# Monitoring prior to BMP stormwater management installations on PERT property

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This progress report described 5 monitoring tasks implemented property prior to installing the stormwater management projects on PERT property: (1) bioassessment of the local reach of Terwood Run, (2) continuous stormwater monitoring using data loggers, (3) evaluation of bank erosion using pins, (4) water quality sampling, and (5) weather station monitoring. All of these activities were carried out by faculty and students in the Department of Geology at Temple University in consultation with other members of the project.

Monitoring began in October 2005 with the goal of collecting close to a year of data before the stormwater management projects were installed.

## Bioassessment

Identify and counting macroinvertebrates is an integrated measure of stream health because these biological markers respond to water quality over time. We collected samples at three locations on the reach of Terwood Run upstream of the proposed restoration project, adjacent to the project, and downstream of the project. Several years ago, the Philadelphia Water Department collected a single sample near this reach for bioassessment. They found the reach to be moderately impaired.

For this study, three replicate samples were collected at each location in addition to a fourth leaf litter sample. A student was trained by Derron LeBrake of Emerald Creek Inc to identify and count the macroinvertebrates. Each sample took about four hours to count. About 30 different macroinvertebrates were identified, and the most common was Chironomidae (or midge). These are known to be very tolerant and often form the majority in macroinvertebrate counts. Although the assessment is still in progress, preliminary data indicate that the stream is moderately impaired on the local scale as well.

## Bank Erosion

Bank pins were installed at 4 sites along the reach of Terwood Run. Two rows of pins were hammered into exposed banks and their lengths were measured. The pin lengths were measured again approximately monthly. Erosion appeared to be episodic. In December (after a snow melt) there was 10 to 15 cm erosion shown in the measurement of pins. In the spring and summer when water levels and stormflow were not as high, there was little change in the pin lengths (2 cm or less). Recently, growth of vines has covered some of the pin sites which further inhibits erosion. Some additional pins have been installed to provide more complete coverage.

*Pins in bank, site 1, Terwood Run*

Continuous Stormwater Monitoring

Data loggers were installed at two locations at PERT. The loggers recorded temperature, water level, and conductivity of the water (a measure of dissolved ions) at 15 minute intervals. One logger was installed near the PERT office where a storm pipe moves water from the parking lot to a small pond below. A second logger was installed on Terwood Run downstream of the proposed stormwater management project. The loggers were installed in early October 2005, but some of the early data were lost due to a large storm which flooded the sites. The loggers have continued to collect data until late August 2006, when a large storm brought debris down Terwood Run which cut the wires for that logger. A new logger has been installed but there was a gap in the data.

The logger on Terwood Run recorded around 65 storms of various sizes. In the fall and winter, water level increases of 5 to 60 cm were observed. The largest increases were associated with rainfall that melted snow. In the spring, stormflow increased the water level 5 to 30 cm and in the summer the range was 1 to 12 cm. Conductivity may increase or descrease during storms, depending on whether dilution or mobilization of urban water is dominant. The most prominent example of mobilization of urban water is during snow melt when the conductivity was observed to increase up to 1600 uS/cm. This increase is associated with road salt and is estimated at 300-500 mg/L of dissolved salt at the peak. Mobilization of road salt at this and other sites has been observed in all four seasons, and it is believed that pockets of salt remain after winter de-icing. So far there is only 2 months of data since the wetland was installed so there are not yet sufficient data to compare response before and after.

