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NYS Center for Clean Water Technology (CCWT)

Natural Systems for Removing Nitrogen from On-Site Wastewater

Harold W. Walker, PhD, PE

www.stonybrook.edu/cleanwater

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CCWT Team

Administrative

Christopher Gobler, Co-Director
Harold Walker, Co-Director
Jennifer Garvey, Associate Director
Roy Price, Research Coordinator
Hilary Wolfskill, Administrative Assistant

Faculty Collaborators

Bruce Brownawell
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Xinwei Mao
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Yubin Zeng
Qingzhi Zhu

Post-doctoral Researchers

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Pejman Hadi

Graduate Students

Max Grabinski
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Xiangyu Huang
Benjamin Kramer
Megan Lads
Sarah Lotfikatouli
Jeanette Lee
Samantha Roberts
Mengying Yang

Undergraduate Students

Gregory Look
Kennedy Ezumah

Overview

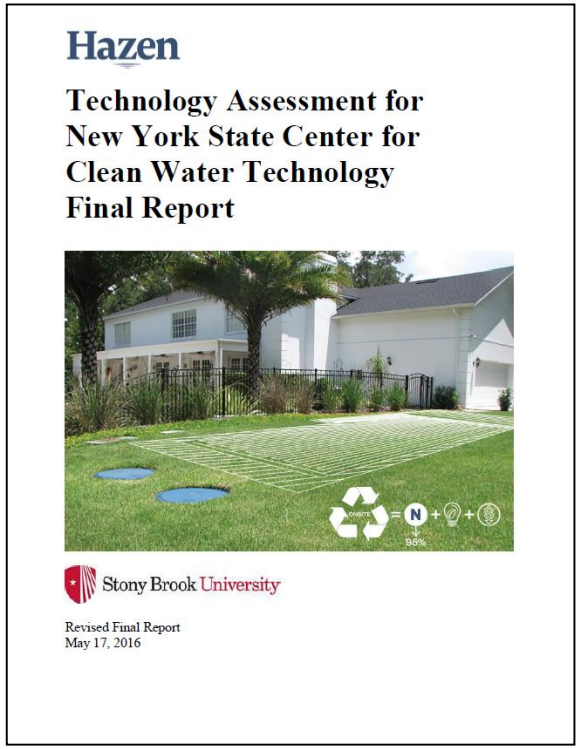
- Mission of the Center
- On-Site Nitrogen Removal Technology Assessment
- Soil, Plant and Wetland Processes
  - Nitrogen Removing Biofilters (NRBs)
  - Constructed Wetlands

Short Term Objectives: Three to Five Years

- Build multi-disciplinary teams to develop OWTS technologies that:
  - **Reduce nitrogen levels to below 10 mg/liter.**
  - **Cost $10K or less per (typical) household to install, and less than $500 per annum to maintain.**
  - **Have a life expectancy of at least 30 years**
- Communicate knowledge and progress to key stakeholders.

CCWT Technology Assessment

- Reviewed manufacturer information, research literature, past technology reviews
- Met with practitioners, researchers in the field, other stakeholders
- Engaged Hazen and Sawyer to compile existing information and develop a technology assessment



Hazen

Technology Assessment for New York State Center for Clean Water Technology Final Report

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Revised Final Report
May 17, 2016

