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# *Permeable Reactive Barriers (PRB) Achieving Nitrogen Removal & TMDL Compliance*

Martha's Vineyard Commission Conference


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Environmental Engineers/Consultants

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# PRB Groundwater Treatment Options

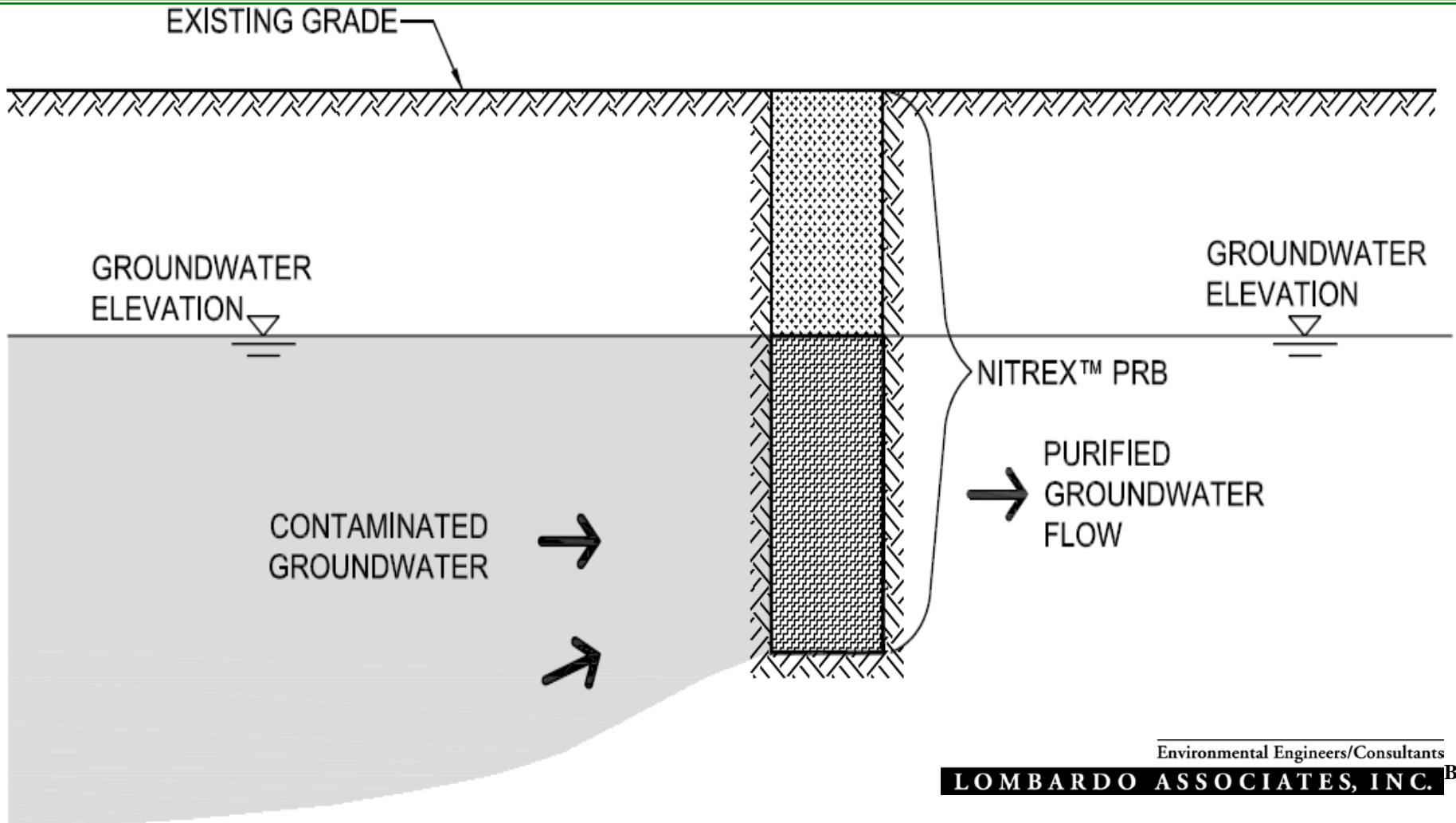
## Areawide Treatment

- Where applicable, generally least cost option Immediate Water Quality Benefit
- Addressing legacy and future development of N discharges