*Data logger at Terwood Run, measures water level, conductivity and temperature*

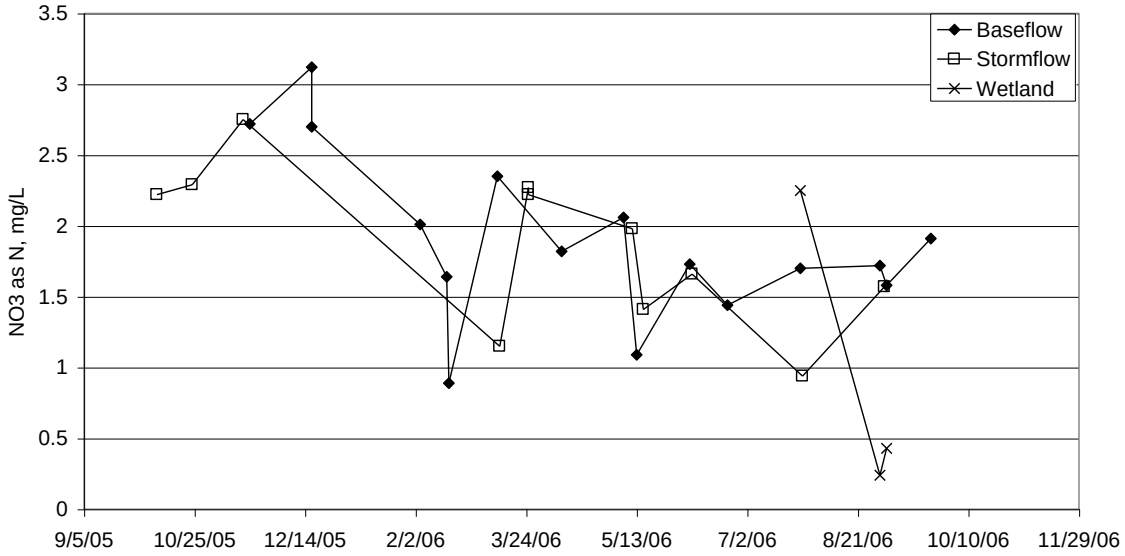
The logger at the PERT parking lot shows that stormwater does not pond at the pipe. Water level fluctuations were generally only 1-2 cm and the conductivity sensor was not underwater long enough to record significant changes. We have installed 5 plastic monitoring pipes directly in the infiltration trenches, and these should be more effective in evaluating the variations in water levels from the stormwater management systems near the PERT office.

Water Quality Monitoring

Stormwater samplers were installed next to the loggers at the PERT parking lot and Terwood Run. Stormwater samples were collected approximately monthly.
In addition to stormwater samples, monthly (non-storm) samples were collected from Terwood Run, the existing pond near the proposed "upland" pond installation, and a discharge pipe from a farm pond. After the installation of the restoration projects, the upland pond and the wetland near Terwood Run were also sampled monthly.

The samples were analyzed for anions, including nitrate, phosphate, and chloride. Nitrate and phosphate are typical nutrients found in urban streams, and chloride, as mentioned earlier, can be introduced through road salt. Concentrations of phosphate were typically non-detect and always less than 0.5 mg/L. Nitrate concentrations varied from 1 mg/L to 3 mg/L with an average just under 2 mg/L. This is typical of urban streams but seasonal variation was not observed which may indicate an atmospheric source. Chloride from road salt varied throughout the year and was discussed in the section on continuous monitoring using conductivity loggers.

The stormwater samples showed similar concentrations of nutrients to base level at Terwood Run. Although the total load may have increased during storms, there was not flushing to the extent that concentrations increased.




*Summary of nitrate data at Terwood Run for baseflow, stormflow, and recently installed wetland*

Weather Station

To compare responsiveness to storms, the size of the storm needs to be recorded. At the beginning of the project a weather station at Mason's Mill Office Park about ½ mile from the PERT sites was used to obtain precipitation data. The data were available on weatherunderground.com. For the large storm in October 2005, this station was down, so data from the Northeast Philadelphia Airport were used (data from NOAA web site). To see if there were differences in precipitation rates at the different locations, including data from an old weather station on the PERT property, data were compared when all three weather stations were supposed to be online. Although the timing of events was the same, the magnitudes did vary. As a result, we decided to install a weather station on the PERT property to get weather data closer to the field site. This weather station was installed in July 2006.

We compared stormwater response on Terwood Run to the precipitation data from the Northeast Philadelphia Airport in the early part of the study. We found that for small storms, there was a weak correlation between amount of precipitation and size of water level response. The lack of a strong correlation points out that there are a variety of factors that contribute to stormwater response. It may not be easy to use stormwater response to evaluate the effectiveness of the stormwater management; the larger storms are more likely to be a test of the stormwater management system but stormwater response alone should not be used as a test.