

Meeting Minutes

To George Meservey, Director of Planning & Community Development
Michael Domenica, PE, Program Manager

CC Betsy Shreve-Gibb, AICP, AECOM Project Director
Paul Dombrowski, P.E., AECOM
James Begley, LSP, MT Environmental Restoration

Subject **Town of Orleans, MA
Water Quality and Wastewater Planning
Draft Permeable Reactive Barrier Working Group Meeting Minutes**

Project Number 60476644

From Thomas Parece, P.E., AECOM Project Manager

Date and Time August 15, 2016 at 2:00 p.m.

1. Attendees and Affiliation

See Attached Sign in Sheet

2. Minutes

- A Permeable Reactive Barrier (PRB) workshop meeting was held at Orleans Town Hall on August 15, 2016 at 2:00 PM. The meeting included a presentation by Paul Dombrowski of AECOM and Jim Begley of MT Environmental Restoration (refer to attached). The presentation included an overview of work completed by the AECOM PRB Team to date including Demonstration Test site selection, evaluation, and recommendations for priority test locations. The results of groundwater hydrogeologic investigations at potential Demonstration Test locations were presented with interpretation.
- The Work Plan prepared for the PRB Demonstration Tests includes construction of an injection type PRBs with emulsified vegetable oil (EVO) carbon substrate.
- The potential for migration of EVO and dissolved iron were discussed with participants. A slide with a conceptual diagram of an EVO injection point and a photomicrograph of EVO in the pore space between sand grains was used as a visual aid in the discussion. Experience with EVO injection has shown EVO migration to be limited, typically with less than 20 feet of horizontal migration beyond injection areas and with 100 feet of migration as the largest distance observed.
- Dissolved iron is expected to migrate until the iron is stabilized by mixing with more aerobic groundwater downgradient of the PRB. Potential PRB locations should be more than 100 feet from surface waters to prevent surface water impacts from injected EVO and mobilized dissolved iron.

- The detection of 1,4-dioxane in groundwater at the Town Landfill was discussed with an outline of plans to assess groundwater at the landfill to define the area affected by 1,4-dioxane for risk assessment. The same assessment will be used to collect data to further define the extent of nitrogen compounds migrating from the landfill/former septage lagoon area (the nitrogen flux).

3. Action Items

Item Number	Description	Responsibility	Due Date
1	Request by participants for the August 17, 2016 Water Quality Advisory Panel meeting included more information on the potential for water quality impacts from 1,4-dioxane if it were to reach the Nauset Estuary and a current estimate of nitrogen flux from the Orleans landfill and former septage lagoons.	Paul Dombrowski and Jim Begley	08/17/16
2	Provide range of estimated Nitrogen Flux from the Town Landfill.	Paul Dombrowski and Jim Begley	08/17/16
3	Identify risk of shellfish with 1,4-dioxane.	Paul Dombrowski and Jim Begley	09/05/16
4	Next Meeting - TBD	All	TBD



PRB WORK GROUP MEETING
 AUGUST 15, 2016

<u>NAME</u>	<u>AFFILIATION</u>	<u>PHONE/ E-MAIL (IF NECESSARY)</u>
MIKE DOMENICA THOMAS PARÉCE	WRA AECOM	
Jim Begley	MT Env. Restoration	
Paul Dombrowski	AECOM	
JUDITH BRUCE	CWMS	
ALAN MCCLENNEN	BOJ	ALANBOJIS@AOL.COM
BRIAN DUDLEY charles Hattis	Mass DEP Eastham	CDH800Saw@yahoo.com
FRANK NICHOLS	DPW	
Tom Daley	DPW	
genia Pati	stakeholder	on file