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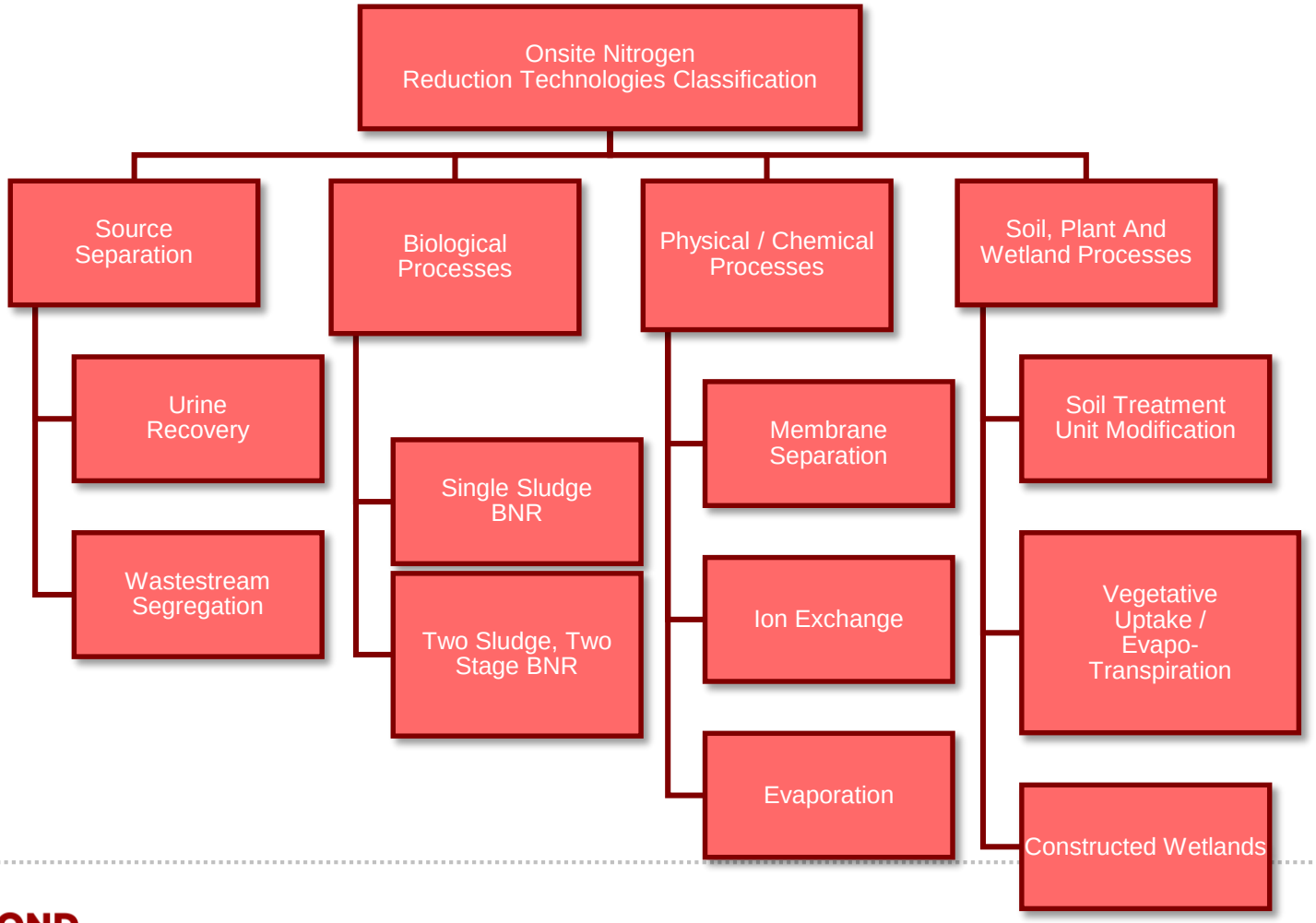
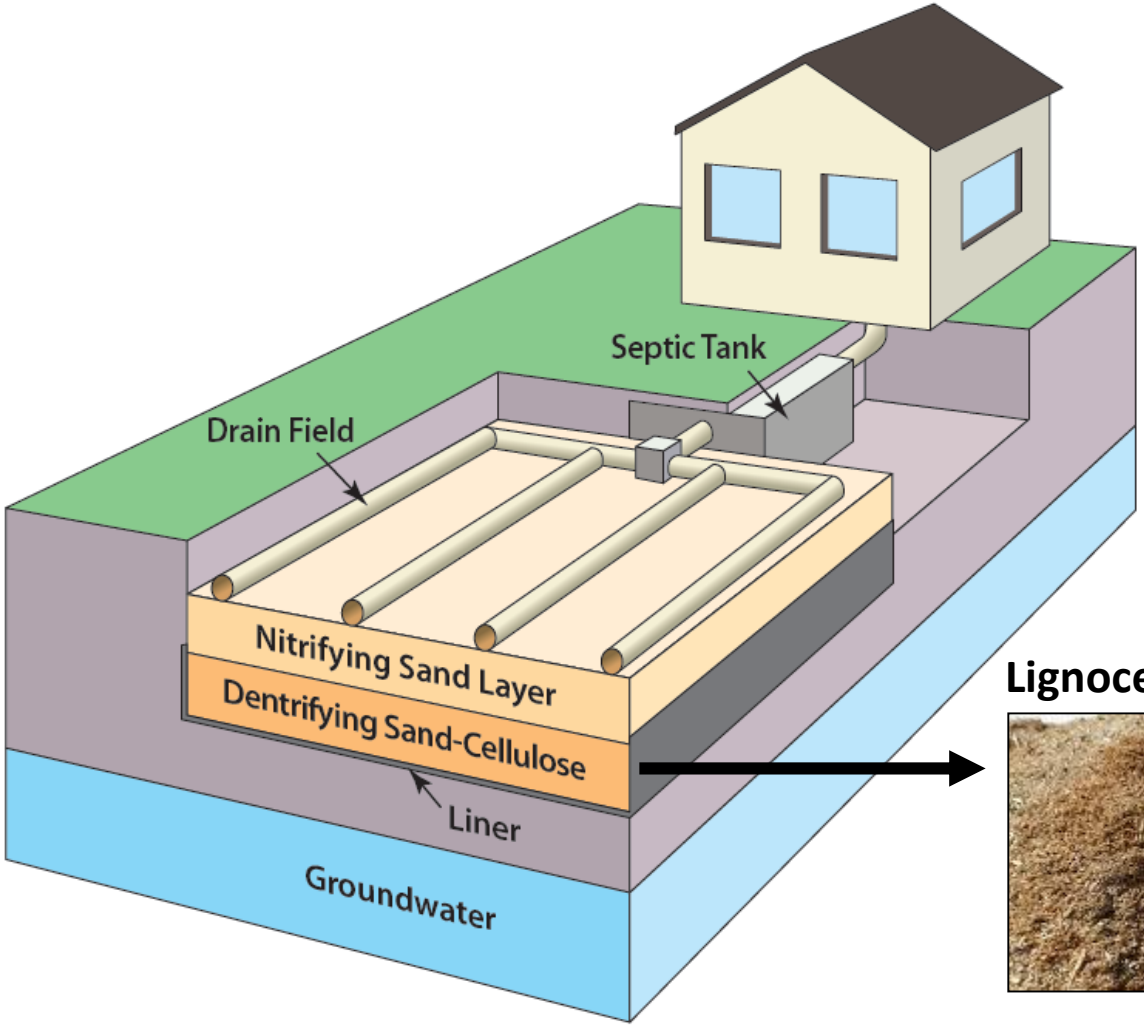
Taxonomy of nitrogen reduction technologies



