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Long Island Nitrogen Action Plan (LINAP) - Newsletter NYS Center for Clean Water Technology Update

In this issue of the LINAP newsletter, we highlight the initiatives led by the team at the NYS Center for Clean Water Technology (CCWT).

- Nitrogen Removing Biofilters
- Constructed Wetlands
- Wastewater Research and Innovation Facility
- Permeable Reactive Barriers
- Verified Water

Nitrogen Removing Biofilters

The New York State Center for Clean Water Technologies (CCWT) has now installed 20 non-proprietary [Nitrogen Removing Biofilters \(NRB\)](#) at residential homes across Suffolk County intended to reduce nitrogen in final effluent to below 10 mg/liter. The Center has also collaborated with Indian Health Services to install additional NRBs at the Shinnecock Nation.

NRBs remove nitrogen and other pollutants from wastewater by nitrification in a sand bed followed by denitrification in an anoxic (oxygen free) sand/woodchip biofilter.

The CCWT currently has developed three variations of NRBs. The first design is an unlined NRB which is intended for final disposal so wastewater percolates through layers of sand and/or woodchips before disposal to groundwater. The second is a lined NRB which is designed to maintain saturated conditions in the sand and woodchip layer. This saturation allows for continuously anoxic conditions which favor greater denitrification than can be achieved in unlined NRBs. The third design couples a nitrifying sand bed with an accessible and saturated woodchip box.

Testing of the systems over the past several years has led to several important findings about the performance of the different designs. The lined and woodchip box NRBs have achieved high removal rates of 85% and 89% of total organic nitrogen and ammonia and show low concentrations of total nitrogen in final effluent. These findings compare to similar results published by Suffolk County's Department of Health Services for Innovative Alternative Onsite Wastewater Treatment Systems (IAOWTS) that have been provisionally accepted or approved

for general use in the County. The Center expects the lined systems to complete pilot phase testing in the first quarter of 2023 and gain approval for provisional acceptance permitting shortly after.

Five professional engineers and three local excavating companies have the expertise to design or build NRBs as a result of the Center's collaboration with them. With the transition to provisionally accepted permitting for lined NRBs, the Center anticipates holding training session to qualify more engineers and contractors to design or install these field-built systems. The Center has just completed installations of two additional woodchip box NRB which, together with three installations at the Shinnecock Nation, will bring the total installed base for Article 19 permitting to eight systems, the minimum necessary to start pilot phase testing for provisional acceptance.

Unlined NRBs have not denitrified as well as lined and woodchip box NRBs therefore, the unlined NRB design will not be introduced commercially at this time. The Center has initiated plans to modify the design to slow percolation of wastewater and increase residence time (and therefore time to denitrify) and anticipates installing a prototype of the modified design at the Massachusetts Alternate Septic System Test Center in early 2023.



Installation of NRBs. Photo Credit: CCWT

Constructed Wetlands

In 2022, the Center received funding to install [constructed wetland wastewater treatment systems](#) at the Pollack Krasner House in East Hampton, Bridge Gardens, and the Quogue Wildlife Refuge in Southampton. These systems will use recirculating gravel filters for nitrification, woodchip boxes for denitrification and plants for nutrient uptake. The Center expects the systems will produce final effluent with nitrogen well below Article 19 thresholds of 19mg/liter. The Center will begin testing under Article 19 after the systems are installed to ensure the limit is met. The systems will also provide attractive landscaping solutions consistent with aesthetic character of the spaces where they are installed.

Wastewater Research and Innovation Facility

Experiments at the Center's Wastewater Research and Innovation Facility (WRIF) are ongoing with the aim of continually improving the design of the Center's wastewater treatment technology. Raw wastewater from a Suffolk County Department of Public Works' sewage pumping station is used to test design concepts and modifications to improve treatment designs.

A proprietary nitrogen removing system designed by the Center's Associate Director for Wastewater, Frank Russo, was installed at the WRIF and has begun treating wastewater. The system is called Flex Treat and it packages nitrification and denitrification into a compact, precast, concrete box which can be delivered and installed economically to residences in a short-time and allows flexibility to adjust wastewater loading rates, aeration, and wastewater recirculation to optimize nitrogen removal. The Center anticipates testing the system at the WRIF during 2023, prior to testing under the Article 19 permitting process.



Photo Credit: CCWT

Permeable Reactive Barriers

The Center is working on a variety of [permeable reactive barrier \(PRB\) projects](#). A PRB is an in-situ structure that treats contaminated groundwater by allowing the groundwater to pass through a reactive or absorptive medium that helps remove contaminants. PRBs have the potential to help mitigate legacy nitrogen, i.e., nitrogen that remains in soil or groundwater from historical application or use.

The Center is testing the treatment of groundwater in a bulkhead PRB in Hampton Bays. This bulkhead PRB is a woodchip-based subsurface barrier that intercepts nitrogen polluted groundwater flowing towards Shinnecock Bay. The project has provided useful information on design configuration for optimal nitrogen removal which minimize undesirable by-products such as methane production. The PRB is expected to remove more than 1.5 metric tons of nitrogen over the next 20 years.

The Center has begun site characterization- identifying the source(s) and type(s) of contamination- at a prospective PRB location at Shirley Beach near Lake Agawam. Further, the Center and CDM, an engineering and construction firm, will use a Community Preservation Fund grant, to install an injection well which will introduce carbon into the groundwater to enhance denitrification to remediate nitrate flowing into the lake.



Installation of bulkhead PRB in Hampton Bay. Photo Credit: CCWT.

Verified Water

A nitrogen sensor was developed by SUNY Stony Brook University faculty member Dr. Qing Zhu which simultaneously measures nitrate and ammonia in wastewater and final treated effluent. The sensor design completed an ISO (International Organization for Standardization) field verification test sponsored by the EPA and assessed by global engineering consultants VerifiGlobal and Battelle.

The Center has formed a new company, Verified Water, to initiate widespread commercial development of the nitrogen sensor. The company has begun installations for customers on Cape Cod and in Suffolk County.

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