Town of

Orleans
Massachusetts

Orleans Water Quality Advisory Panel

Permeable Reactive Barrier (PRB) Stakeholder Workshop

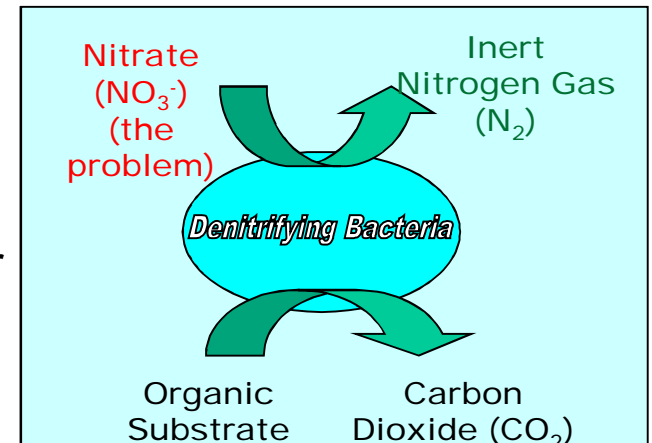
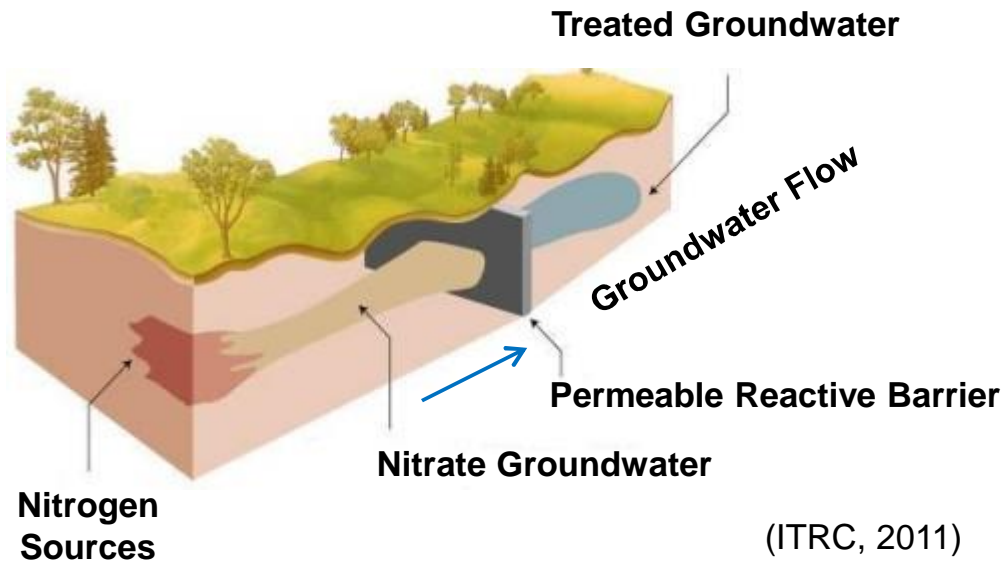
Paul Dombrowski, AECOM Technical Services, Inc.
James Begley, MT Environmental Restoration

August 15, 2016



PRB Overview

- ❖ A PRB Consists of a Zone of Reactive Material Installed in the Path of a Dissolved Contaminant (e.g. nitrate) Plume



- ❖ Denitrification - Biological Process by Bacteria Ubiquitous in the Environment
 - Nitrate converted to inert nitrogen gas (N_2)
 - Requires anoxic (low oxygen conditions)

Planning and Design-AECOM PRB Team Activities

- ❖ Technical Memo on Site Characterization for PRBs
 - Groundwater & soil investigation to support PRB planning

- ❖ Technical Memo for Preliminary Engineering Work Plan for PRBs
 - Includes results from groundwater & soil investigations

- ❖ Final Technical Memos available on Town website



PRB Planning and Design – Site Characterization

❖ Technical Memorandum on Site Characterization for PRBs

- Final memo submitted to Town in May 2016
- Evaluated sites using 4 major criteria (20 sub-criteria)
 - Site Suitability
 - Permitting
 - Project Evaluation
 - Other Considerations
- 8 sites in Orleans
 - A. Main Street/Tonset Road
 - B. Eldredge Parkway
 - C. Town Cove Gibson Road
 - D. Namequoit Road
 - E. Town Landfill
 - F. Paw Wah Pond
 - G. Rock Harbor Road Area
 - H. Lonnie's Pond

