Travel Cost	$	1,700.00
	Total	$	31,400.00
Monitoring for Fouling			
	Labor Cost	$	1,500.00
	Materials and Equipment	$	3,800.00
	Total	$	5,300.00
Monitoring for PRB Effectiveness			
	Labor Cost	$	3,000.00
	Materials and Equipment	$	7,700.00
	Total	$	10,700.00
	ETI Patent Fee & Review	$	165,500.00
	TOTAL COST	$	1,641,600.00

Appendix D

Copy of Certificate of Insurance

MARSH USA INC. — CERTIFICATE OF INSURANCE

CERTIFICATE NUMBER SEA-000501403-00

PRODUCER
Marsh Risk & Insurance Services
Post Office Box 193880
Attn: Alicia Cantavella
San Francisco, CA 94119-3880

URSS-Z-ALL-W/PRO-

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER OTHER THAN THOSE PROVIDED IN THE POLICY. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES DESCRIBED HEREIN.

INSURED
URS CORPORATION
100 CALIFORNIA STREET
SUITE 500
SAN FRANCISCO, CA 94111

COMPANIES AFFORDING COVERAGE

COMPANY A NATIONAL UNION FIRE INS. CO. OF PITTSBURGH, PA.
COMPANY B AMERICAN MANUFACTURERS MUTUAL INSURANCE CO.
COMPANY C AMERICAN INTERNATIONAL SPECIALTY LINES INS. CO.
COMPANY D INSURANCE CO. OF THE STATE OF PA

COVERAGES This certificate supersedes and replaces any previously issued certificate for the policy period noted below. 38

THIS IS TO CERTIFY THAT POLICIES OF INSURANCE DESCRIBED HEREIN HAVE BEEN ISSUED TO THE INSURED NAMED HEREIN FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THE CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, CONDITIONS AND EXCLUSIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

CO LTR	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	LIMITS	
A	GENERAL LIABILITY [X] COMMERCIAL GENERAL LIABILITY [ ] CLAIMS MADE [X] OCCUR [ ] OWNER'S & CONTRACTOR'S PROT	GL933-1972	04/01/02	04/01/03	GENERAL AGGREGATE	$ 2,000,000
					PRODUCTS - COMP/OP AGG	$ 2,000,000
					PERSONAL & ADV INJURY	$ 1,000,000
					EACH OCCURRENCE	$ 1,000,000
					FIRE DAMAGE (Any one fire)	$ 1,000,000
					MED EXP (Any one person)	$ 5,000
B	AUTOMOBILE LIABILITY	F5Y006395-00 AOS	04/01/02	04/01/03	COMBINED SINGLE LIMIT	$ 1,000,000
B	[X] ANY AUTO	F5Y006396-00 HI	04/01/02	04/01/03		
B	[ ] ALL OWNED AUTOS	F5Y006397-00 VA	04/01/02	04/01/03	BODILY INJURY (Per person)	$
B	[ ] SCHEDULED AUTOS	F5Y006398-00 TX	04/01/02	04/01/03		
B	[X] HIRED AUTOS	X3P084803-00 MASS	04/01/02	04/01/03	BODILY INJURY (Per accident)	$
	[X] NON-OWNED AUTOS					
					PROPERTY DAMAGE	$
	GARAGE LIABILITY [ ] ANY AUTO				AUTO ONLY - EA ACCIDENT	$
					OTHER THAN AUTO ONLY:	
					EACH ACCIDENT	$
					AGGREGATE	$
	EXCESS LIABILITY [ ] UMBRELLA FORM [ ] OTHER THAN UMBRELLA FORM				EACH OCCURRENCE	$
					AGGREGATE	$
						$
A	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY	708-4967 AOS	01/01/02	01/01/03	[X] WC STATUTORY LIMITS [ ] OTHER	
A		708-4968 CA	01/01/02	01/01/03	EL EACH ACCIDENT	$ 1,000,000
D	THE PROPRIETOR/ PARTNERS/EXECUTIVE OFFICERS ARE: [ ] INCL [ ] EXCL	708-4970 MA, TX, VA	01/01/02	01/01/03	EL DISEASE-POLICY LIMIT	$ 1,000,000
					EL DISEASE-EACH EMPLOYEE	$ 1,000,000
C	OTHER PROF. LIABILITY (E&O) CLAIMS MADE FORM	476-3090	04/01/02	04/01/03	EACH CLAIM	2,000,000
					AGGREGATE	2,000,000

DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/SPECIAL ITEMS (LIMITS MAY BE SUBJECT TO DEDUCTIBLES OR RETENTIONS)
EVIDENCE OF INSURANCE.

CERTIFICATE HOLDER

To be completed upon award

CANCELLATION

SHOULD ANY OF THE POLICIES DESCRIBED HEREIN BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE INSURER AFFORDING COVERAGE WILL ENDEAVOR TO MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED HEREIN, BUT FAILURE TO MAIL SUCH NOTICE SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE INSURER AFFORDING COVERAGE, ITS AGENTS OR REPRESENTATIVES.

MARSH USA INC.
BY: Michio Nekota

MM1(9/99) VALID AS OF: 04/25/02

Appendix E

List of Subcontractors

List of Subcontractors

(1) Oliver Enterprises - Utility Locate
7900 McDermott Road
Manlius, NY 13104
Tele: (315) 682-8070
FAX: (315) 682-6007

(2) Knapp Electric – Mix Tank and Trailer Electrical Service
40 Lakeshore Road
Fulton, New York 13069
Tele: (315) 592-5933

(3) Certified Environmental Services, Inc. – Groundwater Sampling and Analysis
1401 Erie Blvd. East
Syracuse, NY 13210
Tele: (315) 478-2374
FAX: (315) 478-2107

(4) Envirometal Technologies Inc. – Patent Fees
745 Bridge Street W., Suite 7
Waterloo, Ontario
Canada, N2V 2G6
Tele: (519) 746-2204
FAX: (516) 746-2209

END

OF

DOCUMENT