

Monitoring LID Practices

Updated BMP database incorporates LID-specific guidance

By T. Andrew Earles, Jane K. Clary & Marcus Quigley

The International Stormwater Best Management Practices (BMPs) Database was established in 1996 by the U.S. Environmental Protection Agency (EPA) and the Urban Water Resources Research Council (UWRRC) of the American Society of Civil Engineers (ASCE). This resource was created for the collection and analysis of data linking the design and performance of storm water BMPs.

The database currently contains more than 300 studies and analyses of data from extended dry detention ponds, wet ponds, infiltration basins, vegetated swales, bioretention facilities and other BMPs. “Urban Stormwater BMP Performance Monitoring: A Guidance Manual for Meeting the National Stormwater BMP Database Requirements” has been available on the BMP database website (www.bmpdatabase.org) since 2002.

LID Applications

Runoff volume reduction practices, often referred to as low-impact development (LID), have been implemented with



Conventional monitoring strategies may not reflect the water quality and quantity benefits of LID practices. (Photo provided by Nathan Hardebeck)

increasing frequency in recent years. The sponsors of the database—the Water Environment Research Foundation, ASCE Environmental and Water Resources Institute, EPA, Federal Highway Administration and American Public Works Association—recognized the need for improved integration of LID into the database.

Some of the entries that currently populate the database are LID practices (i.e., bioretention/porous landscape detention, swales, buffers and infiltration basins). Today the capabilities of the database are being expanded to accommodate site-level LID studies with multiple practices in combination, as well as data on individual practices.

Going beyond BMPs that treat storm water runoff, LID practices are designed to reduce the amount of runoff that is generated by a site by reducing effective impervious area and maximizing infiltration, as opposed to the storage-and-release techniques used by BMPs such as extended dry detention ponds, retention ponds and constructed wetland basins. Clustered development, narrower streets and the minimization of disconnected impervious area are examples of LID practices for reducing runoff. For LID practices such as bioretention, a common design goal is to infiltrate all of the runoff up to a certain design event.

Developments designed with LID techniques often involve multiple practices distributed throughout a catchment. A small-scale residential development might have one dozen rain gardens, hundreds of feet of vegetated swales, multiple areas of porous pavement and cisterns at the majority of the houses.

Monitoring Challenges

The monitoring of LID practices can present numerous challenges. As a part of the enhancement to the BMP database, improved guidance taking into account the following information will be incorporated into the monitoring manual.

An inflow/outflow surface hydrology monitoring approach that may be appropriate for a storage-and-release BMP such as an extended detention basin does not apply. Because of

the reduction and infiltration goals of LID, there may be no surface outflow to measure or sample for small, frequently occurring events. Measurement and sampling of inflows can also be problematic because many LID practices are designed to collect runoff as sheet flow from localized impervious surfaces. LID preventive practices to reduce and infiltrate runoff can be very effective for storm water management, but quantifying the benefits of such practices, especially in the context of water quality, requires monitoring strategies that go beyond a conventional BMP mass-balance approach.

Quantifying the hydrologic budget for LID practices is often more complicated than conducting the event-based hydrologic monitoring of conventional practices. In addition to the measurement of surface inflows and outflows being more difficult for LID practices, it may be necessary to measure infiltration rates, evapotranspiration, flow in underdrains, changes in soil moisture and localized groundwater effects.

Because of the distributed nature of LID practices, it is generally not technically or economically feasible to monitor all of the LID practices implemented on a given site at the development or catchment scale. When there is sufficient rainfall to exceed the infiltration and storage capabilities of the overall system, monitoring at an outfall location may be an effective way to characterize the quantity and quality of the runoff from the site. Monitoring individual practices within the development, on the other hand, would be extremely costly and unlikely to adequately characterize the big picture.

Manual Updates

To quantify the hydrologic and water quality benefits of an LID development relative to a development without LID controls, a paired watershed monitoring approach may be effective. The paired watershed option has been a feature of the BMP database for many years, but few studies that are currently in the database have used this approach. Therefore, adding guidance for conducting paired watershed studies will be a major focus of the update of the monitoring manual. The updated manual will include

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enhanced guidance for BMP-level (i.e., individual practice) monitoring as well.

In its efforts to enhance LID capabilities of the BMP database and provide improved guidance, the BMP database team has solicited input from the UWRRC and an expert panel of scientists and engineers who have contributed LID studies. These experts come from North Carolina State University, Villanova University, University of New Hampshire, University of Washington, University of Alabama and the Urban Water Research Institute. Representatives from the BMP database team and EPA storm water quality consultants also serve on the panel.

The BMP database team completed a draft of the revised monitoring guidance in December 2008. A final version, which will incorporate comments from the UWRRC and advisory panel members, is expected to be released in the spring of 2009. **SWS**

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Predicting Floods

Timely and accurate water level monitoring technology

By Dale Beardsley

Ocean level monitoring has become increasingly important in scientific areas of study due to factors such as global warming as well as seasonal changes that result in extensive flooding and damage. Ocean level data is imperative to physical oceanographers' research; therefore, they are in search of the most accurate, quick and cost-effective data acquisition equipment in the field.



Over the years, water level monitoring equipment has evolved from a mechanical means of measurement involving buoys and manual data collection, where human error was a significant factor, to electronic techniques involving radar and acoustic sensors. Some level transducers automatically capture data and transmit it to a host PC.

Decision Making Data

When AmberJackSolutions, a company specializing in custom data acquisition and telemetry solutions, wanted to expand the capabilities of its B600 versatile tide gauge, the company looked at different aspects of the gauge's monitoring functions, specifically its water level sensors. AmberJackSolutions compared the radar, acoustic and pressure technologies typically used to capture water level data in oceanic applications.

Staff found that the pressure sensor technology used in hydrostatic transducers provided data more quickly and accurately than that of the other alternatives.

The company invested in Pressure Systems' KPSI 735T hydrostatic submersible level transducer for use in its tide gauge system. The 735T features titanium construction, and each transducer includes a SuperDry vent filter that utilizes a unique water block feature.

"Our tide gauge systems collect data used to make informed decisions about sea levels and, in conjunction with seismic activity, to detect tsunamis," said David Mendes, hardware engineer for AmberJackSolutions. "The installation costs are offset by the validity and timeliness of the information generated by the transducers and our customers' subsequent ability to act on their data."

With the use of Pressure Systems' 735T level transducer, data can now be conveniently transmitted through GPRS protocol, saved on an SQL database in real time and downloaded for graphical viewing. The B600 tide gauge from AmberJackSolutions has been installed on several islands in the Portuguese Azores.

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