

Lombardo Associates, Inc.  
Representative Groundwater &  
Stormwater Treatment  
Project Descriptions

- Passive Groundwater Treatment Project Description
- Waquoit Bay Permeable Reactive Barrier (PRB)

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Environmental Engineers/Consultants

**LOMBARDO ASSOCIATES, INC.**

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49 Edge Hill Road

Newton, Massachusetts 02467

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# Passive Groundwater Treatment for Nitrogen, Phosphorus & Perchlorate Removal

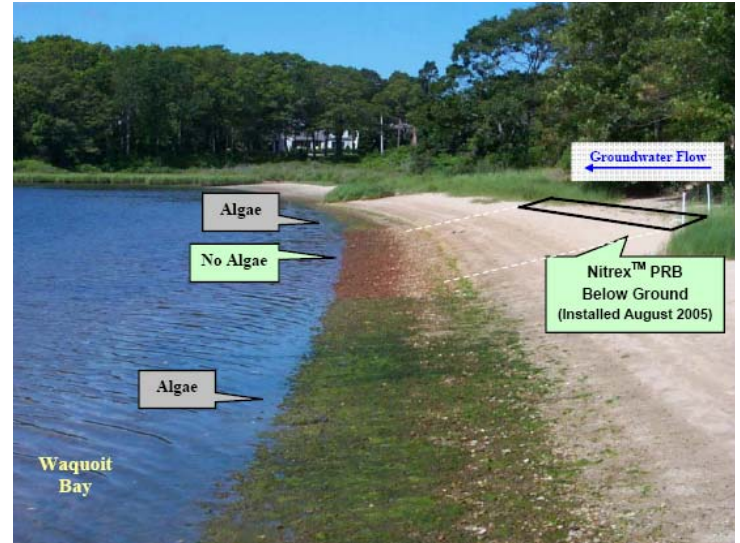
Nitrate Nitrogen < 0.1 -0.6 mg/l

Total Phosphorus < 0.1 mg/l

Total Perchlorate < 0.2 ug/l

**Project:** Permeable Reactive Barrier (PRB)  
Passive Groundwater Treatment  
Nitrogen Removal

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## Site 1 – Nitrogen Removal – Cape Cod, Massachusetts