Nitrogen Removing Biofilters (NRB)



Lignocellulose = wood, chips, dust, etc

Carbon source to promote denitrification

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Full-scale system results over 500+ days operation

n	TKN mg N/L		NH_3 mg N/L		NO_x mg N/L		TN mg N/L		Fecal Coliform (Ct/100 mL)		% TN Reduction
	mean	range	mean	range	mean	range	mean	range	mean	range	mean
13	50.5	30-64	43.5	27-54	0.07	0.02-0.4	50.5	30-64	65,033	20,000-420,000	
13	2.1	1.0-4.9	0.1	0.01-1.6	23.3	1.3-47	25.4	2.5-51.6	1,000 (n=1)	1,000 (n=1)	50%
13	2.1	0.9-4.2	0.2	0.04-0.7	5.8	0.02-14	7.9	1.0-16	32	Non-detect-6,800	84%
13	1.3	0.8-1.8	0.3	0.02-0.9	0.6	0.02-5.3	1.9	0.84-7.1	5	Non-detect-300	96%

CCWT NRB Design Charrette March 2016

- Two-day gathering of regional and national experts on NRBs.
- Consensus on testing Long Island native materials.
- Consensus building on function and optimal, next generation design.

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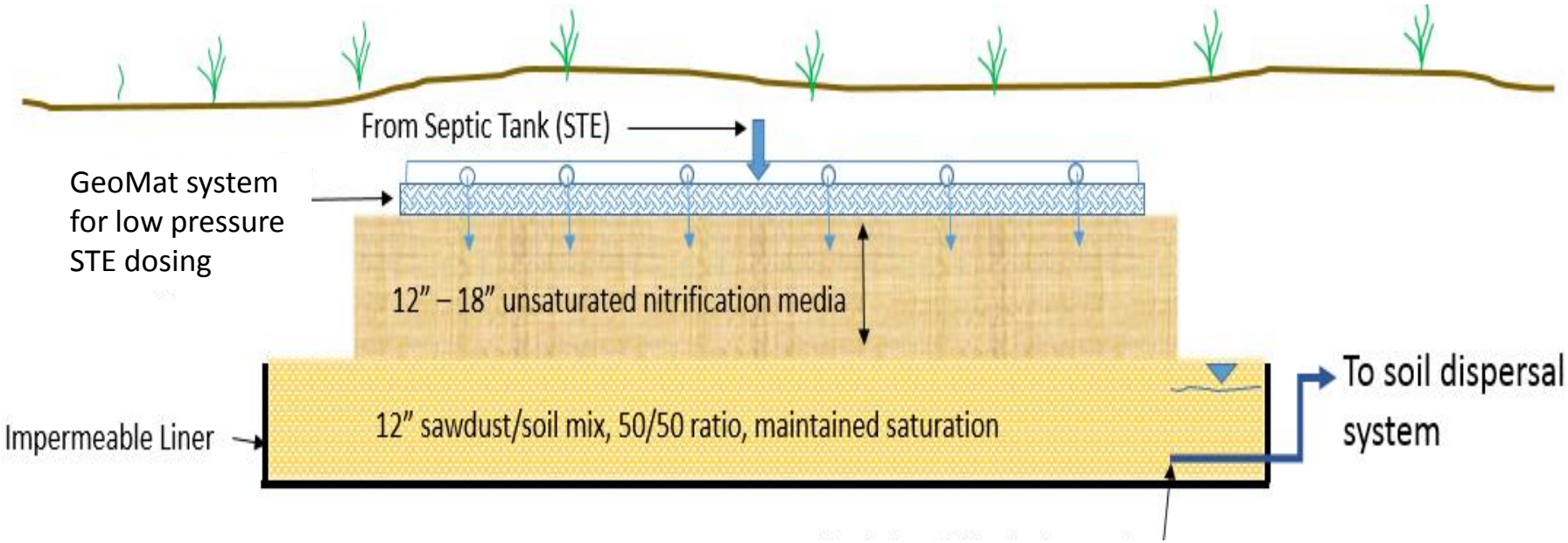
NITROGEN REMOVING BIOFILTERS FOR ONSITE WASTEWATER TREATMENT ON LONG ISLAND: CURRENT AND FUTURE PROSPECTS