• **Top rated sites in red**



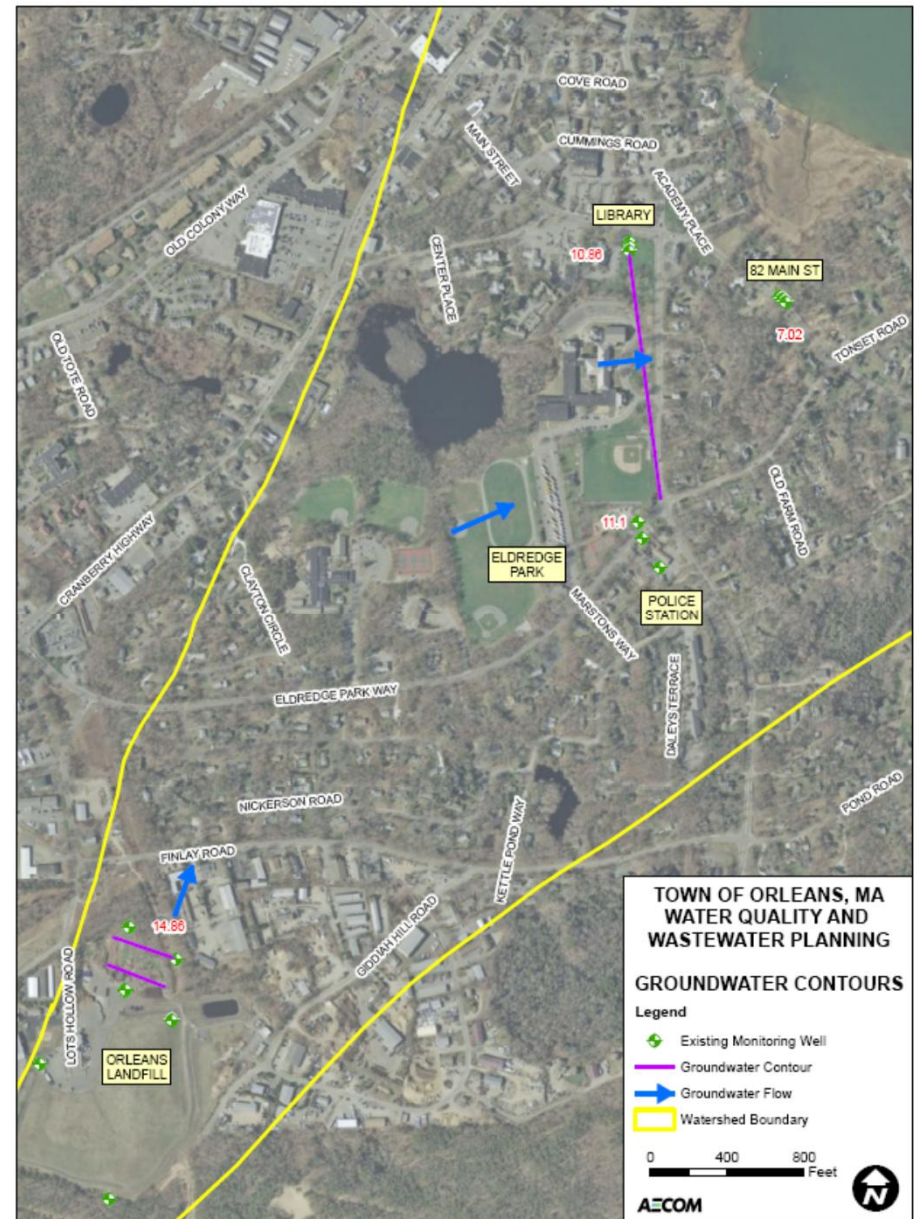
PRB Planning and Design – 2016 Field Investigations

- ❖ Collected soil & groundwater samples from highest 4 ranked locations
- ❖ New multi-depth wells installed
 - Snow Library
 - 82 Main Street
 - Gibson Road at Asas Landing
 - Town Landfill
- ❖ Sampled existing wells at Town Landfill and Eldredge Park
- ❖ Measured Parameters to Support PRB Site Selection and Design
 - Vertical Profile of Nitrate (and ammonia) Concentrations
 - Depth to Groundwater
 - Groundwater Flow Velocity
 - Soil Types
 - Other Groundwater Analytes of Interest



