RAN Fact Sheet

Redesigning the American Neighborhood

Comparing Stormwater Best Management Practices

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Best Management Practices (BMPs) used in stormwater management have been developed to decrease the risk and impact of flooding and to protect the quality and quantity of local water resources. Types of stormwater management BMPs that can be constructed include wet ponds, gravel wetlands, and rain gardens.

Two examples of stormwater best management practices: a wet pond on the left and a rain garden on the right (http://www.maplewoodmn.govoffice.com.

Among the many types of stormwater BMPs, there are varying degrees of success in maintaining water quality and flow control. Additionally, the cost-effectiveness of BMPs varies considerably.

Comparing BMPs

Typically stormwater BMPs have been compared on the basis of their direct environmental impact (i.e. ability to retain pollutants and peak flows of stormwater) and initial capital cost. The RAN Project and BMP managers have realized, however, that the cost of BMPs does not end at installation but also includes costs for preventative maintenance, corrective repair, and replacement or removal. Therefore, a more complete picture of the costs over a BMP's life-cycle is important to help understand its true cost-effectiveness.

Culvert cleaning and drainage dredging, examples of costly BMP maintenance.

Likewise, the ecological and human health impacts of each BMP extend beyond just its ability to retain pollutants and peak flows of stormwater. In addition to these environmental benefits there are also ecological and human health consequences associated with the production, construction, operation, maintenance, and decommissioning of stormwater BMPs and facilities.

Life-Cycle Approaches

The RAN project has begun to investigate and compare structural stormwater BMPs from this life-cycle perspective using environmental life-cycle assessment (LCA) and economic life-cycle costing (LCC) approaches. The LCA method attempts to account for all environmental benefits and burdens (i.e. release of pollutants to the air, water, and soil and consumption of material resources) over the entire life cycle of a product or process. This life-cycle inventory identifies impacts such as potential to contribute to global climate change, contaminate freshwater resources, cause human respiratory problems, or deplete fossil fuels.

Construction of BMPs for stormwater management may impact the environment over both the short-term and the long-term.

The magnitude and importance of these impacts may then be weighted and combined to achieve a net environmental performance or ecological footprint. The transport and fate of pollutants of particular concern may also be examined individually using mass balances, such as carbon footprinting.

The economic costs over the life-cycle are often accounted for as well. Direct costs to the owner over time are typically reported through LCC, while the combination of direct, indirect, and hidden costs, including ecological and social externalities, is generally reported through full (or true) cost accounting.

Comparing Stormwater Best Management Practices

RAN-University of New Hampshire BMP Life-Cycle Study

In order to conduct a detailed and objective comparison of the life-cycle performances of various BMPs, the RAN Project partnered with the University of New Hampshire's Stormwater Center where twelve structural stormwater BMPs have been constructed and are operated and maintained in parallel. Of these twelve, five were selected for evaluation from a life-cycle perspective, including an ADS pre-manufactured subsurface unit, a wet pond, two variations in bioretention design, and a gravel wetland. To complete the inventory, the life-cycle operations, associated emissions, and resource consumption of the BMPs were recorded, estimated, and modeled from construction through end-of-life.

Human and ecological health impacts of inventoried emissions and resources were then characterized as using the U.S. Environmental Protection Agency's TRACI method and weighted according to values set by the EPA Science Advisory Board.

Key Findings

There is no universal relationship between BMP cost and operational performance or life-cycle environmental performance. Excluding operations, the construction phase both causes the greatest impact and is the most costly for all the BMPs, except the wet pond. Corrective maintenance is also an important contributor over a 30-year life-cycle.

In most cases, the operational benefits of BMPs outweigh the other life-cycle impacts, but some BMPs clearly perform better from a life-cycle perspective. Based on operational performance, life-cycle performance, and life-cycle cost, bioretention and gravel wetland BMPs are the best performers for the cost. Both life-cycle performance and cost-effectiveness may be maximized through integration of BMPs and BMP maintenance with landscaping features and public amenities, a concept central to low-impact development.

For a relative comparison of the costs and impacts of the BMPs analyzed, go to http://www.uvm.edu/~ran/ran/toolbox/documents/bmpcostgraphs.pdf.

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