JUNE 2016

The New York State Center for Clean Water Technology

www.stonybrook.edu/cleanwater

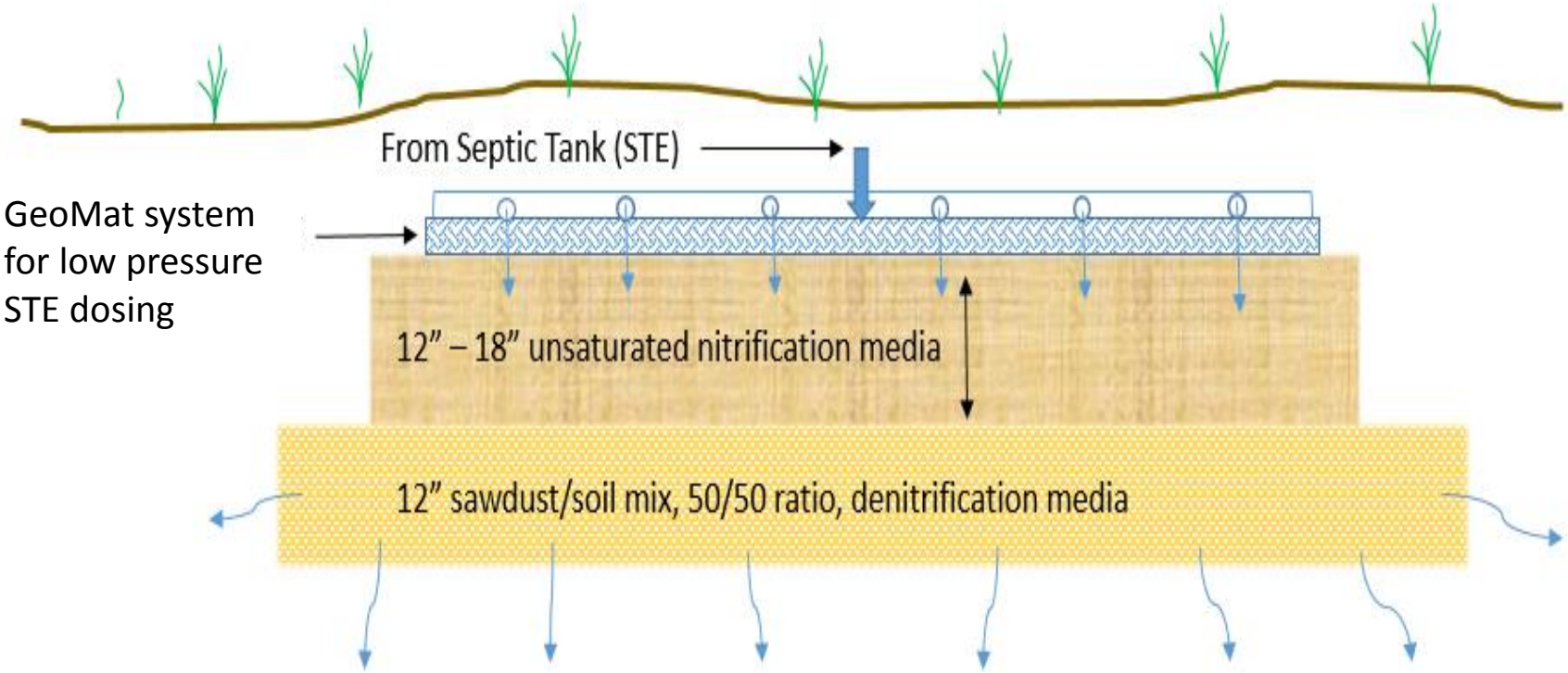
Lined, saturated NRB



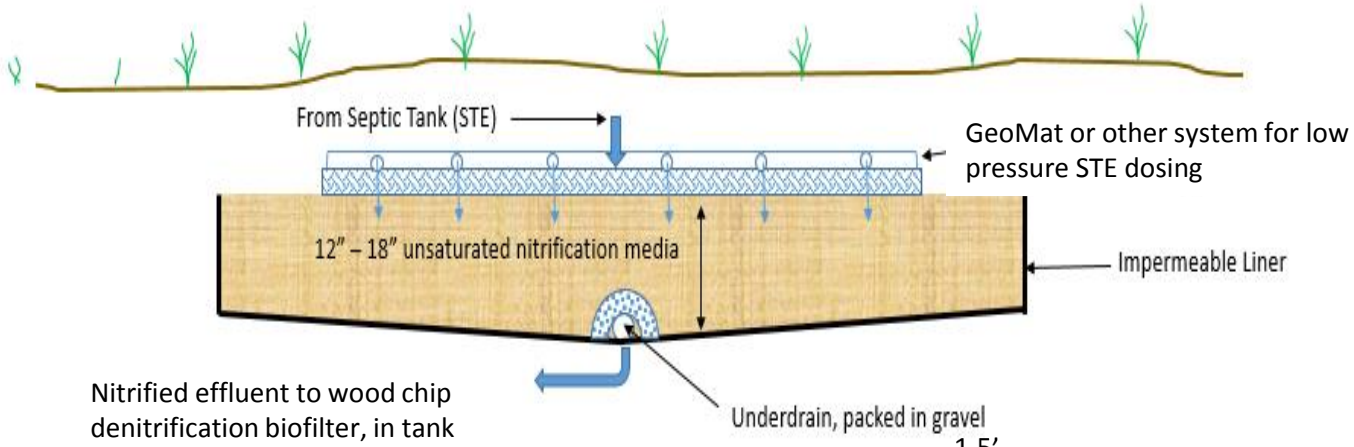
Underdrain, within denite media

Unlined, unsaturated NRB

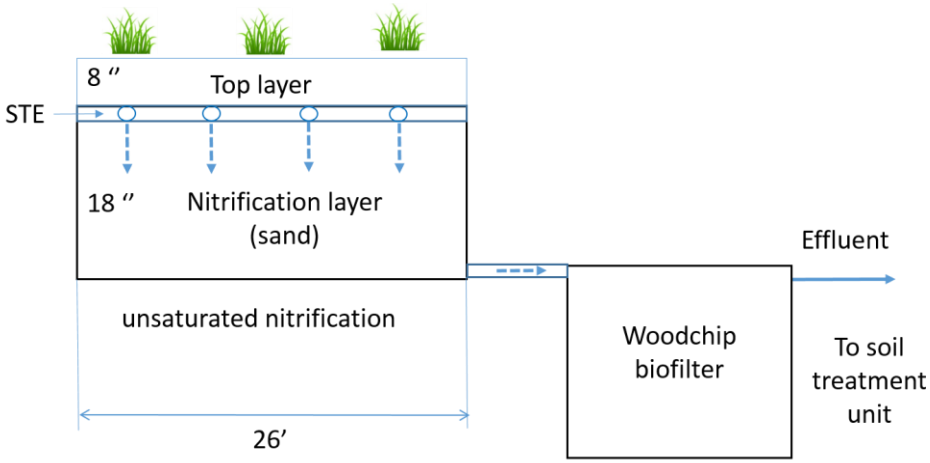
GeoMat system for low pressure STE dosing

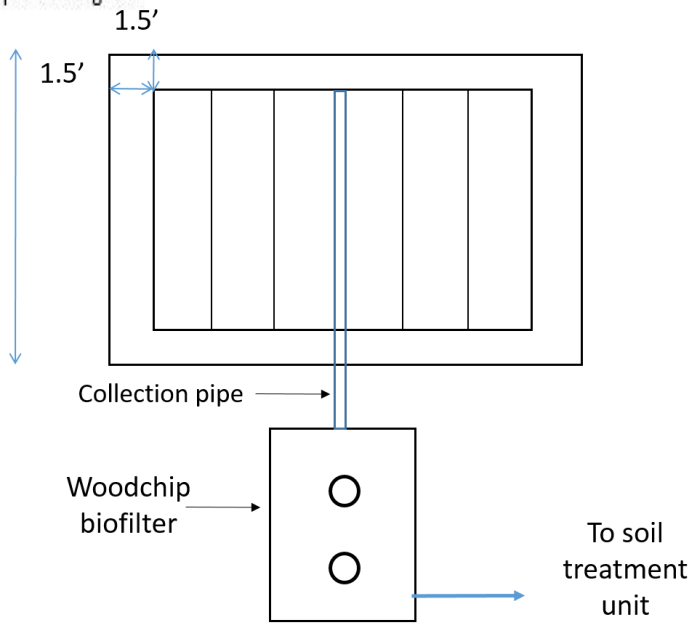


Replaceable woodchip biofilter