Results of Investigation

- ❖ Groundwater flow directions confirmed in areas of interest
- ❖ Initial view of nitrate/ammonia profile
- ❖ Better understanding of area hydrogeology
 - Aquifer material and groundwater flow velocity



Nitrate Concentrations in Groundwater

- ❖ Eldredge Park – up to ~21 mg/L (5 years historical data)
- ❖ Landfill – up to ~40 mg/L (10 years historical data)
- ❖ Library – maximum ~ 2 mg/L (one round of samples)
- ❖ Main Street near Town Cove maximum ~ 5 mg/L (one round of samples)
- ❖ Asas Landing < 1mg/L (one round of samples)

Preliminary estimate: Groundwater flow velocity is in the range of 1 to 5 feet/day so nitrate flux is high



PRB Planning and Design – Preliminary Design

- ❖ Technical Memorandum on Preliminary Engineering Work Plan for PRBs
 - Memo finalized in May 2016
 - Preliminary Design for PRB Demonstration Tests
 - Process Description
 - Demonstration Test Objectives
 - Demonstration Test Sizing
 - Amendments and Application Methods
 - Treatment Dosages
 - Performance Monitoring



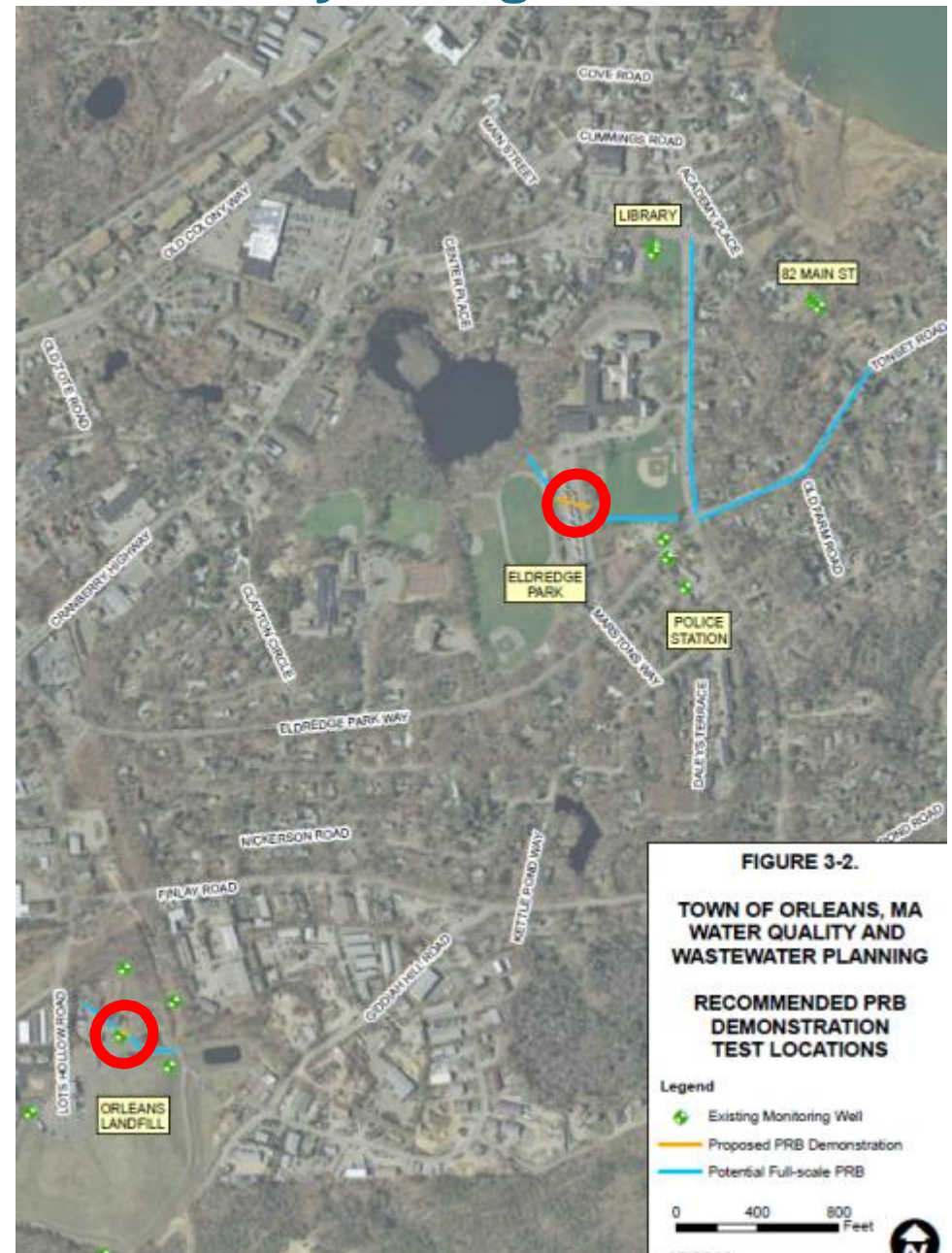
PRB Planning and Design – Preliminary Design

