Research and Tools for Decentralized Systems from WERF and the DWRC

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EPA Decentralized MOU Partnership Web Seminar
September 18, 2012
• Rural communities, suburbs, and cities are looking for ways to meet water, wastewater, and stormwater needs
• Decentralized systems can be an affordable, sustainable solution
• Can be used with centralized systems for optimization
Introduction

• $16 million in research available on decentralized systems
  – Decision-making tools
  – Design
  – Management options
  – Much more...

• Research program is a joint effort between the WERF and the Decentralized Water Resources Collaborative (DWRC) with funding from U.S. EPA
DWRC History:

- Phase 1: 1997-2003
  - Administered by Washington U. in St. Louis
  - 30+ projects, $8 mill.

- Phase 2: 2003-2010
  - Administered by WERF
  - 40+ projects, $8 mill.
1. Program Scope
2. Research Highlights
3. Outreach

Questions/Discussion
1. Septic / Onsite Systems

**Total housing units served by septic systems**

<table>
<thead>
<tr>
<th>Year</th>
<th>Units Served</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>24.6</td>
</tr>
<tr>
<td>1989</td>
<td>25.1</td>
</tr>
<tr>
<td>2001</td>
<td>25.8</td>
</tr>
<tr>
<td>2007</td>
<td>26.1</td>
</tr>
</tbody>
</table>

**Total housing units served by septic and centralized/clustered systems**

- Septic systems* (20%)
- Centralized/clustered systems** (80%)

Source: US EPA

Source: NDWRCDP
2. Small Community and Cluster Systems
3. Urban and Suburban Applications

Source: Ed Clerico, Alliance Environmental
Source: Terence Kerns, theEcoVillage.com.au
Source: Sidwell Friends
4. LID / Green Infrastructure for Stormwater

Source: Barr Engineering Company and the City of Burnsville, MN
Program Scope

The Wastewater Management Continuum

- Individual Systems
- Small Clusters
- Large Clusters
- Small WWTPs
- Large POTWs

Source: Vic D'Amato, Tetra Tech
Focus Areas:

• WERF

• CAWT

• EPRI

• NRECA

• CIDWT

• NOWRA

Environmental Science & Engineering

Management, Economics, & Policy

Training and Education
• Environmental Science and Engineering
  – Quantitative Tools to Determine the Expected Performance of Wastewater Soil Treatment Units
  – Evaluation of Greenhouse Gas Emissions from Septic Systems
  – Influent Constituent Characteristics of the Modern Waste Stream from Single Sources
• Management, Economics, and Policy
  – Business Attributes of Successful Responsible Management Entities
  – International Issues and Innovations in Integrated and Decentralized Water Resource Infrastructure
  – Overcoming Barriers to Evaluation and Use of Decentralized Wastewater Technologies and Management
• Training and Education
  – Educational Curriculum for Onsite/Decentralized Wastewater Treatment
  – Installer Training Program
  – Decentralized Wastewater Treatment O&M Service Provider Training Program
  – Decentralized Wastewater Glossary
Highlights From Select Projects
Guidance for Establishing Successful Responsible Management Entities

- Professional management ensures performance and reliability of decentralized systems
- Responsible management entities (RMEs) are a successful management model
- A website was created to provide all the resources needed to establish an RME

www.werf.org/RME
<table>
<thead>
<tr>
<th>Getting started with this resource</th>
<th>Which way is up?</th>
<th>What does it mean for me?</th>
<th>How do I ...?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guide to the fact sheets</td>
<td>Fact Sheet 3: How regulations work in this sector</td>
<td>Fact Sheet 5: Operating successfully as a governmental organization</td>
<td>Fact Sheet 8: Writing and updating your business plan</td>
</tr>
<tr>
<td>Fact Sheet 1: What is an RME and why do we need one?</td>
<td>Fact Sheet 4: Business structures and models</td>
<td>Fact Sheet 6: Operating successfully as a private RME or service provider</td>
<td>Fact Sheet 9: Projecting your financial requirements</td>
</tr>
<tr>
<td>Fact Sheet 2: Working within the local context</td>
<td></td>
<td>Fact Sheet 7: Developers, designers, homeowners' associations, and contractors</td>
<td>Fact Sheet 10: Marketing: Making your services known</td>
</tr>
</tbody>
</table>