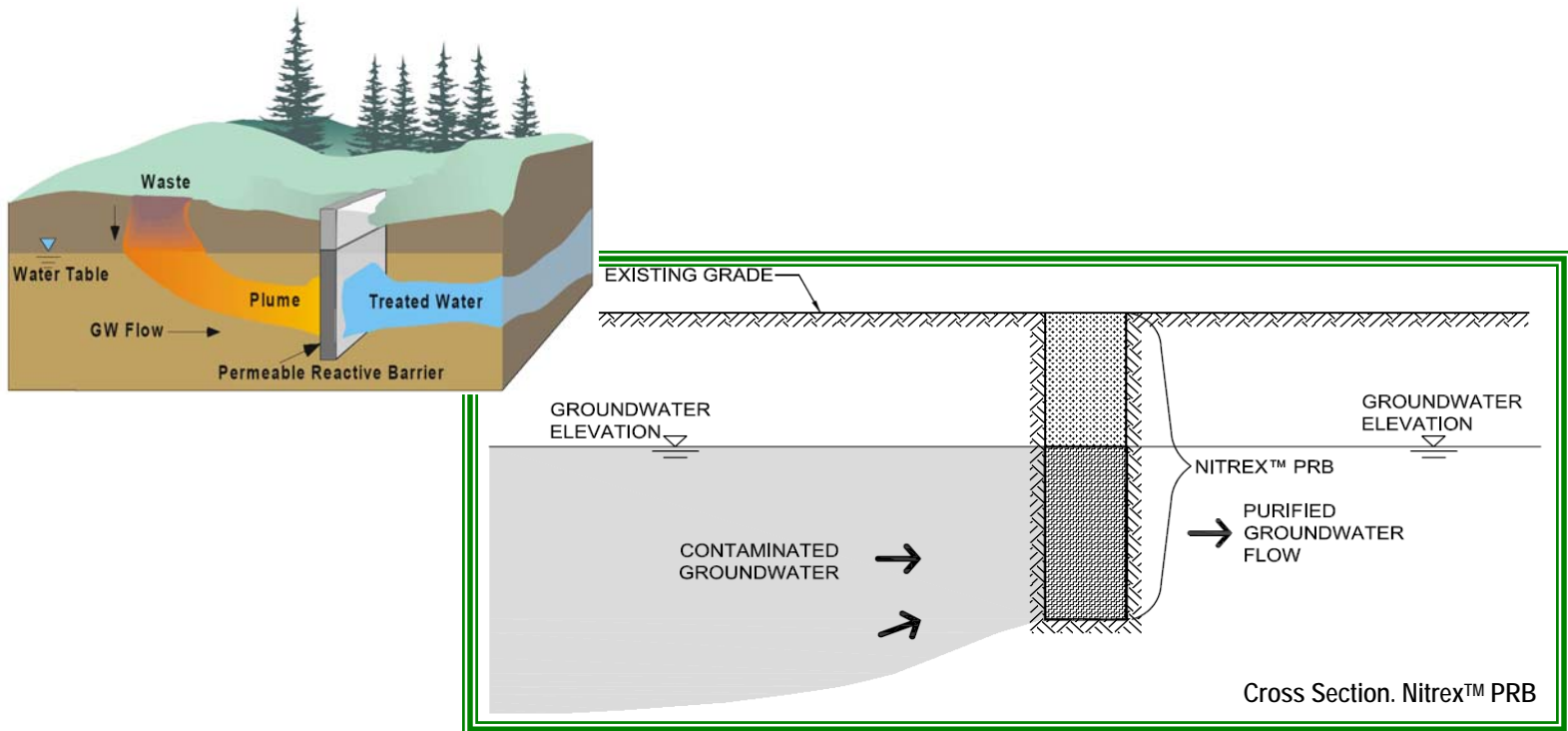


As part of a Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET) funded demonstrated project, the Woods Hole Marine Biological Lab (MBL) retained Lombardo Associates, Inc. (LAI) for installation of the patented Nitrex™ groundwater nitrogen removal technology at two locations on Cape Cod, MA in the Waquoit Bay watershed.



## Performance

Site	Influent Nitrate – N (mg/l)	Effluent Nitrate – N (mg/l)
Waquoit Bay, MA	1.74	0.007
Childs River, MA	7.19	0.568



### Site 2 – Nitrogen Removal – Southern New England

Two Nitrex™ PRBs were installed in a Rhode Island coastal watershed. Upstream and downstream concentrations of nitrate, ammonia, and dissolved organic nitrogen in the groundwater were monitored over two annual cycles. The dissolved inorganic nitrogen (DIN) levels are presented below.

Site	Influent DIN (mg/l)	Effluent DIN (mg/l)
Coastal Site #1	3.9	0.2
Coastal Site #2	3.7	0.1

DIN = Dissolved Inorganic Nitrogen = Ammonium + Nitrate + Nitrite

### Site 3 – Perchlorate and Nitrogen Removal – Ontario, Canada

Ontario, Canada Site	Nitrate - N (mg/l)	Perchlorate (ug/l)
Influent	50	50
Effluent	<0.1	<0.2

### Site 4 – Phosphorus Removal – Massachusetts Site

Massachusetts Site	Influent Phosphorus (mg/l)	Effluent Phosphorus (mg/l)
Site #1	1.7	0.1



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Algae

No Algae

Nitrex™ PRB Below Ground  
(Installed August 2005)

Groundwater Flow

Waquoit Bay

Algae

Nitrex™ Permeable Reactive Barrier (PRB)  
For Nitrogen Removal  
Waquoit Bay National Estuarine Research  
Reserve (WBNERR), Falmouth, MA

Evaluated by the Woods Hole Marine  
Biological Laboratory (MBL)

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Photo Taken July 2009 by  
Chris Weidman (WBNERR)