- ❖ Detailed Demonstration Tests

1. Eldridge Park
2. Town Landfill

- ❖ 50 to 200 feet long Demonstration Tests

- ❖ Assume treatment 40 feet below groundwater table



PRB Application Method – Injection

- ❖ Widely accepted groundwater treatment method and equipment readily available.
- ❖ Small equipment footprint
 - small drill rig
 - all pumps and mixing tanks contained to box truck/trailer
 - All points temporary
- ❖ Injection can generate a wider treatment zone than trench
- ❖ Application not limited by depth
- ❖ Shorter field construction time than trenching
- ❖ Injection can be performed under roadways
 - Hose ramps can be used to keep street open to traffic
 - Limited impact to traffic and abutters



PRB Amendment – Emulsified Vegetable Oil

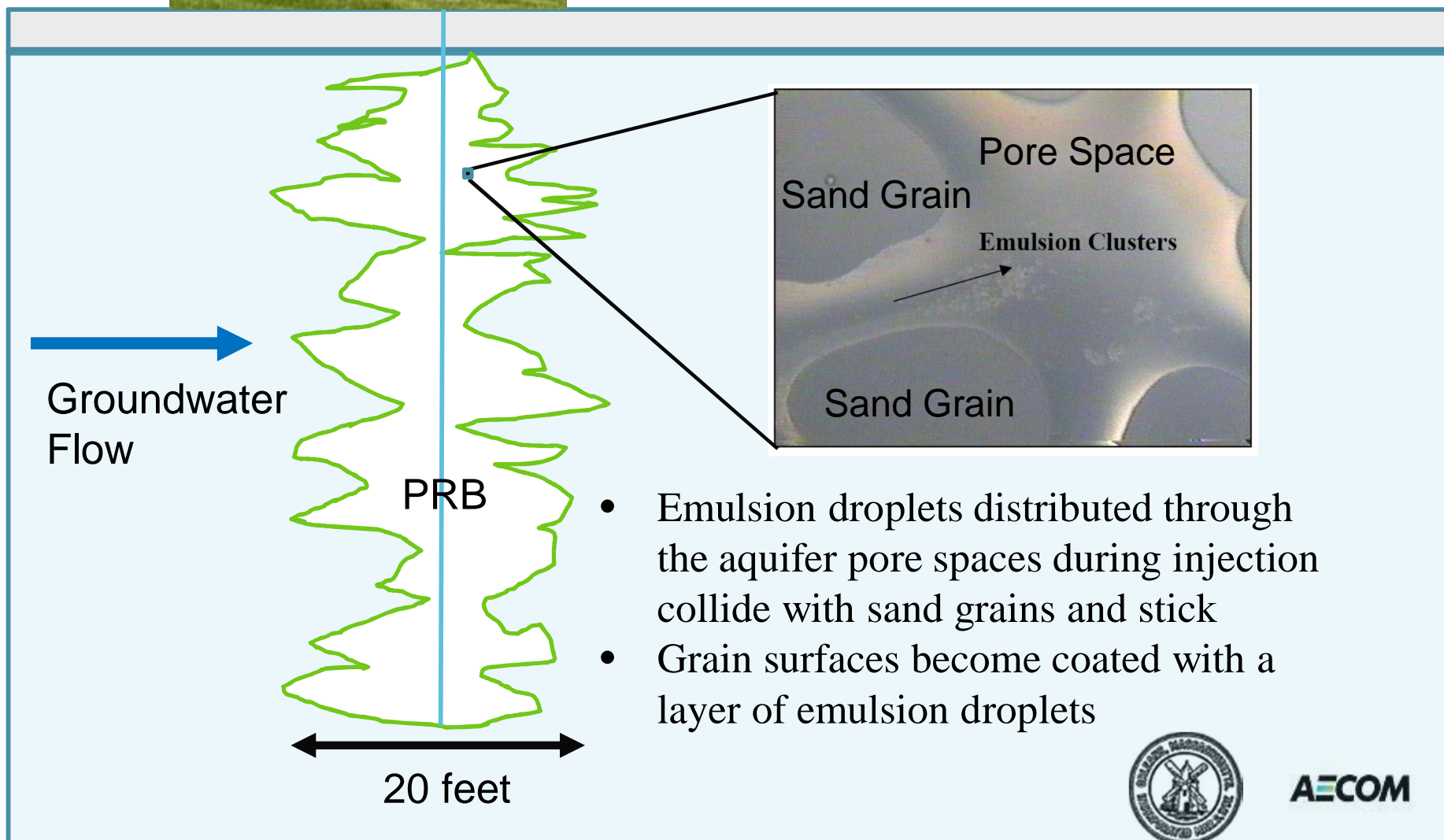
- ❖ Emulsified Vegetable Oil is a food-grade substrate made with soybean oil (oil-in-water emulsion with consistency similar to soy milk)
- ❖ Emulsion slowly releases dissolved organic carbon and provides a long term carbon source for denitrifying bacteria
- ❖ Emulsions are designed to be immobile once injected into groundwater
- ❖ AECOM experience at 10s of sites – emulsion never travels more than 100 feet (mostly less than 20 feet)
- ❖ Laboratory studies with Cape Cod sand used to develop an emulsion mixture that does not migrate (less than 3 feet in a column study)



