Urban Stormwater Management in 2050

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Outline

• Recent forecasts
• External drivers of change
• Forecasted water supply trends
• Forecast wastewater trends
• Forecast stormwater trends
• Urban water management model
• Research needs
Selected Recent Urban Water Forecasts

• Novotny. 2006. Blue Water in Green Cities. NSF.
• Marsalek et al. 2007. IWA/IAHR Joint Committee on Urban Drainage.
Common Findings of These Studies

• Wastewater and stormwater reuse are essential components of future systems.
• Decentralized control systems encourage reuse.
• Higher density urbanization will reduce the impact of vehicular transport in generating imperviousness.
• Infiltration-based decentralized controls can cause long-term groundwater contamination.
• Federal urban water agencies remain fragmented in their approach to urban water.
Forecasted Changes to 2050 Water Supply

- Indoor use drops from 70 to 40 gpcd
- Outdoor water use increases due to rapidly growing popularity of automatic sprinkling systems. Largest water use in many cities.
- Use of alternative water supplies becomes the main source of water to support growth
Alachua County, FL Homes with Sprinklers

- **Count of Homes Built**
- **% of homes with sprinklers**

- **Effective Year Built**
- **Total Number of Homes Built**

- **Percent of Homes with In-ground Irrigation**
Forecasted Changes to 2050 Wastewater Systems

• Increasing treatment requirements for reuse
• Decreased base flow due to water conservation
• Real-time control of infiltration-inflow that causes overflows
Florida’s Reuse Provides 36 gpcd of Water Supply Needs

Florida DEP (2009)
Forecasted Changes to 2050 Stormwater

• Stormwater BMPs are ubiquitous within the urban area. Control can be achieved by manipulating the rainfall-runoff-transport relationship as well as installing a downstream control.

• Use local storage for stormwater reuse

• Sensors to measure stormwater fluxes and help manage decentralized controls
Conventional vs. LID Stormwater Designs

Conventional site design increases runoff for nearly all storms.

Roadways, Paved Surfaces and Turf Used to Collect, Convey and Concentrate Runoff
Causes of Imperviousness in Urban Areas

- % imperviousness based on detailed mapping of 6 U.S. urban areas by Slonecker and Tilley (2006)
- Vehicular transportation accounts for 62% of imperviousness
On-site Controls in Gainesville, FL
Centralized vs. Distributed Stormwater Detention/Retention Systems
Imperviousness: The Need for Hydrologic Restoration

Stormwater charges based on:
- Smaller event quality control
- Large event flood control
- Imperviousness charges
  - Impervious categories (i.e. DCIA)

On-site restoration credits:
- Requires quantifiable hydrologic restoration
- Requires quantifiable load management
Stormwater Reuse

• Significant seasonal storage is needed to utilize more than 30-40% of reuse capacity
• Stormwater ponds provide a potential major source of storage
• Stormwater reuse is growing
  – Need to address water quality concerns
Stormwater Models and Methods

• Separate models at a range of scales:
  – SS simulation/optimization
  – SWMM simulation
  – CFD simulation

• Analytical methods at a range of resolutions: For example,
  – Lumped gravimetric indices
    • TSS or SSC
  – Particle size distributions (PSD)

• Linking model scales and method resolution
  – Combine SWMM, CFD, PSDs
  – Link stormwater with water & wastewater
Generic Water Budget Calculations
Surface Soil Moisture Storage

Length
Width
Depth

Precipitation
Evaporation
Makeup
Splash-out
Backwash
Overflow
Leaks
De

pht

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Research Needs

• Long-term experimental urban watersheds
• Reestablish the equivalent of the Office of Water Resources Research at the federal level to provide funding for research that looks at integrated urban water systems
• New methods to permit integrated evaluations of all functional units in urban areas that recognize the multipurpose uses, e.g., front yard:
  – Is a landscape feature that needs irrigation water and adds fertilizers, pesticides, and yard litter to urban system
  – Provides shading and recreation
  – Stores and Infiltrates stormwater from precipitation and runon.