Download a full set of all fact sheets.
Performance and Costs of Decentralized Systems

• Provides basic wastewater management information to planners and decision-makers in very small communities
  – Mayor Smith

Products:
• Factbook
  – Wastewater Basics for Small Communities
• Factsheets
  – Collection systems (4)
  – Treatment systems (8)
  – Dispersal/disposal systems (7)
• Spreadsheet
  – Economic model of wastewater options

www.werf.org/decentralizedcost
<table>
<thead>
<tr>
<th>Collection Fact Sheets</th>
<th>Treatment Fact Sheets</th>
<th>Dispersal Fact Sheets</th>
<th>Cost Tool</th>
</tr>
</thead>
<tbody>
<tr>
<td>C2: Pressure Sewer Systems</td>
<td>T2: Suspended Growth Aerobic</td>
<td>D2: Low Pressure Distribution</td>
<td>Wastewater Planning Model, Version 1.0</td>
</tr>
<tr>
<td></td>
<td>Treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C3: Effluent Sewer Systems</td>
<td>T3: Fixed Growth Aerobic Treatment</td>
<td>D3: Drip Distribution</td>
<td></td>
</tr>
<tr>
<td>C4: Vacuum sewer Systems</td>
<td>T4: Constructed Wetland Systems</td>
<td>D4: Spray Distribution</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T5: Lagoons</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>T6: Nutrient Reduction</td>
<td>D5: Evapotranspiration System</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T7: Disinfection</td>
<td>D6: Surface Water Discharge</td>
<td></td>
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<tr>
<td></td>
<td>T8: Residuals Management</td>
<td>D7: Wastewater Reuse</td>
<td></td>
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</table>
Decentralized Wastewater Treatment O&M Service Provider Training Program

- **Benefits**
  - Addressed the critical need for education and training for practitioners who provide O&M for onsite wastewater treatment systems
  - Provided training materials for developing a base level of knowledge of O&M service provider practitioners
  - Established a national basis for the best practices among O&M service providers

www.onsiteconsortium.org
When to Consider Distributed Systems in an Urban and Suburban Context

• Analyzed 20 case studies in U.S. and Australia where decentralized/distributed systems are being used in areas where traditional approach would be centralized
• Study critical path details and decision processes for how these projects were planned and implemented
• Products:
  – Case studies and white papers
  – Decentralized Wastewater Stakeholder Model (Excel)

[Website Link]

www.werf.org/distributedwater
• Green Buildings and Sustainable Sites
  – Integration into buildings and landscapes
  – Resource conservation, recovery and reuse within facilities
  – Education and recreation

• Independent Communities
  – Maintain fiscal control
  – Preserve community character
  – Underserved communities

• Utility Optimization
  – Managed distributed systems
  – Sewer mining
  – Satellite reuse

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**Case Studies Listed by Type**

**Green Building/Sustainable Sites (GB)**
- Battery Park City, New York City (UO)
- Couran Cove Island Resort, Queensland, Australia (IC)
- Currimbin Ecovillage, Queensland, Australia (IC)
- Dockside Green, Victoria, British Columbia, Canada (UO)
- Philip Merrill Center, Annapolis, Maryland
- Sidwell Friends School, Washington, D.C.
- Workplace6 Recycled Water Factory, Sydney, Australia (UO)

**Independent Communities (IC)**
- Bethel Heights, Arkansas
- Gillette Stadium, Foxborough, Massachusetts (GB)
- Lake Elmo, Minnesota
- Piperton, Tennessee
- Warren, Vermont
- Weston Solar Aquatics, Weston, Massachusetts (GB)
- Wickford Village, Rhode Island