Direct Injection Rig



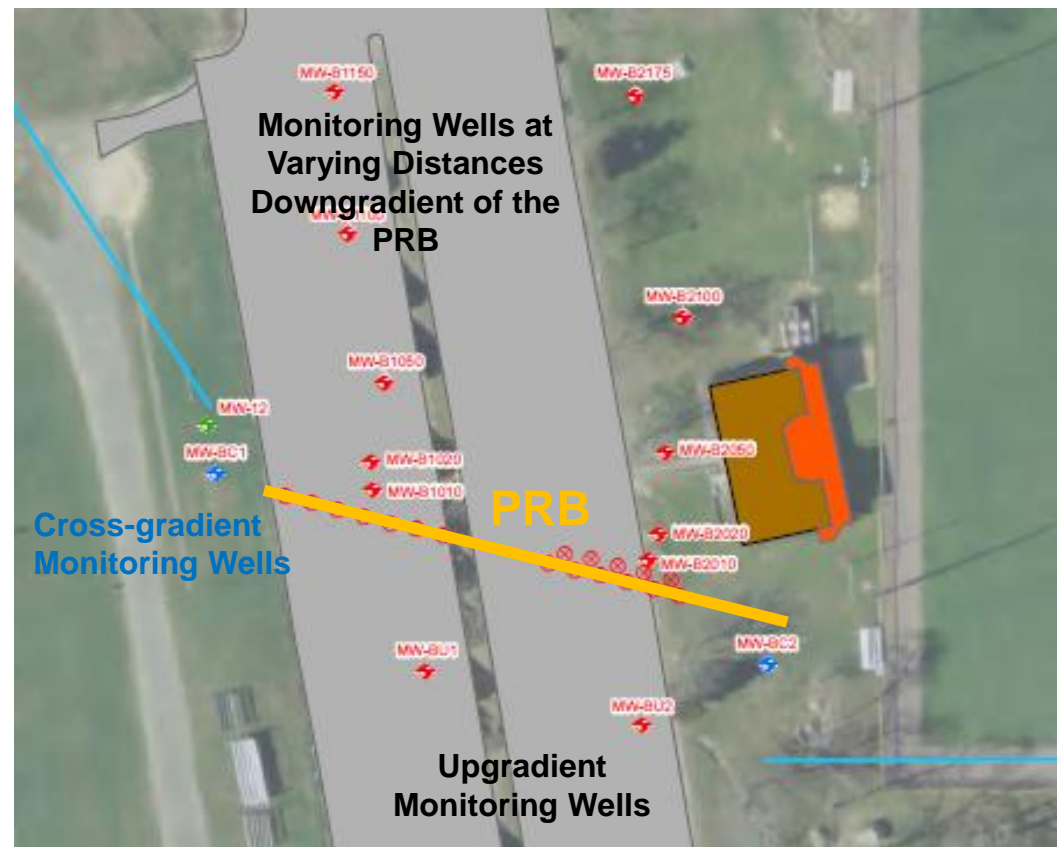
Conceptual Cross Section of a Permeable Reactive Barrier (PRB)