Nitrified effluent to wood chip denitrification biofilter, in tank





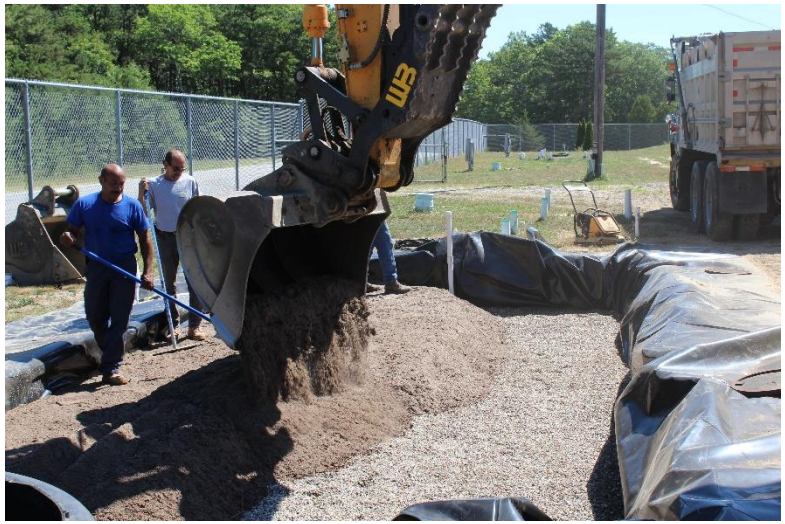
Denitrification

Testing at the Massachusetts Alternative Septic System Test Center (MASSTC)

Effluent collection port

Pea stone at the bottom

denitrification layer mixing
50/50 sand/woodchip



denitrification layer loading

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Manifold installation

Free end (2 feet head left)

