



Research and Tools for Decentralized Systems from WERF and the DWRC



Jeff Moeller, P.E., WERF

EPA Decentralized MOU Partnership
Web Seminar
September 18, 2012

Introduction



- 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



Coalition for Alternative Wastewater Treatment



Introduction



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.

Agenda



1. Program Scope
2. Research Highlights
3. Outreach

Questions/Discussion

Program Scope

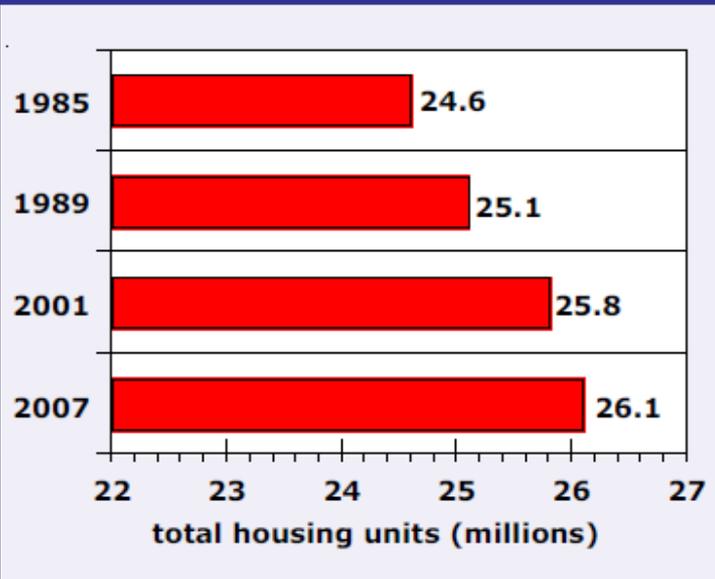


1. Septic / Onsite Systems

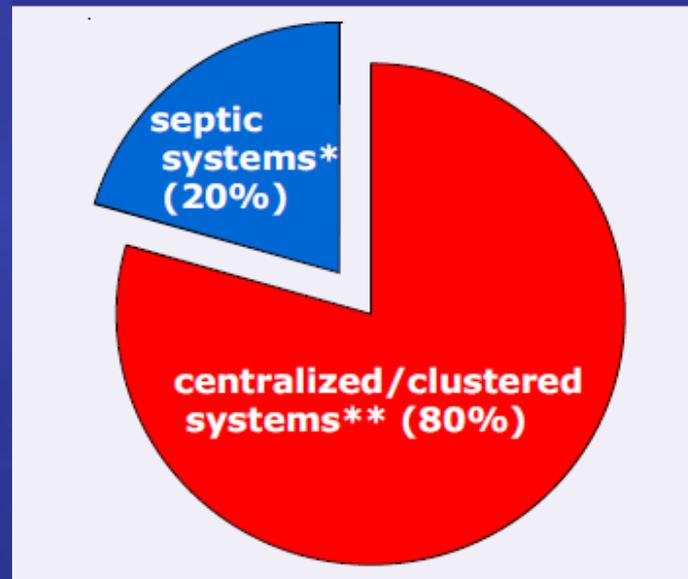


Source: NDWRCDP

Total housing units served by septic systems



Total housing units served by septic and centralized/clustered systems



Source: US EPA

Program Scope



2. Small Community and Cluster Systems



Source: Premier Tech Aqua, Ecoflo Cluster



Source: Orenco Systems



Source:
Loudon County

Program Scope



3. Urban and Suburban Applications



Source: Sidwell Friends



Source:
Ed Clerico, Alliance
Environmental

Source:
Terence Kerns,
theEcoVillage.com.au

Program Scope



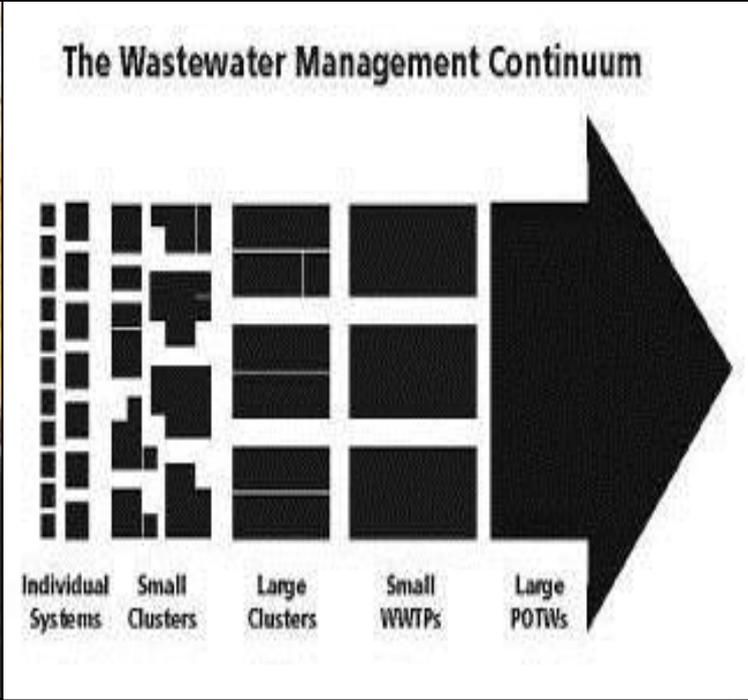
4. LID / Green Infrastructure for Stormwater



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



Program Scope



Source: Vic D'Amato, Tetra Tech

Program Scope

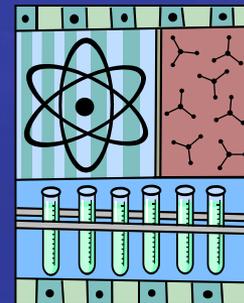


Focus Areas:

- WERF



Environmental
Science &
Engineering



- CAWT

- EPRI



- NRECA

Management,
Economics, &
Policy



- CIDWT

- NOWRA



Training and
Education



Research Highlights



- 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

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Collaboration. Innovation. Results.

Decentralized Systems

FINAL REPORT

1.1 Background and M
Throughout the U.S., decentralized approaches for U.S. population is served by new development being very wastewater management plan design, installation, operation quality and the public served. While DWTS vary in on septic tanks the retention of discharge of wastewater effluent meeting groundwater (Cof al., 2001; U.S. EPA, 1997; 2 Engineered treatment units (in site conditions are also suitable subtypes (STU) loading concern

State of the Science:
Review of Quantitative Tools to Determine Wastewater Soil Treatment Unit Performance

Copublished by
IWA
