

New Jersey Department of Transportation
Bureau of Research

Technical Brief



Stormwater System Monitoring and Evaluation

The New Jersey Department of Transportation (NJDOT) has installed numerous prefabricated stormwater treatment systems throughout the State. The use of such systems, known as Manufactured Treatment Devices (MTDs), is expected to continue in the foreseeable future. As the responsible party for the maintenance of these MTDs, NJDOT initiated this project with the goal of determining optimum maintenance intervals and expected maintenance costs for these MTDs. This project has resulted in long-term water quality performance evaluation, characterization of trapped contaminants, and the development of maintenance procedures and intervals.

Background

On February 2, 2004, with the adoption of the N. J. Department of Environmental Protection Stormwater Management Rules (N.J.A.C. 7:8), the adoption of these devices became necessary to comply with the stricter stormwater management standards for roads and highways. See Figure 1 for an example of MTDs.

Under the jurisdiction of the NJDOT, the MTDs will need to be inspected and maintained by NJDOT personnel or by its contractors under NJDOT supervision. This study can thus serve as the basis for a maintenance and inspection plan that optimizes the time and resources invested in the maintenance of the MTDs.

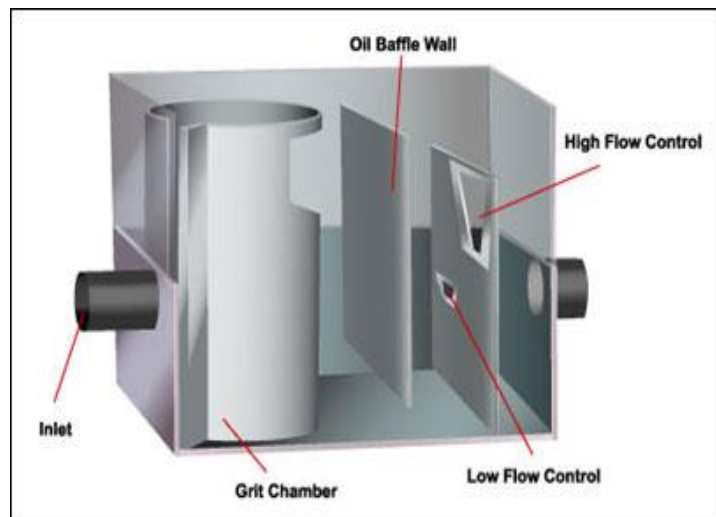


Figure 1. Vortechs Stormwater Treatment System
(Source: <http://www.vortechtechnics.com/>)

Research Objectives and Approach

- To monitor the amounts of sediment, oil, grease, and buoyant debris that would actually be trapped in the stormwater treatment system units installed by NJDOT.
- To find a relationship between trapped amounts of sediment, oil, grease, and buoyant debris and highway drainage area characteristics.

- To provide NJDOT with quantitative guidance on the maintenance/cleanup schedule and to suggest measures to reduce maintenance/cleanup frequency.

A thorough literature search covered the most recent existing knowledge on stormwater Best Management Practices (BMPs) maintenance and regulations, highway runoff quantity and quality, maintenance procedure and costs, and field monitoring methods. In order to insure compliance with all New Jersey regulations concerning MTDs, in the elaboration of the recommendations and results of this study, the NJDEP Stormwater Management Rule: N.J.A.C.7.8 and the NJDEP Best Management Manual were used as two of the primary sources of information. This information was complemented by the maintenance guidelines and procedures recommended by different manufacturers and other manuals and guidelines produced by independent organizations such as ASCE. Of particular importance was the Vortechs® Stormwater Treatment System manual, since at the time of conducting this study, over 75% of MTDs installed in New Jersey and identified in the course of this study were of this type.

From the 65 devices identified in the study, 12 Vortechs® Stormwater Treatment Systems were chosen to be monitored. The 12 monitored devices were spread through 8 different sites and included what would be expected to be high, medium and low maintenance areas. Figure 2 shows the locations of the 12 MTDs chosen for this study.

