

## **Optimizing Nitrogen Removal in Advanced Onsite Wastewater Treatment Systems within the Greater Narragansett Bay Watershed**

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Rhode Island's Narragansett Bay has experienced the negative effects of nitrogen loading, which has prompted the installation of advanced nitrogen removal onsite wastewater treatment systems (OWTS) in coastal areas. To decrease nitrogen inputs to Narragansett Bay, a final effluent total nitrogen (TN) concentration standard of 19 mg N/L has been established. However, final effluent TN concentrations for single family systems are not monitored after system installation, making it difficult to determine the extent to which these systems contribute to lowering nitrogen loads to Narragansett Bay. We measured the TN concentration in effluent from 42 advanced nitrogen removal OWTS within the greater Narragansett Bay watershed.

Sampling was carried out monthly between March 2015 and May 2016. Median final effluent TN concentrations for all systems during this sampling period ranged from 12.8 to 17.4 mg N/L, depending on technology type. The percentage of systems in compliance with the TN standard varied: 71 percent for Advantex, 57 percent for FAST, and 50 percent for SeptiTech. In contrast, a study in Barnstable County, Massachusetts, where local regulations require that effluent TN levels be monitored quarterly found that a higher proportion of Advantex (78 percent), FAST (80 percent) systems, but a lower proportion (33 percent) of SeptiTech systems met the 19 mg N/L standard.

The proportion of systems that meet the standard in Rhode Island may be increased if effluent monitoring is implemented. To this end, we also evaluated rapid tests that may be used to monitor effluent quickly and inexpensively. We evaluated the accuracy of rapid tests commonly used to analyze wastewater (test strips for ammonium, pH, nitrate, and alkalinity; pH pocket meter; and a titration kit for dissolved oxygen) by comparing values obtained in the field to values measured using standard methods in the laboratory. Regression analysis indicated that all test strip-based methods produced inaccurate results, but their accuracy can be improved when used in the laboratory. Evaluation of an alternative suite of rapid tests indicated that an ammonium test kit and pH and nitrate test strips produced relatively accurate results when used in the field.

We also performed multiple linear regression analyses separated by system type to determine which parameters (ammonium, nitrate, alkalinity, pH, DO, sample temperature, BOD, recirculation ratio, average forward flow) best predict effluent TN concentrations. The wastewater properties that best predicted total nitrogen levels were ammonium, nitrate, pH, BOD, and average forward flow.

Our results show that advanced nitrogen removal OWTS within the Narragansett Bay watershed can produce effluent TN levels that meet the 19 mg N/L standard. Furthermore, our

study showed that the accuracy of rapid tests should be considered before the tests are used to monitor effluent properties.

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