Publishing

Figure 3-4. The N Cycle as it Nitsch et al., 2002. Reprinted

Figure 3-4. SWAT Soil N Pools and Processes that Move N in and out of Pools. Nitsch et al., 2002. Reprinted with permission.

Mineral N **Organic N**

Volatilization
Denitrification
Plant Uptake

Ammonification
Nitrification
Plant Uptake

Active
Stable
Fresh

Mineral Nitrates
Organic N
Plant residue
Fertilizer Nitrates

3-10
WERF

Research Highlights



- 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*

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Home → Search Research & Knowledge Areas → Decentralized Systems (Pinar Frenay)

Responsible Management Entities Guidance Fact Sheets

Across the U.S., there is a need for more businesses that successfully manage decentralized systems. Decentralized systems are increasing in prevalence as an option that delivers sound economic, social and environmental outcomes, if effectively managed.

The resources below provide guidance for successfully establishing and running organizations that manage decentralized wastewater systems – Responsible Management Entities, or “RMEs.” (See Fact Sheet 1 for further explanation of RMEs).

Decentralized wastewater systems include the collection, treatment, and dispersal or reuse of wastewater from individual homes (such as septic systems), clusters of homes, isolated communities, industries, or institutional facilities at or near the point of waste generation. (CIDWT Decentralized Wastewater Glossary 2007)

The fact sheets can be used by existing RMEs seeking to improve their operations, prospective RMEs considering setting up, and other individuals and organizations looking to enter the decentralized wastewater field. The fact sheets serve different audiences by enabling navigation from three angles:

“Which way is up?” These focus on local context and how conditions in your area influence your determination of what organization works best.
 “What does it mean for me?” These are tailored for different kinds of organizations.
 “How do I . . . ?” These step through the basics of some key business tools and how they apply.

(Download Acrobat Reader if you can't read the linked fact sheets below.)

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

Download a full set of all fact sheets.