## Single Property

- Generally only economically applicable at sites with groundwater at ~ 5 feet below surface for single family or ~ 10 feet for commercial applications

# Nitrex™ PRB for Groundwater Treatment



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Algae

No Algae

Nitrex™ PRB Below Ground  
(Installed August 2005)

Waquoit Bay

Algae

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

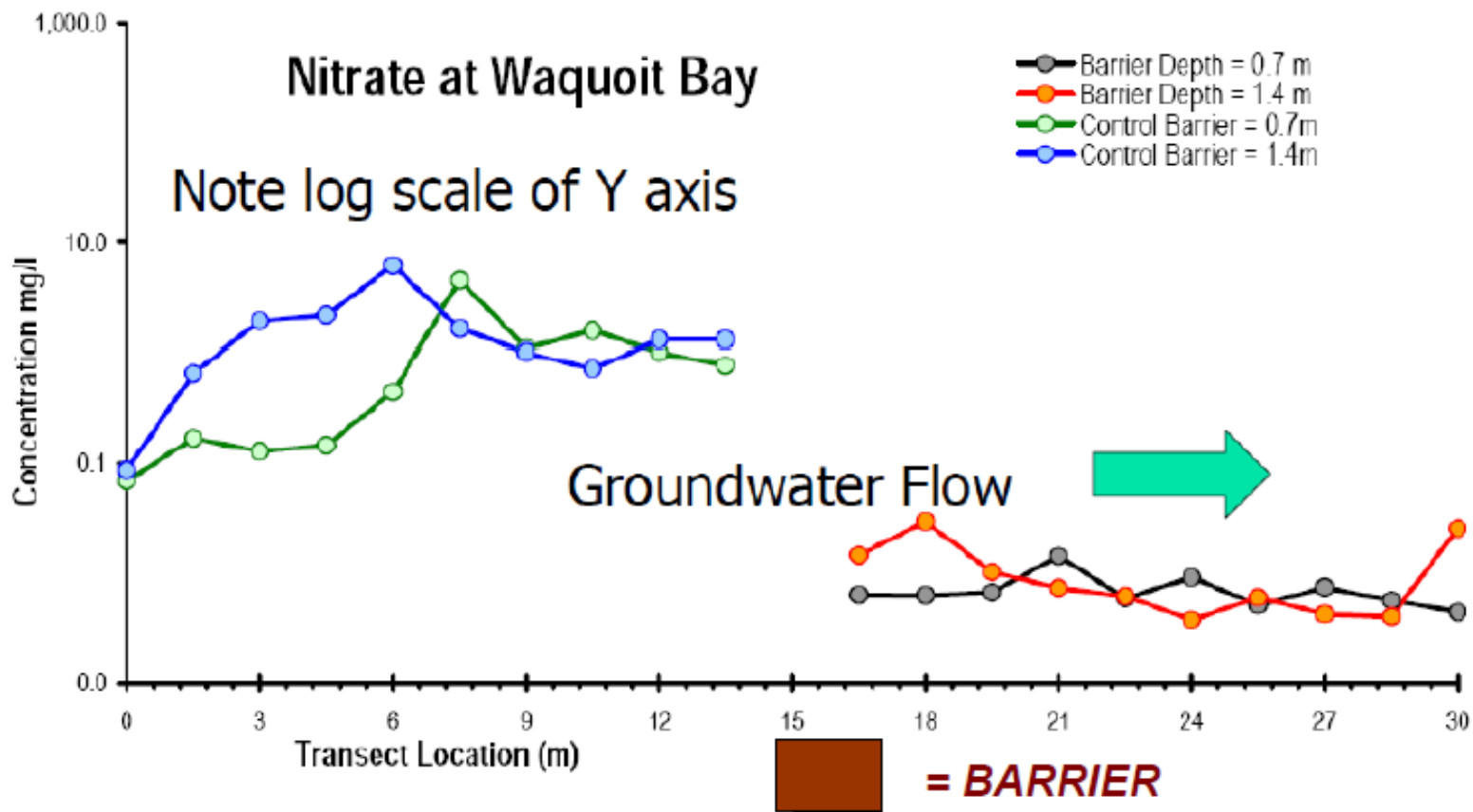
Evaluated by the Woods Hole Marine  
Biological Laboratory (MBL)