Top soil

finish

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Saturated System: grass beginning to grow

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NRBs part of Suffolk County Demonstration Program

- Install 3-5 systems as part of "Experimental" phase of approval process
- <19 mg/L TN for 75% of systems installed

Rev. 3/9/16; Law No. 16-ED-173
Issue Date: 3/10/16
RFEI for Phase II Demo. I/A OWTS

SC Purchasing RFEI No. 15016-A
Commodity Code 918 43

COUNTY OF SUFFOLK
REQUEST FOR EXPRESSION OF INTEREST (RFEI) 15016-A

Suffolk County Purchasing Division on behalf of the Suffolk County Department of Health Services and the Department of Economic Development and Planning is seeking expressions of interest for

PHASE II DEMONSTRATION OF (I/A OWTS)
INNOVATIVE ALTERNATIVE ONSITE WASTEWATER TREATMENT SYSTEMS IN SUFFOLK COUNTY

TIMELINE

Issue Date: **Thursday, March 10, 2016**

All Potential Interested Applicants MUST First Register Online by: (Required) **Monday, March 21, 2016 12:00 P.M. (NOON)**
at:
www.suffolkcountyny.gov/Departments/Planning/ReclaimOurWaterInitiativeUpdate.aspx

Technical Questions Due*: **Thursday, March 24 2016 3:30 P.M.**

Information Session: (Optional) **Friday, March 25, 2016 2:00 P.M.**
Suffolk County Dept. of Health Services
Wastewater Management, Suite 2C
360 Yaphank Avenue
Yaphank, NY, 11980

Attendance may be via conference call-in – details will be provided after registering online.

Final Submissions Due: **Friday, April 8, 2016 3:30 P.M.**

Contact Information

Name: Justin Jobin
Environmental Projects Coordinator
Suffolk County Department of Health Services
360 Yaphank Avenue Yaphank, NY, 11980
Tel. (631) 852-5808
Email: justin.jobin@suffolkcountyny.gov

Final Submissions: Response package requirements on next page - submit to contact above.

* *Technical Questions: Must be submitted in writing (email preferred) to contact above.*

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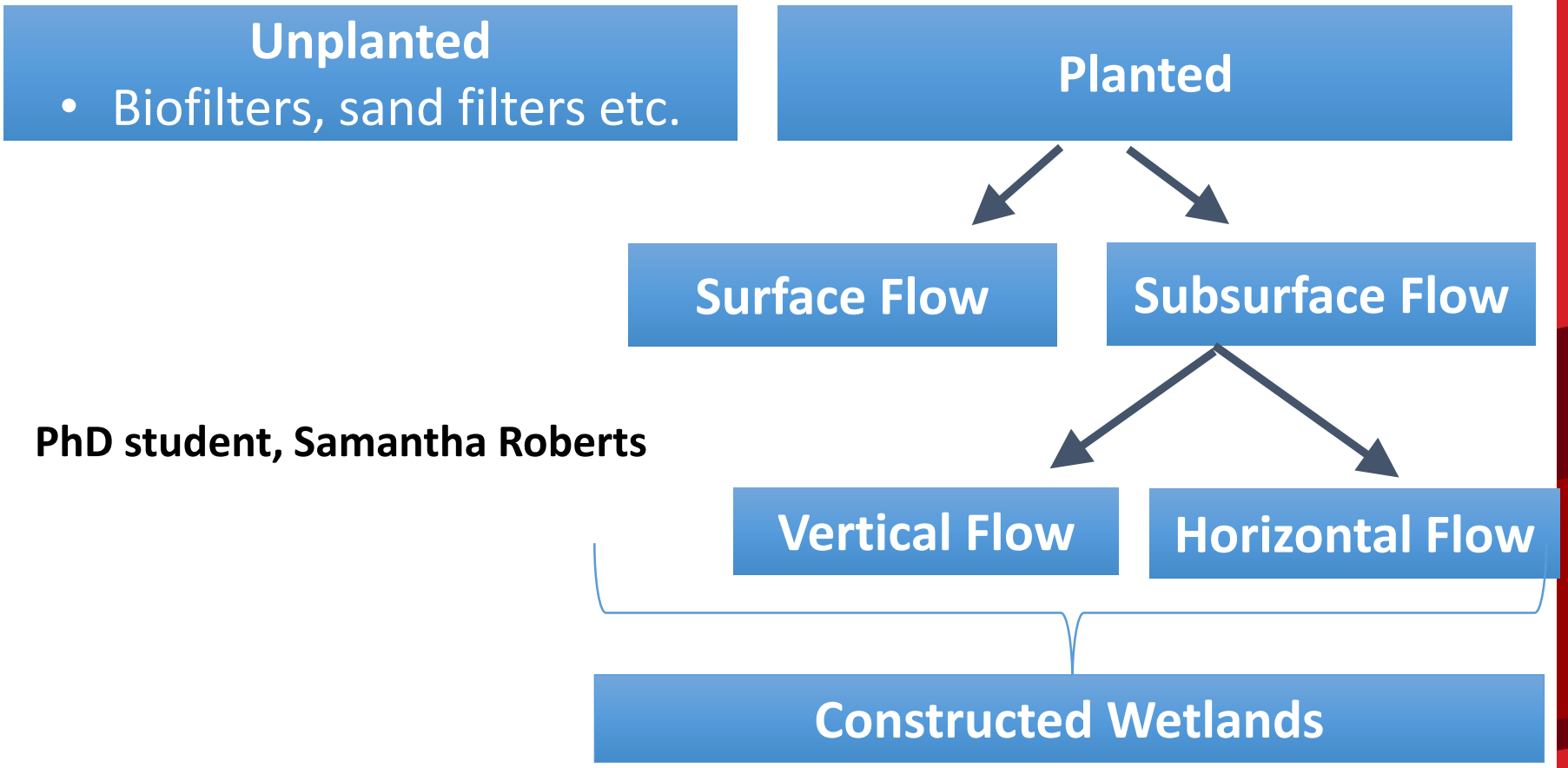
Constructed Wetlands