**Utility Optimization (UO)**
- LOTT Alliance, Lacey, Olympia, and Tumwater, Washington
- Loudoun Water, Loudoun County, Virginia (IC)
- Mobile Area Water and Sewer System, Mobile, Alabama
- Pennant Hills Golf Club, Sydney, Australia
- Sand Creek, Aurora, Colorado
- University of North Carolina at Chapel Hill, North Carolina (GB)
• Water-centric brownfield redevelopment based on integrated resource management

• *Fit-for-purpose*, reclaimed water supply (augmented by rainwater)
  – Toilet flushing, landscape irrigation, green roof watering, and natural stream/pond

• Stream/pond complex provides residential access, enhancing unit value, ecological function and biodiversity

• On site press for sludge dewatering to produce feedstock for co-located gasification plant
  – Single operations company = reduced staffing, maintenance and commissioning, and travel, reducing impact
- Privately-driven sewer mining project
- Conveyance costs associated with more traditional centralized reuse systems often render satellite users uneconomic
- MBR treatment system produces 172,000 gallons of high quality water per day
- Treated water is used to irrigate the 22 hectares (55 acres) of greens, tees and fairways.
## Decentralized Wastewater Stakeholders Decision Model

<table>
<thead>
<tr>
<th>Economic</th>
<th>Environmental</th>
<th>Societal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximize Economic Value</td>
<td>Optimize Environmental Benefit</td>
<td>Fulfill Community Objectives</td>
</tr>
</tbody>
</table>

### Economic
- **Minimize Capital Costs**
  - Planning and Design
  - Land
  - Phasing
  - Existing Treatment
  - Existing Collection
  - Financing
- **Minimize Operating Costs**
  - Financing Cost
  - Labor
  - Power
  - Byproducts
  - Other
- **Meet Community Economic Needs**
  - Availability
  - Adaptability
  - Externalities

### Environmental
- **Water Quality**
  - Avoidance
  - Removal
- **Water Quantity**
  - Water Balance
  - Sustain Flow
- **Natural Environment**
  - Biodiversity
  - Disturbance
  - Global Warming

### Societal
- **Quality of Life**
  - Health
  - Outdoor Environment
  - Built Environment
- **Stability**
  - Dependable
  - Resilient
  - Safe
- **Equitability**
  - Serves All Equally
  - Charges Everyone Fairly
Case Studies on New Water Paradigm

• Creates a platform for communities to overcome challenges through operating under key sustainability principles and practices.

• Uses examples from 2 case study communities (Tucson/Pima County, Arizona and Northern Kentucky) to offer real world context.
21st Century challenges

- Increasing and variable energy costs
- Climate change
- Increased drought frequency and intensity
- Limited fresh water supplies
- Water quality impairment
- Ecosystem health and natural service deterioration
- Aging Infrastructure
Old paradigm

– Highly specialized
– Centralized
– Segregated
– Linear
– Extractive
– Inflexible

New paradigm

– Multifunctional
– Decentralized
– Integrated
– Systemic
– Restorative
– Adaptive
Using Rainwater to Grow Livable Communities

- Stormwater BMPs are an effective ways to address stormwater runoff
- A website encourages and facilitates integration of BMPs into development
- Tools and resources for effective communication and implementation
We chose some of the best, but there are many more—with new examples every day.
Chicago, Illinois
Becoming the "Greenest City in America"
Before: Vacant lot before greening (Source for both: Pennsylvania Horticultural Society)

After: Vacant lot was regraded to capture stormwater and planted with trees, shrubs, and grass
Kansas City, MO

- 10,000 rain gardens
- CSO mitigation planning
- Stormwater management
- Green space
- Revitalization projects
Transforming Our Cities: High Performance Green Infrastructure (ongoing)

- Smart BMPs
- Highly distributed real time control of GI
Pilot Technology: Advanced Rainwater Harvesting

Simplest Definition: Drain storage in advance of predicted rainfall or other trigger
User Experience: Task Specific User Dashboards
Pilot Technology:
Controlled Under Drain Bioretention
New Reports

- Stormwater Non-Potable Beneficial Uses and Effects on Urban Infrastructure (2012)


- Long-term Study on Landscape Irrigation Using Household Graywater – Experimental Study (Oct 2012)
New Projects

• One Water Management Network (in cooperation with US Water Alliance)

• Institutional Approaches for Green Infrastructure and Integrated Water Management Success – RFP Coming Soon
Outreach

Award Winning Website: www.decentralizedwater.org
Outreach

Quick Guide

The quick guide provides a snapshot of every product available from the DWRC, including links to tools and reports.