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Photo Taken July 2009 by  
Chris Weidman (WBNERR)

# Waquoit Bay PRB Installation - 2005

# NITRATE AT WAQUOIT BAY DATA COLLECTED BY WOODS HOLE MARINE BIOLOGICAL LAB (MBL)



# Child's River PRB – 2005 Installation

- Untreated GW TN ~3 mg/L
- Treated GW TN ~0.1



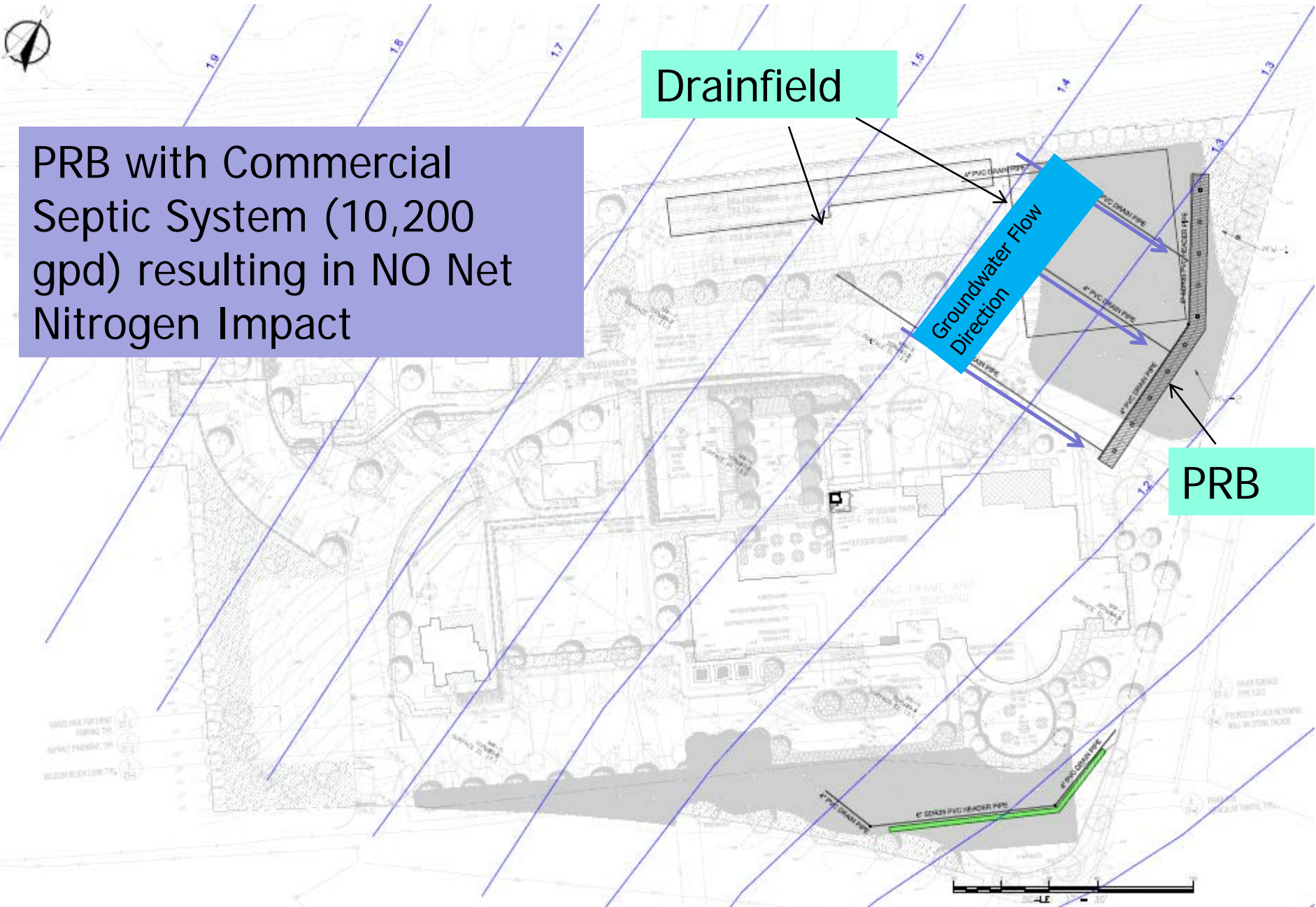


PRB with Commercial Septic System (10,200 gpd) resulting in NO Net Nitrogen Impact

