EXECUTIVE SUMMARY

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WATER ENVIRONMENT RESEARCH FOUNDATION

STORMWATER

Decentralized Stormwater Controls for Urban Retrofit and Combined Sewer Overflow Reduction

Rainwater runoff that is diverted from roads, rooftops, and parking lots during storm events contributes to combined sewer overflows (CSOs). Decentralized controls, also known as best management practices, manage rainwater runoff on a small scale, and are constructed to capture rain where it falls. These controls use natural hydrologic cycle elements (such as infiltration and evapotranspiration) to dampen stormwater surges that overwhelm combined systems.

Capturing rainwater where if falls offers appealing technical alternatives to stormwater runoff capture than conventional end-of-pipe measures. Decentralized controls have the potential to reduce the frequency and volume of CSO events. In addition, a decentralized approach to stormwater management allows communities the flexibility to respond to ever-changing economic and environmental conditions.

Decentralized Stormwater Controls

Decentralized controls have the capability to meet multiple rainwater runoff management objectives, including:

- flow rate attenuation;
- volume reduction; and
- water quality improvement.

An evaluation process has yielded a short list of 11 classes of decentralized controls deemed suitable for urban retrofit and CSO reduction. This research focuses on how decentralized controls can reduce the volume of rainwater runoff generated and, consequently, entering the combined sewer system in urban areas.

Treatment Train

The ability to use multiple hydrologic and hydraulic processes allows the controls to be combined into a treatment train to meet targeted rainwater management objectives. The controls can be integrated into many common urban land uses on both public and private property, which enhances flexibility in siting rainwater runoff control measures.

Because these controls can be constructed on an individual basis, or in conjunction with other projects, a variety of funding options is possible. Most importantly, these practices provide source control of rainwater runoff, allowing management strategies to be targeted at specific sites rather than requiring the planning and construction of large-scale, capital-intensive centralized controls.

All of these characteristics give decentralized source controls the potential to reduce the volume of rainwater that enters a combined sewer system, thus mitigating the number of combined sewer overflows in a watershed.

Retrofit Feasibility

A key challenge is overcoming concerns regarding hydrologic performance, mainly because decentralized controls for rainfall capture and runoff volume reduc-

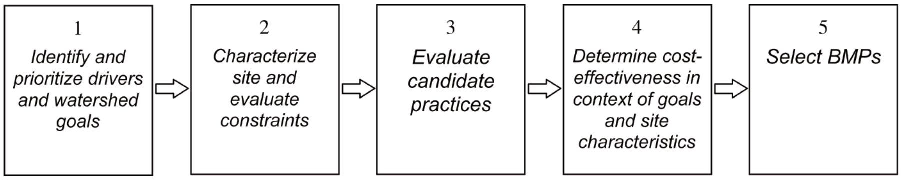

Figure 1. Implementation Strategy for Decentralized Controls.

BENEFITS

- Evaluates decentralized controls such as rain barrels, rain gardens, disconnected downspouts, filter strips, and porous pavement.
- Identifies functional processes of decentralized controls and methods to quantify reductions in stormwater volumes.
- Provides control strategies to reduce the quantity and volume of CSOs.
- Outlines a five-step framework for evaluating and selecting source control elements of a rainwater management implementation strategy

RELATED PRODUCTS

Best Practices for Treatment of Wet Weather Wastewater Flows (00CTS6),

Critical Assessment of Stormwater Control Selection Issues (02SW1)

Model Standards for Decentralized Stormwater Management (04DEC12SG)

RELATED ONGOING RESEARCH

Characterizing the Quality of Effluent and Other Contributory Sources during Peak Wet Weather Events (03-CTS-12PP)

International Stormwater BMP Database, www.bmpdatabase.org (03-SW-1CO)

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tion rely to a large extent on landscaping-type solutions. This means their feasibility often depends on soil characteristics. Three areas of concern are addressed:

Standing Water This concern has three aspects: nuisance, aesthetic, and public health. Scale is a consideration. For example, homeowners like their yards to be well-drained and dry year-round.

Structural This concern also has three aspects: basement flooding; potential for undermining building and roadway foundations if the soil is either reactive to saturation or not well-drained; and utility conflicts that result in limited space.

Maintenance The degree of concern is a function of scale: It makes a difference whether the decentralized control is a rain garden on a single-family lot or a vegetated roof on a major building. The report identifies the maintenance factors affecting long-term feasibility.

Five-Step Framework

The research team created a five-step framework for evaluating and selecting source control elements of a rainwater management implementation strategy (Figure 1). Step 1 defines the problem by clarifying the drivers—reasons why the retrofit is occurring. The CSO mitigation strategy must consider primary and secondary watershed goals, which may be long term and independent of CSO mitigation goals. Step 2 characterizes the site by evaluating the type of project (i.e., redevelopment or retrofit); analyzing land cover and soil; and identifying hot spots (e.g., flood prone areas, industrial districts).

Once the drivers, the watershed planning goals, and the site characteristics are well understood, specific decentralized controls can be evaluated for their suitability, considering feasibility and design variables (Step 3). The project is then, in Step 4, analyzed for cost effectiveness in the context of the goals and site characteristics. In Step 5, the project planners will select one or more appropriate decentralized controls, or none if they select a no-build option. The selected controls should reflect the work done in Steps 1 through 4, and be based on the overall watershed and natural resource protection goals.

Simulation and Cost-Effectiveness

In recent years, the rainwater runoff modeling focus has shifted to assess whether traditional simulation tools could be reasonably downscaled to evaluate micro-scale processes such as rainfall and runoff at the individual parcel scale. To provide an answer, contemporary simulation and optimization software can be used to evaluate decentralized control options.

Evaluation of decentralized options for CSO control is more complex than the evaluation of traditional centralized controls. There are a large number of decentralized controls, and many decentralized controls rely on infiltration, which is complex to evaluate. For these reasons, a sophisticated model such as U.S. EPA's Stormwater Management Model (SWMM) is unlikely to be used by local regulatory agencies for routine assessment of decentralized controls. The alternative is to apply a spreadsheet approach.

Benefits Beyond Stormwater

Capturing runoff where it falls in urban areas introduces ancillary benefits into the community that extend beyond runoff volume reduction. The use of decentralized source controls in conjunction with redeveloping land in urban regions creates opportunities, over time, to develop greener communities that will achieve higher levels of ecological and receiving water protection.

Natural processes and functions, when reintroduced into the design of highly urbanized environments, provide holistic benefits. Green infrastructure that uses vegetation and soil to reduce rainwater runoff volume may also reduce air pollution and air temperature (through evapotranspiration) and help to minimize the urban heat island effect, while at the same time providing ground cover that serves a habitat function. Designing with nature can also be seen in a larger sense, as land development that is more sustainable—economically, environmentally, and socially.

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