Research Highlights



- 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*

 National Decentralized Water Resources
Capacity Development Project

Executive Summary



Model Decentralized Wastewater
Practitioner Curriculum

North Carolina State University
Raleigh, North Carolina

March 2005



Research Highlights



Highlights From Select Projects

RMEs



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

RMEs



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[Download a full set of all fact sheets.](#)

RME Website Screenshot

Performance & Cost



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

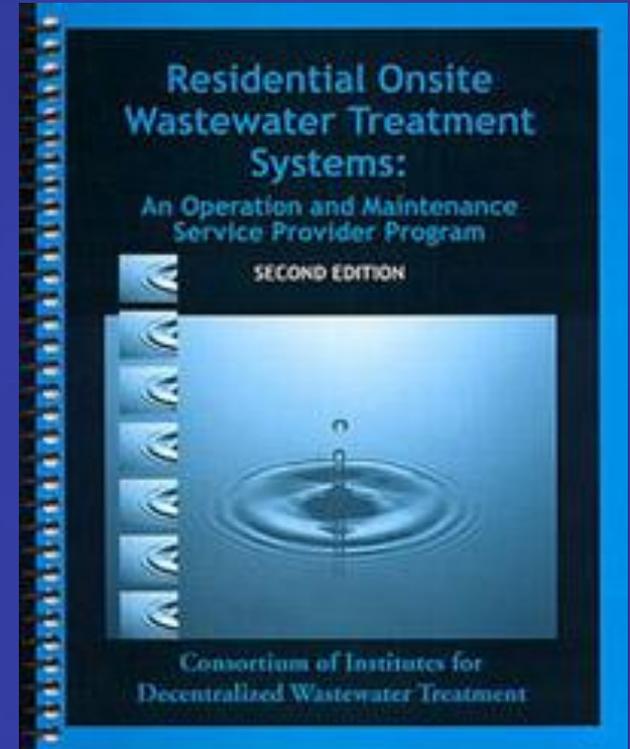
The image shows the cover page of a report titled "Wastewater Basics for Small Community Leaders and Planners". At the top left, there is a vertical label "Wastewater Basics". To the right, the title "Performance & Cost of Decentralized Unit Processes" is displayed, along with the WERF logo (Water Environment Research Foundation) and its tagline "Collaboration. Innovation. Results.". Below this, a dark horizontal bar contains the text "DECENTRALIZED WASTEWATER SYSTEMS". The main title "WASTEWATER BASICS FOR SMALL COMMUNITY LEADERS AND PLANNERS" is centered, with a small graphic of a water drop to the right. Underneath, the "Project Background" section explains that the materials were developed in response to a Request for Proposals (RFP) issued by WERF, supported by funding from the US EPA and administered by WERF as part of the National Decentralized Water Resources Capacity Development Project (NWRCDP). It also mentions that 19 Fact Sheets and an electronic cost estimation tool were developed by the Consortium of Institutes for Decentralized Wastewater Treatment (CIDWT). At the bottom, the "Principle Investigator" is listed as John R. Buchanan, Ph.D., P.E., University of Tennessee, and "Cooperators" include Nancy E. Deal, M.S., R.S., North Carolina State University; David L. Lindbo, Ph.D., North Carolina State University; Adrian T. Hanson, Ph.D., New Mexico State University; David Gustafson, P.E., University of Minnesota; and Randall J. Miles, Ph.D., University of Missouri. A large photograph of a small town nestled in a valley with mountains in the background is at the bottom.

Collection Fact Sheets	Treatment Fact Sheets	Dispersal Fact Sheets	Cost Tool
C1: Gravity Sewer Systems	T1: Liquid-Solid Separation	D1: Gravity Distribution	User's Guide
C2: Pressure Sewer Systems	T2: Suspended Growth Aerobic Treatment	D2: Low Pressure Distribution	Wastewater Planning Model, Version 1.0
C3: Effluent Sewer Systems	T3: Fixed Growth Aerobic Treatment	D3: Drip Distribution	
C4: Vacuum sewer Systems	T4: Constructed Wetland Systems	D4: Spray Distribution	
	T5: Lagoons	D5: Evapotranspiration System	
	T6: Nutrient Reduction	D6: Surface Water Discharge	
	T7: Disinfection	D7: Wastewater Reuse	
	T8: Residuals Management		



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



Urban/Suburban



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)



Photo credits: reprinted with permission from Piperton, Tennessee.

