

Lombardo Associates, Inc.

Representative Phosphorus Removal Project Descriptions



- PhosRID™ Phosphorus Removal Technology Description
- Residential Installations- Nantucket, MA
- Office Building- Central Hudson Gas & Electric, Ulster, NY

Environmental Engineers/ Consultants

LOMBARDO ASSOCIATES, INC.

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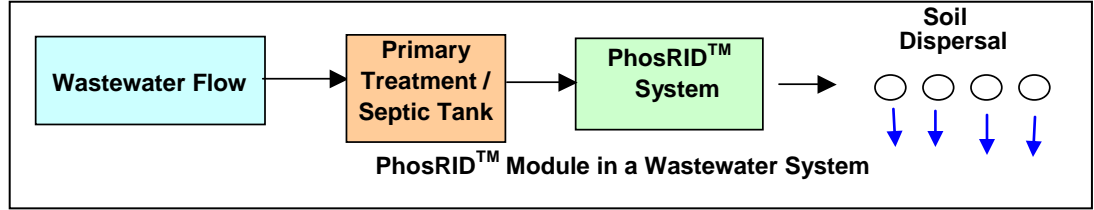
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PhosRID™ Passive Phosphorus Wastewater Removal System



The PhosRID™ system removes phosphorus from water through reductive iron dissolution and mineralization of phosphorus.

Septic System Test Center, MA Project

Project Description

Lombardo Associates, Inc. (LAI) and the University of Waterloo installed a demonstration PhosRID™ phosphorus removal system at the Massachusetts Septic System Test Center. Data collection and analysis was performed by the Barnstable County Health Department.

Project Application Data

- Location: Otis Air Force Base, MA
- Site Application: Massachusetts Septic System Test Center (MASSTC)
- Installation Date: August 2002

Design Profile

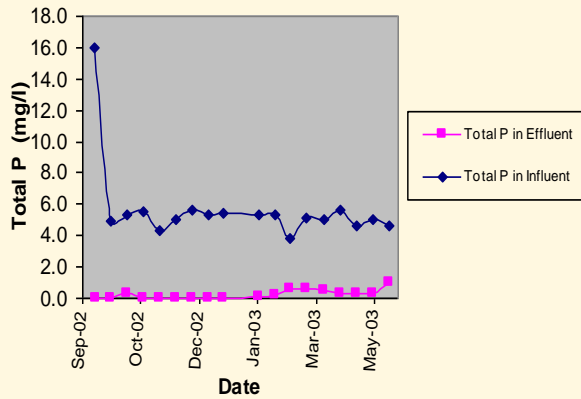
- Design Wastewater Flow: 330 gpd
- Wastewater Treatment Process: Septic Tank – PhosRID™ - Media Filter - Leaching Trench

PhosRID™ Treatment Performance

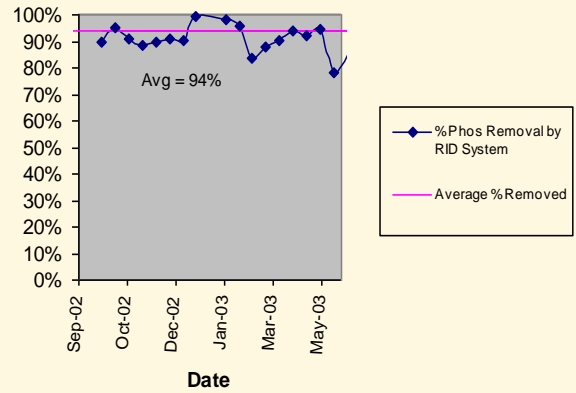
The PhosRID™ installed at the Massachusetts Septic System Test Center has reduced phosphorus in the effluent by an average of 94% over the one year that it has been in operation. In addition, the PhosRID™ has reduced the Total Nitrogen by 54% and BOD in the effluent by 86%.

Result	Influent to RID					RID Filter			
	PO4 -3 (mg-P/L)	BOD ₅ (mg/L)	Total P (mg/L)	TSS (mg/L)	TN (mg/L)	Total P (mg/L)	% P Removal	% BOD Removal	% N Removal
Average (mean)	4.2	150.0	5.7	23.2	33.3	0.4	94%	86%	54%
Standard Deviation	0.6	67.9	2.6	7.3	3.9	0.3	7%	15%	9%
MIN	3.1	46.0	3.8	4.4	26.2	0.0	79%	37%	40%
MAX	5.5	277.0	16.0	40.7	37.2	1.0	100%	99%	63%

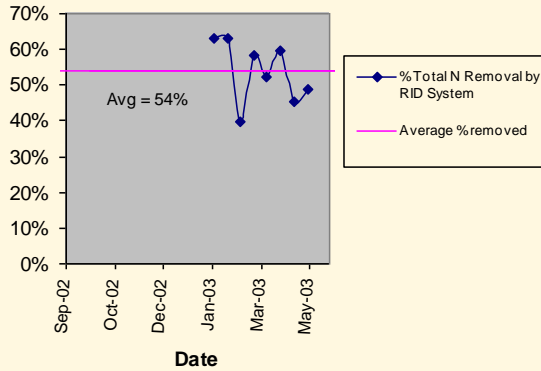
Total P of Influent to and Effluent of PhosRID