Drainfield

Groundwater Flow Direction

PRB



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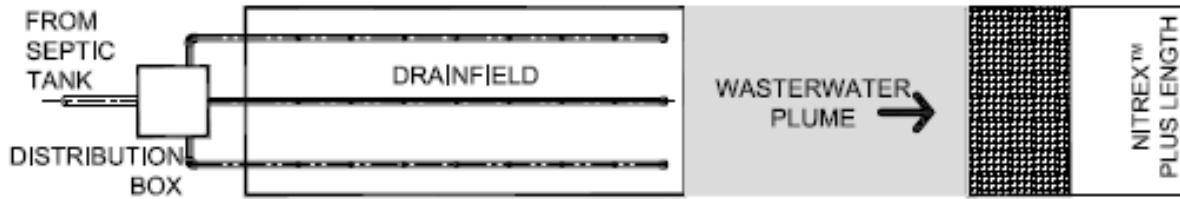


# Lagoon Pond PRB TMDL Compliant Plan

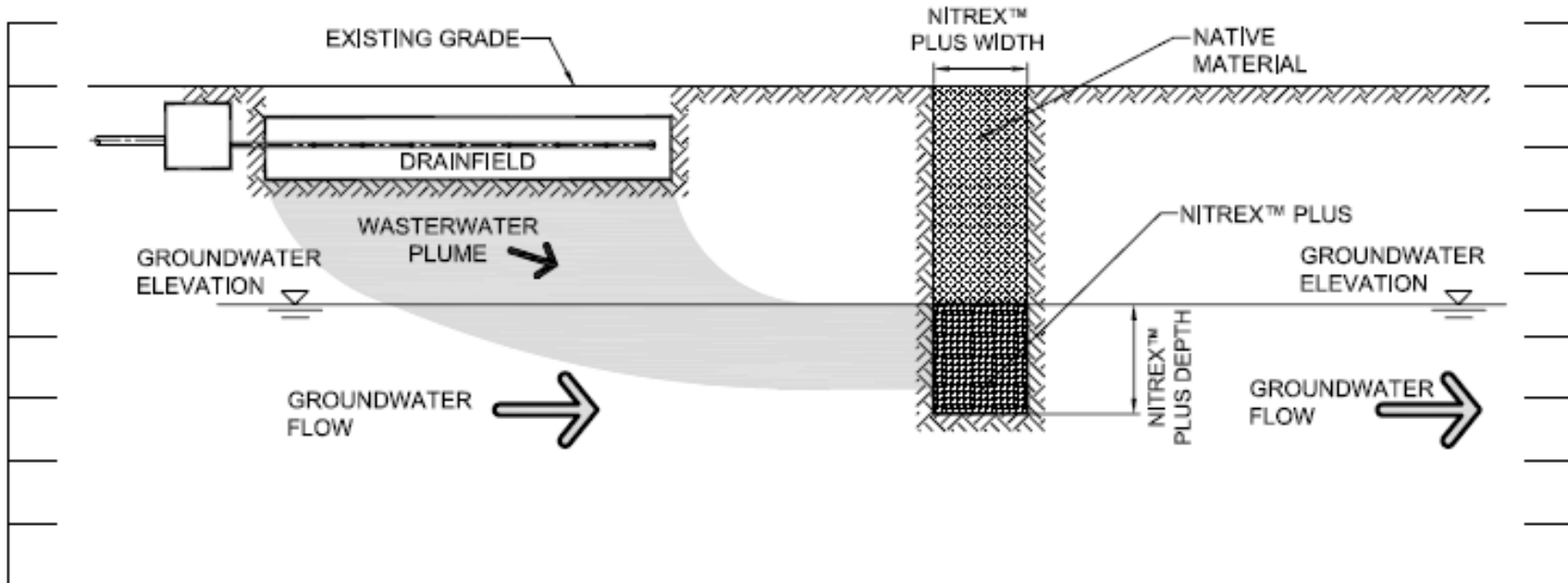




# Nitrex™ Plus With PRB



Plan View



Cross Section  
Nitrex™ Plus Groundwater Denitrification System





# Questions / Discussion

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Gary Rubenstein