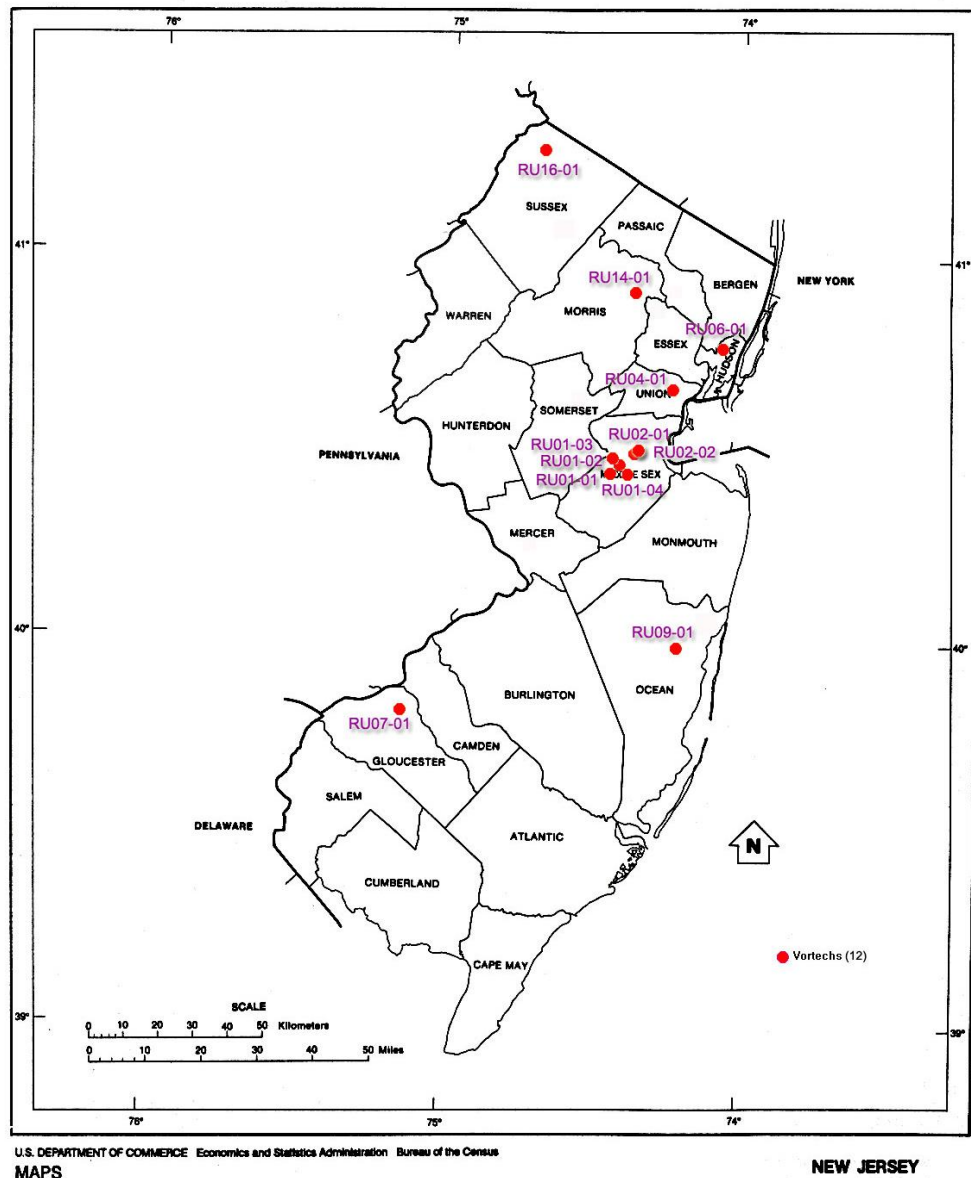


Figure 2. Locations of 12 devices chosen for the study

A detailed inspection form was developed for the monitoring of the devices. The inspection form contained a unique identifying number for each device, detailed location information (including latitude and longitude acquired with a GPS system), a map pinpointing the exact location and traffic conditions of the site, location relative to the road, and the type and measured depth of floatables and sediments among other information valuable to develop a maintenance plan.

Procedures for inspection and cleanout of the devices were developed. Also, detailed observations of the cleanout of each device were recorded and tabulated. This provided a pool of possible problems and solutions that could be encountered during the cleanout procedures of the devices. The removed materials were studied and characterized in order to determine the type and quantity of material being retained by the MTDs. The parameters analyzed were: Total Suspended Solids (TSS), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Phosphorus (TP), Total Kjeldahl Nitrogen (TKN), oil and grease, floatables, and sediment. The sediment was then analyzed to determine weight and volume, particle size characterization, chemical composition and percent organic matter.

After analyzing the captured material in the MTDs and observing the rate at which the MTDs fill up at each site, maintenance guidelines were developed. The maintenance guidance includes estimated maintenance intervals, maintenance procedures, measures that can be taken to reduce maintenance, and guidelines for the design and construction of MTDs aimed at easing the maintenance procedures during operation.

Findings

The water quality test yielded high levels of TSS in the pumped-out stormwater when compared to median municipal wastewater levels. The average COD of the pumped-out stormwater was also found to be higher than the average municipal wastewater levels. Testing of the pumped-out sediments indicated safe levels of heavy metals but high levels of TKN and TP. Ideally, the stormwater pumped-out from the devices should be routed to a wastewater treatment facility for proper treatment.

Several sites yielded high levels of oil and grease. Large amounts of floatables were also collected in many of the MTDs. However, sediment is the primary concern in most MTDs. It was noted that the MTDs collected primarily particles larger than 75 microns. Sediment accumulates slowly in the devices; it is generally noticeable 4 months after cleanout. In general, the maximum allowable sediment depth for a Vortechs® MTD is 2 feet and in a general site with average loading conditions, it was estimated from the observations that the cleanout will be necessary every 4 years. In an exceptional case, a device accumulated 2.3 feet of sediment only twenty months after cleanout. Thus, in cases where heavy loading occurs due to erosion or unusual circumstances such as construction nearby, the device will need to be cleaned at least every 18 months.

As the design for the MTDs change, these maintenance intervals might need to be revised. For example, newly installed devices have a larger retention capacity based on the new design storm. Also, this study was centered around Vortechs® Stormwater Treatment Systems which are currently the most commonly installed; as MTDs from different manufacturers become more common, it will be necessary to perform an analysis on each type of device to determine the cleanout intervals and procedures.

The cost of cleanout per site is approximately \$3,500 for pumpout and approximately \$59/ton for disposal at the time of this study. If the oil was to be separately disposed, one oil boom with a cost of \$150 would need to be used per site. Considering that the number of MTDs is likely to increase in the near future to thousands, the total cost for cleanout and maintenance of MTDs can be expected to be in the low millions. Optimizing the maintenance intervals and cleanout procedures can help reduce the costs.

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A final report is available online at: <http://www.state.nj.us/transportation/refdata/research/>.
 If you would like a copy of the full report, send an e-mail to: Research.Bureau@dot.state.nj.us.

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