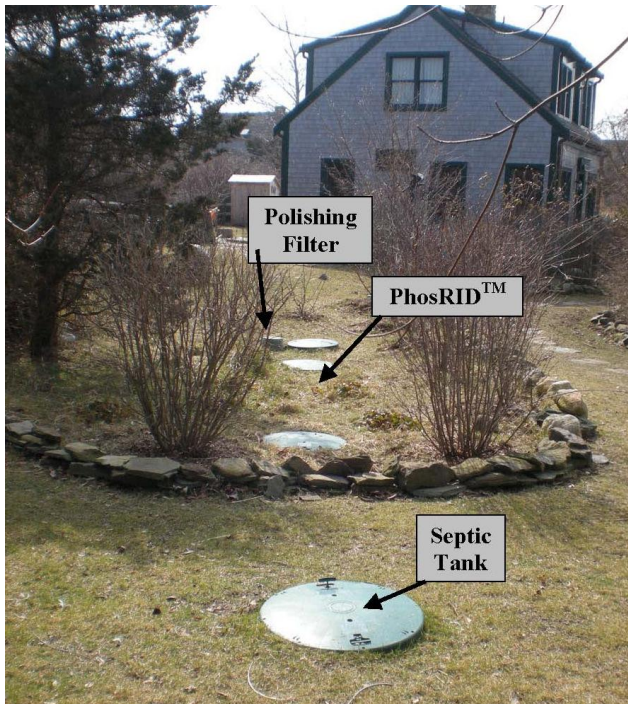
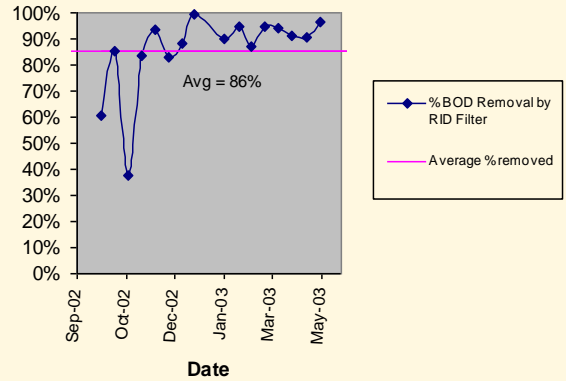
% Total Phos Removal by PhosRID Filter



% Total N Removal by PhosRID Filter



% BOD Removal by PhosRID Filter



Reference:

Mr. George Heufelder
 Barnstable County Department of Health
 Post Office Box 427
 Barnstable, MA 02630
 (508) 375-6616

Nantucket, MA Projects

Lombardo Associates, Inc. (LAI) designed PhosRID™ system components to be integrated with the property's septic tank and soil absorption system. The design flows is 440 gpd for Sites 1 and 2 and 330 gpd for Site 3.

The PhosRID™ technology has proven extremely effective at removing phosphorus from septic tank effluent. In addition, PhosRID™ also provides nitrogen reduction, BOD reduction and reduction in the total suspended solids.

The Nantucket, MA sites performance summary is presented below:

Date	Site #1 56 Meadow View Drive					Site #2 11 Columbus Ave					Site #3 76 Millbrook						
	Average Monthly Flow (gpd)	Septic Tank Effluent TP (mg/l)	PhosRID™ System Effluent (mg/l)			Average Monthly Flow (gpd)	Septic Tank Effluent TP (mg/l)	PhosRID™ System Effluent (mg/l)			Average Monthly Flow ¹ (gpd)	Septic Tank Effluent TP (mg/l)	PhosRID™ System Effluent (mg/l)				
			TP	BOD	TSS			TP	BOD	TSS			TP	BOD	TSS		
07/05/07		1.83	0.12			130.9	1.30	<0.02									
08/09/07		9.5	0.1			144.9	4.10	0.08									
09/11/07		9.5	0.11	<4		35.2	5.00	0.04	<4								
12/17/07		8	0.07	<4	<2	17.7	6.30	<0.02	<4	<2							
03/26/08						1.6	9.50	0.03	<4	<2	180.6						
05/14/08						57.9						2.4	0.11	<4	6.0		
06/25/08						96.6	4.10	<0.02	12.0	5.0	129.2	2.8	<0.02	<4	<4		
07/31/08						307.1					131.2	2.7	<0.02	<4	<2		
09/30/08						50.3	8.00	0.03	44.0	17.0							
10/30/08						5.1					85.2	4.2	<0.02	<4	<2		
01/28/09						0.7	8.70	<0.02	<12	4.0	123.7	5.3	<0.02	<4	<2		
04/30/09											62.8	6.5	0.07				
07/22/09						11.2	4.95	0.03	16.0	<2							
09/10/09							5.70	0.18	<4	10.0							
09/24/09											111.7	3.9	0.01	<4	14		
12/23/09												4.2	<0.01	<4	17		
05/20/10												4	<0.02	<4	2		
07/02/10						29.2	4.50	<0.02	<4	5.0							
09/30/10												4.8	<0.02	<4	3		
11/30/10						90.4	4.5	<0.02	<4	2		3	<0.02	<4	<2		
06/23/11												4.8	<0.02				
Average		7.21	0.10	<4	<2	81.1	5.77	0.05	10.8	5.6	130.0	3.98	0.03	<4	<3		
Percent P Removal		98.6%			99.1%					99.3%							