www.werf.org/distributedwater

Urban/Suburban



- 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

Case Studies Listed by Type
Green Building/Sustainable Sites (GB)
<u>Battery Park City, New York City (UO)</u>
<u>Couran Cove Island Resort, Queensland, Australia (IC)</u>
<u>Currumbin Ecovillage, Queensland, Australia (IC)</u>
<u>Dockside Green, Victoria, British Columbia, Canada (UO)</u>
<u>Philip Merrill Center, Annapolis, Maryland</u>
<u>Sidwell Friends School, Washington, D.C.</u>
<u>Workplace6 Recycled Water Factory, Sydney, Australia (UO)</u>
Independent Communities (IC)
<u>Bethel Heights, Arkansas</u>
<u>Gillette Stadium, Foxborough, Massachusetts (GB)</u>
<u>Lake Elmo, Minnesota</u>
<u>Piperton, Tennessee</u>
<u>Warren, Vermont</u>
<u>Weston Solar Aquatics, Weston, Massachusetts (GB)</u>
<u>Wickford Village, Rhode Island</u>
Utility Optimization (UO)
<u>LOTT Alliance, Lacey, Olympia, and Tumwater, Washington</u>
<u>Loudoun Water, Loudoun County, Virginia (IC)</u>
<u>Mobile Area Water and Sewer System, Mobile, Alabama</u>
<u>Pennant Hills Golf Club, Sydney, Australia</u>
<u>Sand Creek, Aurora, Colorado</u>
<u>University of North Carolina at Chapel Hill, North Carolina (GB)</u>

Dockside Green, Victoria, B.C.



- 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



Sydney Water - Pennant Hills Golf Club



- 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



Economic

Maximize Economic Value

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

Optimize Environmental Benefit

Water Quality

- Avoidance
- Removal

Water Quantity

- Water Balance
- Sustain Flow

Natural Environment

- Biodiversity
- Disturbance
- Global Warming

Societal

Fulfill Community Objectives

Quality of Life

- Health
- Outdoor Environment
- Built Environment

Stability

- Dependable
- Resilient
- Safe

Equitability

- Serves All Equally
- Charges Everyone Fairly

New Water Paradigm



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.

EPRI | ELECTRIC POWER
RESEARCH INSTITUTE

Sustainable Water Resources Management, Volume 3:
Case Studies on New Water Paradigm

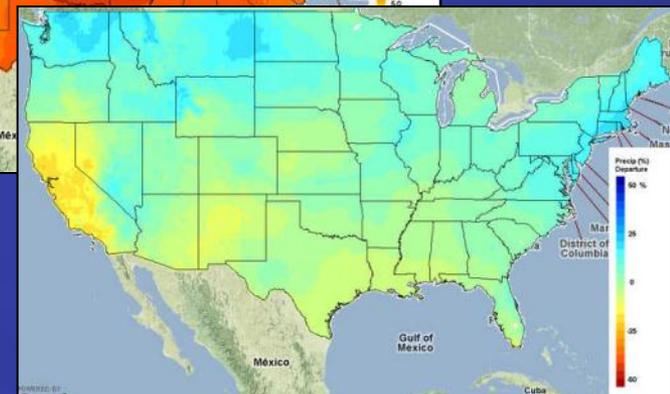
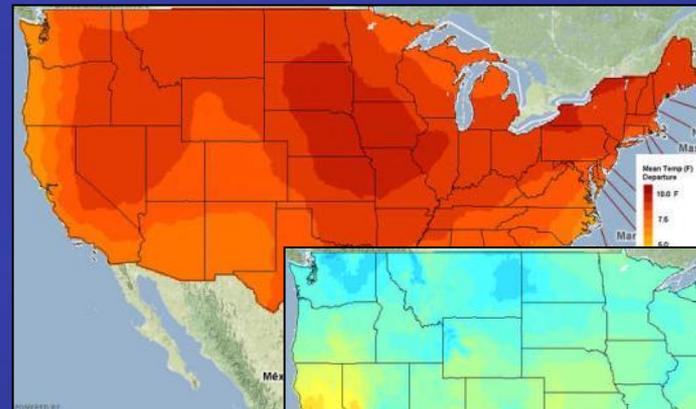
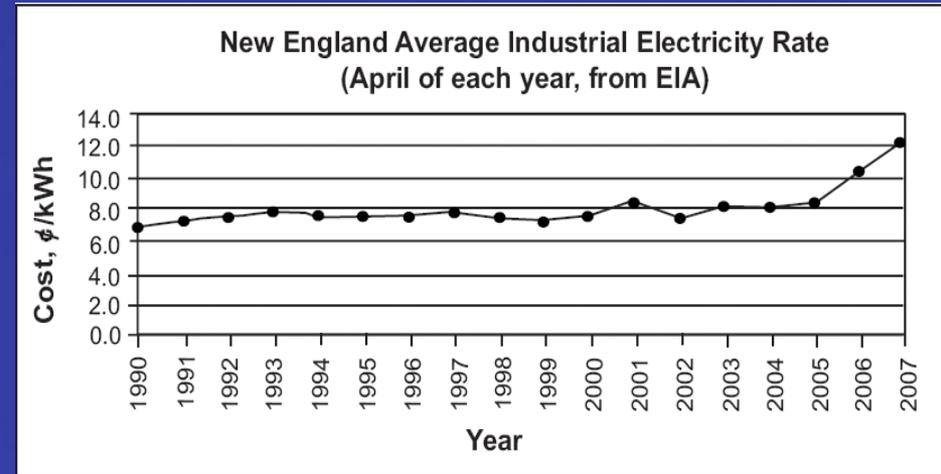