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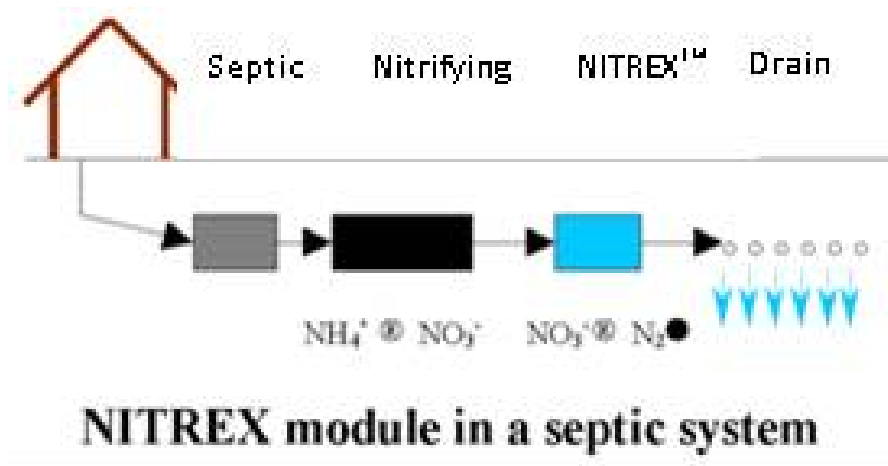
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# Nitrex™ System – How It Works

Passive system – only 1 or 2 pumps that operate ~ 30 minutes / day = ~\$40/yr. O&M – yearly visits after 1<sup>st</sup> 3 years



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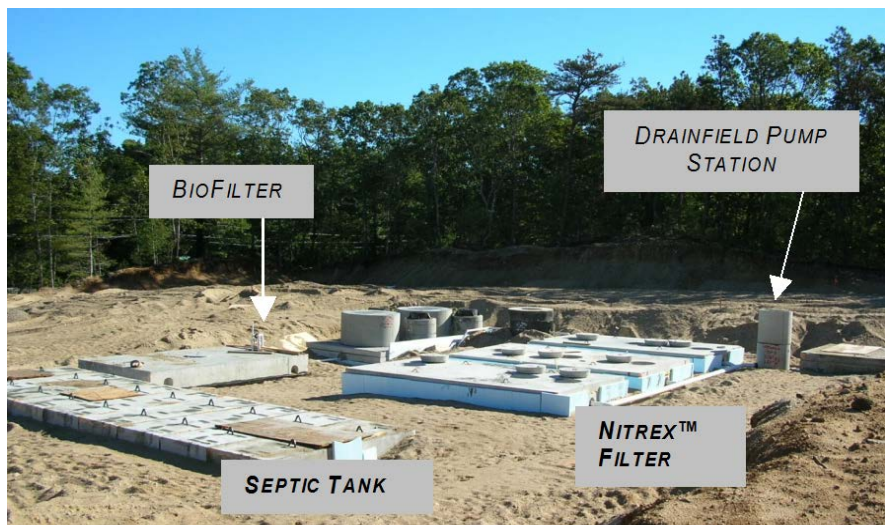
## Nitrex™ Nitrogen Removal Systems - Nitrogen Removal Performance