Quick Guide to Research and Products from the Decentralized Water Resources Collaborative (DWRC)

<table>
<thead>
<tr>
<th>Key to Product Audience:</th>
<th>Engineers/Designers</th>
<th>Scientists/Researchers/Academics</th>
<th>Regulators/Elected Officials/NGOs</th>
<th>Utility Managers/Service Providers/Responsible Management Entities (RMEs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developers</td>
<td>Vendors/Suppliers/Installers</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Product Title</th>
<th>Description</th>
<th>Year</th>
<th>Project #</th>
<th>Audience</th>
<th>Tags</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Science and Engineering</td>
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</tr>
<tr>
<td>Evaluation of GHG Emissions from Septic Systems</td>
<td>Evaluates data and information on methane and other greenhouse gases from septic systems for more accurate GHG inventories.</td>
<td>2010</td>
<td>DEC1210</td>
<td>Utility Managers</td>
<td>Emerging applications, regulatory, monitoring, system management, operation and maintenance</td>
</tr>
<tr>
<td>Non-Traditional Indicators of System Performance</td>
<td>Describes technologies that can be used in the decentralized field to get relevant real-time information about treatment system performance and water quality.</td>
<td>2010</td>
<td>DEC2210</td>
<td>Scientists/Researchers/Academics</td>
<td></td>
</tr>
<tr>
<td>Performance and Costs for Decentralized Unit Processes</td>
<td>Provides guidance on the performance of decentralized unit processes and templates for user-directed cost determination.</td>
<td>2010</td>
<td>DEC2210</td>
<td>Developers</td>
<td>Unit processes, system costs, performance, decision-making, operation and maintenance</td>
</tr>
<tr>
<td>Performance Effects of Water Softener Rate on Chlorine Systems Workshops</td>
<td>Defines research needs to evaluate if there are negative effects to onsite systems from water softener brine, and if so, what can be done to mitigate the problem.</td>
<td>2010</td>
<td>DEC2210</td>
<td>Regulators/Elected Officials/NGOs</td>
<td>Onsite systems, design, soil treatment unit, unit processes, performance, operations and maintenance, wastewater characteristics</td>
</tr>
<tr>
<td>Long-Term Study on Landscape Irrigation Using Household Greywater: Experimental Study (Phase 1)</td>
<td>Provides quantitative data and information to better understand the fate and occurrence of greywater chemical constituents and pathogens and their potential impacts on soil and groundwater quality.</td>
<td>2010</td>
<td>DEC2210</td>
<td>Developers</td>
<td>Water reuse, emerging contaminants, soil treatment unit, wastewater characteristics</td>
</tr>
</tbody>
</table>
The FAQ serves as a guide to the Research and Products from the DWRC, including links.
Outreach

Federal Agency and NGO Briefings

• **Smart, Clean & Green: 21st Century Sustainable Water Infrastructure**

• **Integration: A New Framework and Strategy for Water Management in Cities and Towns**
Outreach

Additional Outreach Efforts

- Educational Video
- Promotional Brochures, Flyers
- PowerPoint Presentation Templates
- Brochure for Centralized Agencies
- Dedicated Outreach Web Page
- Journal, Magazine Articles
- Workshops, Presentations, and Webinars

Research and Products from the Decentralized Water Resources Collaborative

Decentralized systems offer an affordable, sustainable solution for the treatment of wastewater. Nearly $16 million in research products are available from DWRC and the Water Environment Research Foundation on decentralized water and wastewater treatment. For help navigating this wealth of information, go to www.werf.org/decentralizedwater and access the resources below:

www.werf.org/decentralizedoutreach
Questions and Discussion

Contact:
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  jmoeller@werf.org
  571-384-2104
  www.werf.org/decentralized