New Water Paradigm

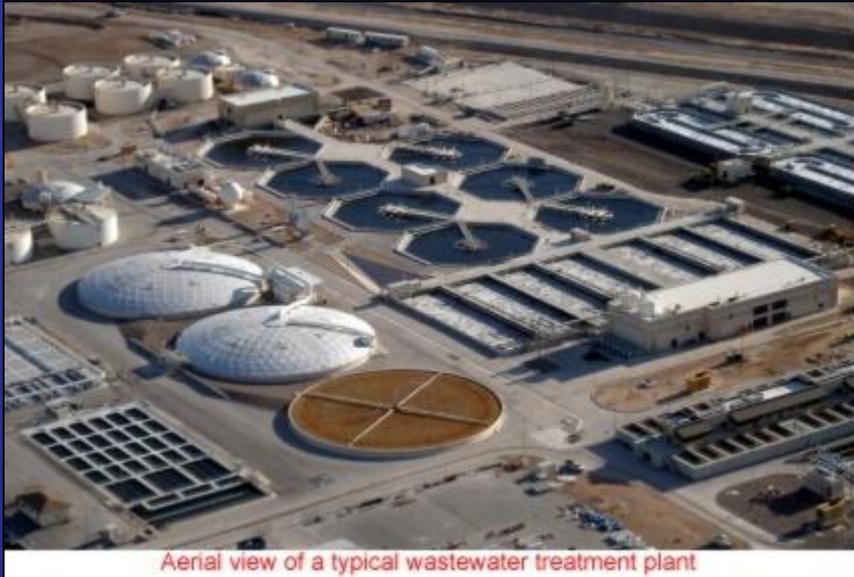


21st Century challenges

- 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



New Water Paradigm



Aerial view of a typical wastewater treatment plant



Old paradigm

- Highly specialized
- Centralized
- Segregated
- Linear
- Extractive
- Inflexible

New paradigm

- Multifunctional
- Decentralized
- Integrated
- Systemic
- Restorative
- Adaptive

Stormwater



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

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Using Rainwater to Grow Livable Communities

Sustainable Stormwater Best Management Practices

Home
Project Information
Site Index
FAQ

Who are you?
Elected Official
Municipal Stormwater Manager
Planner
Builder/Developer
Engineer/Designer
Landscape Architect
Homeowner/General Public
Additional Perspectives

Case Studies
Map
Browse

Toolbox
Basic Principles
Strategies for Success
Frameworks for Success
Communication Aids
Planning/Development Aids
Stormwater BMPs
Stormwater BMP Interactive Model

Resource Links
Information Sources
Funding Sources
Downloads
Glossary

Home

Using Rainwater to Grow Livable Communities Sustainable Stormwater Best Management Practices (BMPs)

Stormwater best management practices (BMPs) are gaining recognition as effective, flexible, and environmentally sound ways for controlling the quantity and improving the quality of stormwater runoff, while also adding amenity to a wide variety of development projects.



This rain garden at Glencoe Elementary School in Portland alleviates neighbors' basement sewer backups and offers educational opportunities.

This website is designed to encourage and facilitate the integration of stormwater BMPs into development projects in your area by providing [tools and resources for effective communication and implementation](#) as well as [in-depth case studies](#) that examine BMP integration in several cities across the United States.

Using the tools and links provided, you can:

- [Learn how you](#) can leverage political, organizational, technical, educational, and other resources to move forward with implementation.
- Arm yourself with effective [tools](#) for teaching others about the benefits of stormwater BMPs, strategies for successful implementation, and how to incorporate BMPs into development projects.
- Discover [communities](#) that have successfully integrated sustainable stormwater practices into their "toolboxes."
- Explore [additional resources](#) to broaden your knowledge and learn more about stormwater management and related topics.