- Designed to improve the quality of effluent

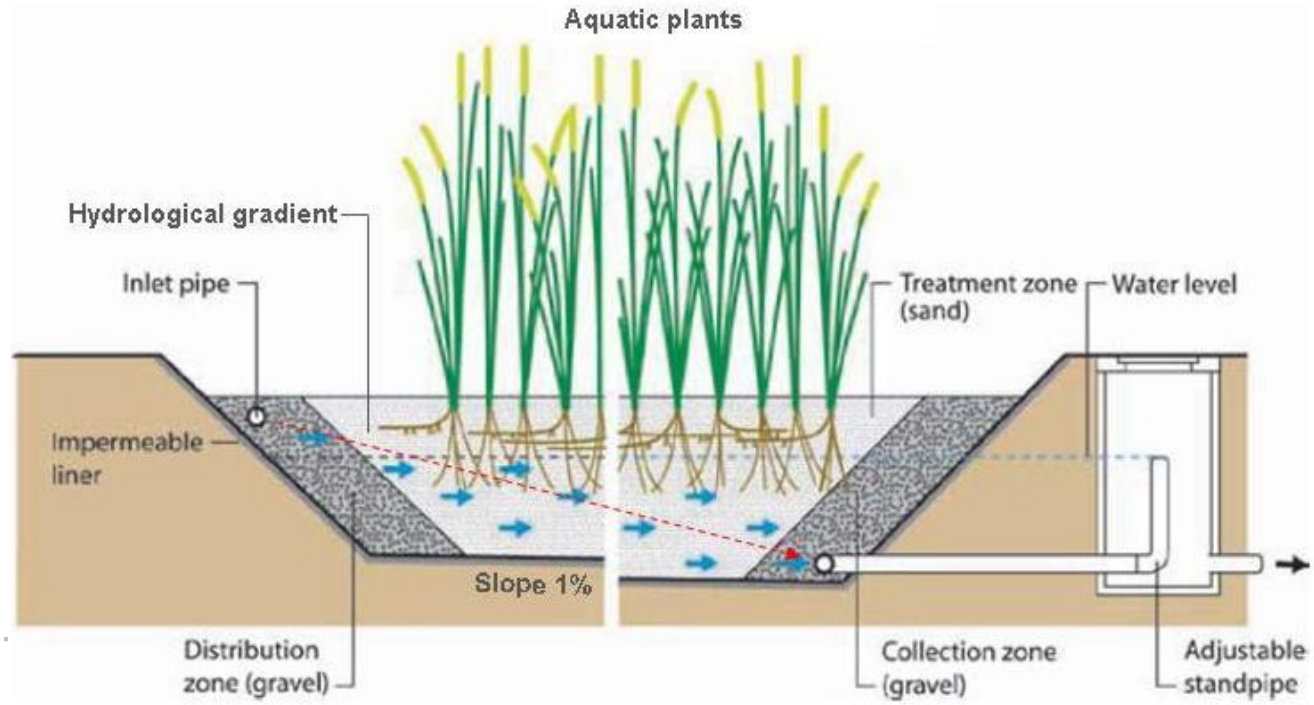


PhD student, Samantha Roberts

Constructed Wetlands

Subsurface Flow: Horizontal

- Gravel and sand-filled channel
- Wastewater flows **horizontally** across system
- Modest treatment, both microbial and vegetative