Lombardo Associates, Inc. (LAI) has been Engineer of Record for over \$200 million of wastewater management projects, including numerous wastewater treatment facilities utilizing a wide variety of on-site and decentralized systems. LAI provides a wide range of services, including engineering feasibility studies, traditional engineering services of planning, design and construction engineering, and the turnkey services of designing, building, owning/financing, and operating wastewater and water facilities. Among our areas of nationally recognized expertise are the planning and implementation of on-site and decentralized wastewater systems and innovative nitrogen and phosphorus removal technologies.

LAI is a recipient of the prestigious American Consulting Engineer's Council Engineering Excellence Award for its innovative wastewater project. Pio Lombardo was an *Engineering News Record* Construction Man of the Year candidate.

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PROJECT DESCRIPTION – CENTRAL HUDSON GAS & ELECTRIC

PhosRID™ Passive Phosphorus Wastewater Removal System

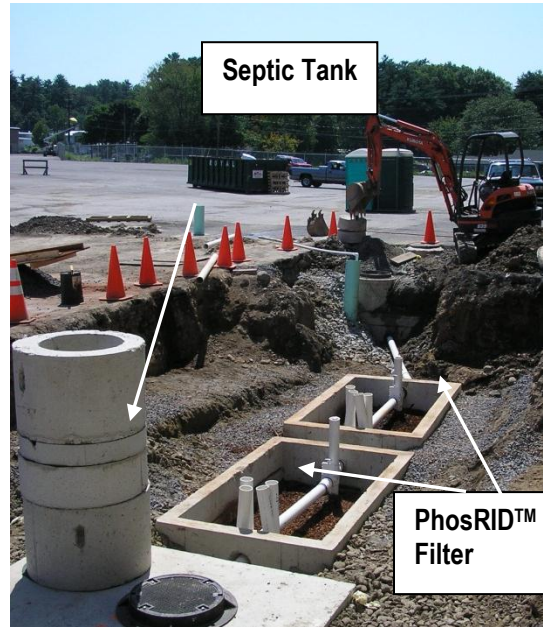
Project: Office Building Wastewater Treatment System

Client: Central Hudson Gas & Electric

Wastewater Engineer: Pio Lombardo, P.E.
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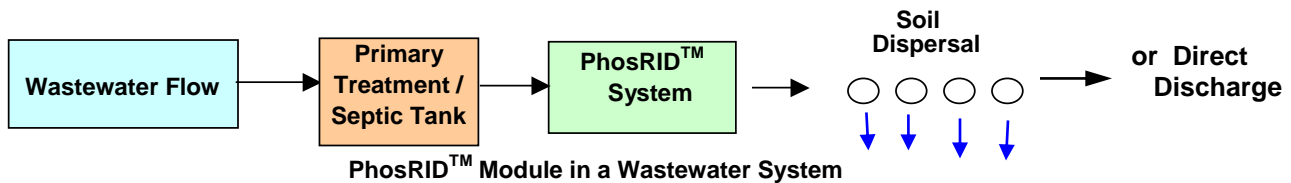
Lombardo Associates, Inc. (LAI) designed & implemented an innovative **PhosRID™** Passive Phosphorus Wastewater Removal System for the **Central Hudson Gas & Electric (CHG&E)** Wastewater Treatment System at CHG&E's Lake Katrine, NY office and operations center. The PhosRID™ system has been operational since **September 2008**. The treatment system's operational parameters are:

Design Criteria: **2,500 gpd**
 Application: **Residential type wastewater, limited showers, no laundry**
 Influent: **Septic tank effluent**
 Influent P: **16.8 mg/l**
 Effluent P: **1.6 mg/l**



Date	Average Flow for Period (gpd)	Septic Tank Effluent TP (mg/l)	Sand Filter Effluent TP (mg/l)
6/22/2009	1,201	21.8	2.4
7/28/2009	1,701	18.0	1.44
8/26/2009	1,004	12.6	0.9
3/23/2010	2,062		1.98
7/20/2010	2,062	12.5	1.05
10/25/2011	2,062	21.9	2.85
Geometric Mean	1,682	16.8	1.6
Percent P Removal			90.3%

The PhosRID™ system is a passive biologically mediated geochemical mineralization system for phosphorus removal, requiring little O&M and consists of a PhosRID™ Filter and optional sand filter or use of drainfield. The PhosRID™ Filter provides approximately 50% BOD and Total Suspended Solids (TSS) reduction. It is estimated that PhosRID™ Media will need to be replenished after 7 – 10 years of use, which can be readily accomplished with an injection of materials into the PhosRID™ Filter.



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