Site #	Location	Application	Septic Tank Effluent Total		Nitrex™ Effluent Total	Sampling Frequency	Total Nitrogen	Period of
				Est.				From
1	2950 Beacon Court, Lusby, MD	Single Family Residence (SFR)	60.0	Est.	1.97	quarterly	96.7%	Sep-09
2	6500 Long Beach Drive, St. Leonard, MD	SFR	60.0	Est.	2.8	quarterly	95.3%	Sep-09
3	6586 Long Beach Drive, St. Leonard, MD	SFR	60.0	Est.	2.95	quarterly	95.1%	Sep-09
4	18040 Barnesville Road, Barnesville, MD	SFR	60.0	Est.	5.47	quarterly	90.9%	Mar-10
5	1933 Clifton Road, Virginia Beach, VA	SFR	60.0	Est.	3.29	annually	94.5%	Aug-09
6	Dana Drive, Crawfordville, FL	SFR	60.0	Est.	4	every 2 months	93.3%	Dec-11
7	Mashpee, MA Main St Villages	30 unit subdivision	56.0		3.85	monthly for 18 months then quarterly	93.1%	May-06
8	Eastham, MA Bracket Landing	40 unit subdivision	45.1		3.11	monthly for 18 months then quarterly	93.1%	Oct-07
9	Suffolk County NY Environmental Center	Environmental Center	100.0		1.90	quarterly	98.1%	Aug-11
10	Bogue Sound Elementary & Croatan High School, Newport NC	Elem & High School	106.1		3.11	weekly for 8 weeks, monthly for 9 months, quarterly	97.1%	Jan-10
11	Malibu Village Plaza Malibu, CA	Shopping Center - Restaurants & Retail	66.2		3.04	weekly	95.4%	Jul-07
12	Stone Residence LaPine, OR	SFR	56.5		2.2	monthly for 23 months	96.1%	Dec-00
13	Fleming Residence LaPine, OR	SFR	68		2.65	monthly for 21 months	96.1%	Dec-00
14	St. Ignatius, MT for MT Dept of Natural Resources	SFR	46.1		3.4	65 total samples	92.6%	Oct-99
15	Massachusetts Alternative Septic System Test Center, Cape Cod MA	330	39.3		4.5	Monthly for 30 months then weekly for 12 months	88.5%	Oct-01
<b>AVERAGE OF ALL SYSTEMS</b>							<b>94.4%</b>	

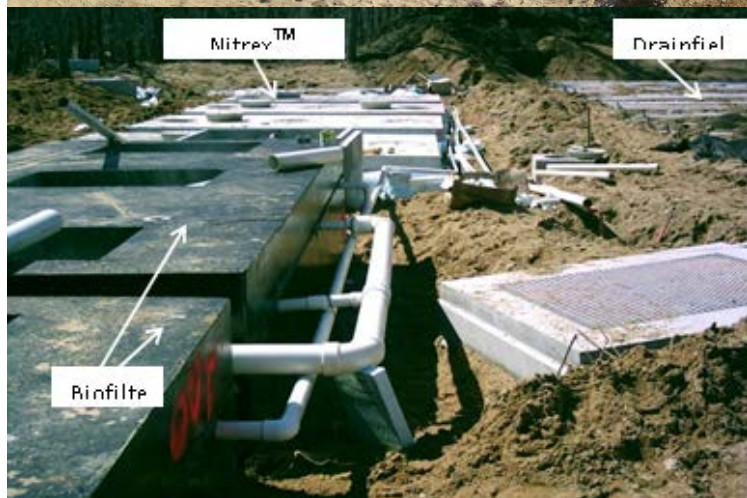
# Residential & Light Commercial Nitrex™ Systems – Mashpee (6,400 gpd) & Eastham (8,600 gpd) MA

Effluent Total Nitrogen Average 3.4 mg/L – since 2007 Quarterly O&M Visits

Mashpee, MA Wastewater System at Substantial Completion



Mashpee, MA Wastewater System at Completion



Brackett Landing, Eastham, MA Nitrex™ Treatment System	
Date	Nitrex™ Effluent Total Nitrogen (mg/l) Geometric Mean
2007 - 2009	2.23
2008 - 2010	2.21
2009 - 2011	2.62
2010 - 2012	2.05

Mashpee, MA Nitrex™ Performance

Date	Effluent
	Total Nitrogen (mg/l)
2006 - 2008 GeoMean	2.8
2007 - 2009 GeoMean	2.9
2008 - 2010 GeoMean	2.2
2009 - 2011 GeoMean	3.0
2010 - 2012 GeoMean	3.1
2011 - 2013 GeoMean	3.0
2012 - 2014 GeoMean	3.1
2013 - 2015 GeoMean	3.8
Period of Record	3.1