AECOM

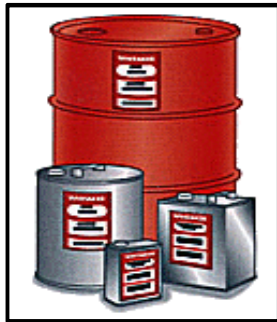
Eldredge Park PRB Demonstration Test Layout & Monitoring Overview

- ❖ 50 to 200 feet long Demonstration Test Emulsion Injection
- ❖ Upgradient and downgradient monitoring wells with quarterly sampling
- ❖ Monitoring Parameters
 - Total Nitrogen
 - Nitrate
 - Ammonia
 - Nitrite
 - Dissolved Metals
 - Sulfate
 - Dissolved Organic Carbon
 - Methane
 - Dissolved Oxygen
 - pH
 - Oxidation-Reduction Potential

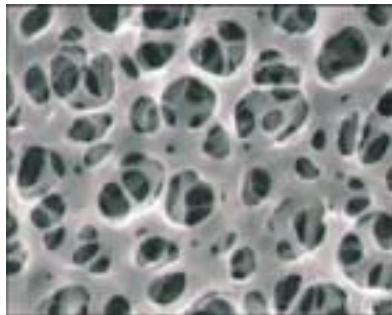


What is 1,4-Dioxane?

- ❖ **Solvent stabilizer** and acid corrosion inhibitor used to prevent decomposition of 1,1,1-trichloroethane
- ❖ Main or minor ingredient of many products
- ❖ Produced as by-product from polyester or nonionic detergent manufacturing process
- ❖ Unlikely to volatilize into soil vapor or sorb to soil particles = highly mobile



Solvent Stabilizer of 1,1,1-TCA



Main ingredient: Cellulose Acetate Membrane Production



Byproduct from detergent production



Dioxane-free detergent



1,4-Dioxane Assessment at Landfill

- ❖ 1,4-Dioxane detected at one well above GW-1 standard
 - 1.4-1.9 $\mu\text{g/L}$ (MW-2D)
- ❖ AECOM PRB team to initiate Phase I assessment of 1,4-dioxane in groundwater at 5 additional locations (multiple depths per location)
- ❖ Analyses will also include nitrate and ammonia to further support extents of nitrogen sources
- ❖ Phase II 1,4-dioxane investigation to be determined based on Phase I results



- ❖ Potential for combined treatment with nitrogen to be evaluated



PRB Next Steps

- ❖ Complete Design for Demonstration Test #1 Eldredge Park – FY 2017
 - To be completed August 2016
- ❖ Implement Demonstration Test #1 Eldredge Park – FY 2017
 - Monitoring well installation – August/September 2016
 - Baseline groundwater sampling – September 2016
 - EVO Application – September/October 2016
- ❖ Town Landfill – FY 2017
 - Implement Groundwater Assessment
 - Identification and Evaluation of Alternatives for Nitrogen and 1,4-dioxane
 - Conceptual Design and Cost Estimate for the Recommended Alternative
- ❖ Town Landfill - FY 2018
 - Implement Demonstration Test #2 with Recommended Alternative
- ❖ Groundwater sampling for PRB Demonstrations – FY 2017–FY 2019





Town of
Orleans
Massachusetts

Thank You

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