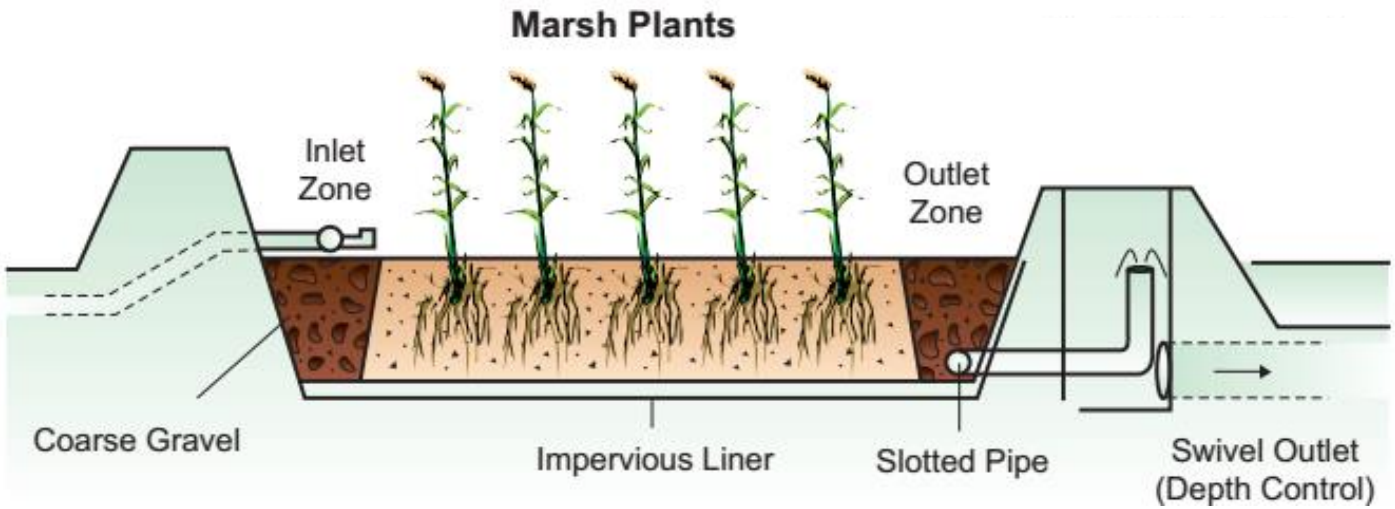


From Tilley et al (2008)

Constructed Wetland

Subsurface Flow: Vertical

- Wastewater drains **vertically** through the filter layers towards a drainage system at the bottom.
- Enhanced microbial and vegetative treatment.
- Optimized via **recirculation** and additions of **denitrifying** tanks, layers (e.g. wood chips).



From Nivala et al (2013)

Constructed Wetlands -Technology Assessment

- Vertical flow, recirculation and/or carbonaceous bioreactors can achieve TN removals up to 95%.
- Natural appearance and potential ecological benefits
- Relatively inexpensive, but have a large footprint.
- Anammox may be an alternative pathway for removing nitrogen in wetlands

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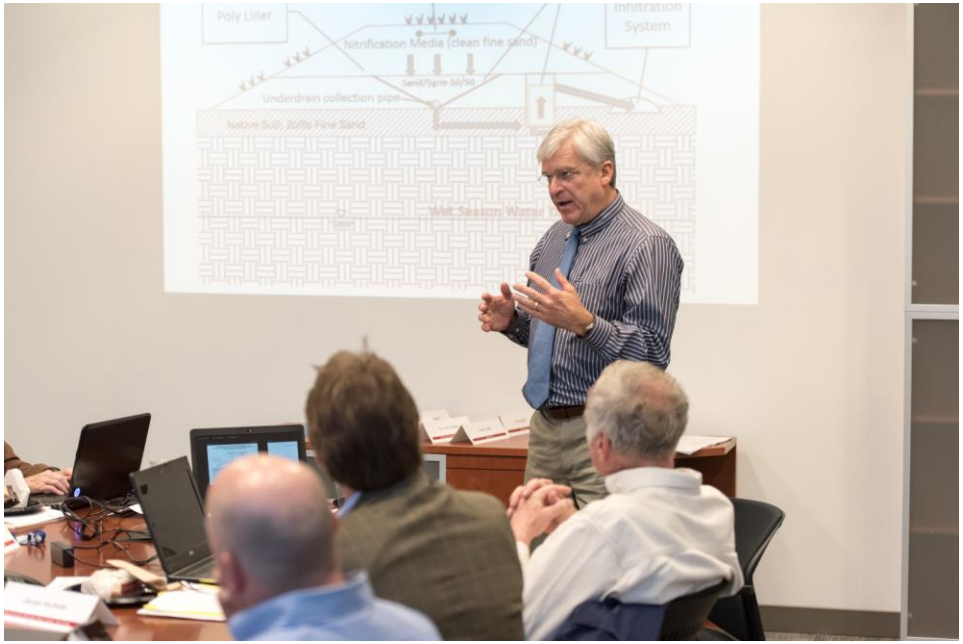
CCWT Wetlands Design Charrette October 2016

- One-day gathering of regional and national experts on constructed wetlands.
- Identify opportunities for innovation.
- Consensus building on function and optimal, next generation design.



Wetland Research at MASSTC

Shelter Island Project Sampling

- Traditional Parameters
  - CBOD, TSS, DO, pH
  - NO2, NO3, TKN, Ammonia-N, Total N
  - Alkalinity
- Microbial ecology and function + N cycling
- Pharmaceutical and personal care products

Summary

- 10/10/30 Goal – 10 mg/L; $10,000; 30 years
- For more information on OWTS technology, please download our Technology Assessment
- NRBs show significant promise and are currently being piloted by the CCWT in MA and shortly in Suffolk County
- Research focused on improving performance of constructed wetlands
  - Technology Assessment
  - Design Charrette
  - MASSTC
  - Shelter Island

Questions?