[Return to top](#)

Water Environment Research Foundation 635 Slaters Lane, Suite G-110 Alexandria, VA 22314 Tel: 571-384-2100 Fax: 703-299-0742

www.werf.org/livablecommunities

Case Studies



*We chose some of the best, but there are many more—
with new examples every day.*



Chicago, Illinois
Becoming the "Greenest City in America"

Stormwater



Philadelphia, Pennsylvania

Neighborhood Transformation Initiative



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

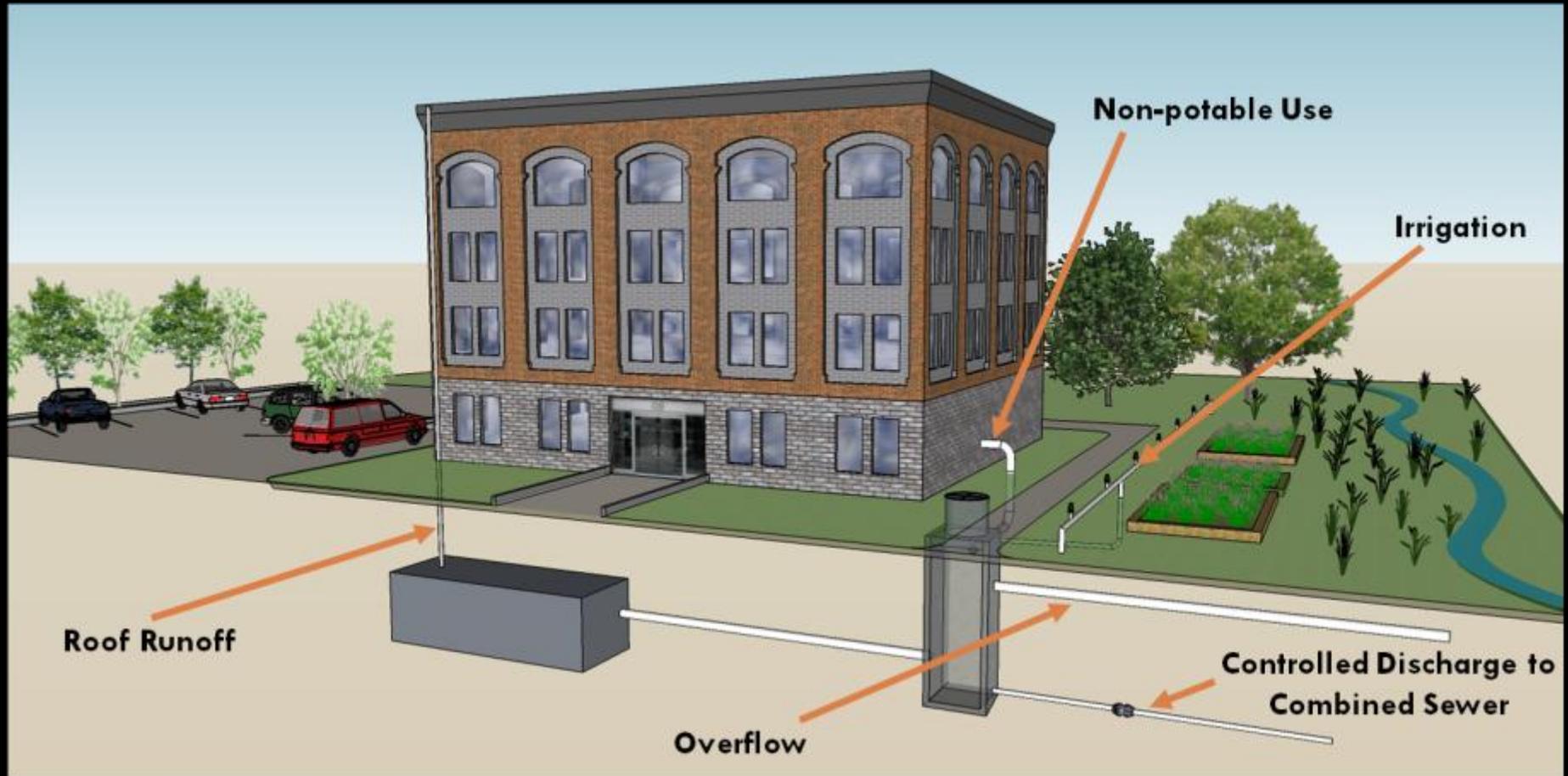
Stormwater



Kansas City, MO

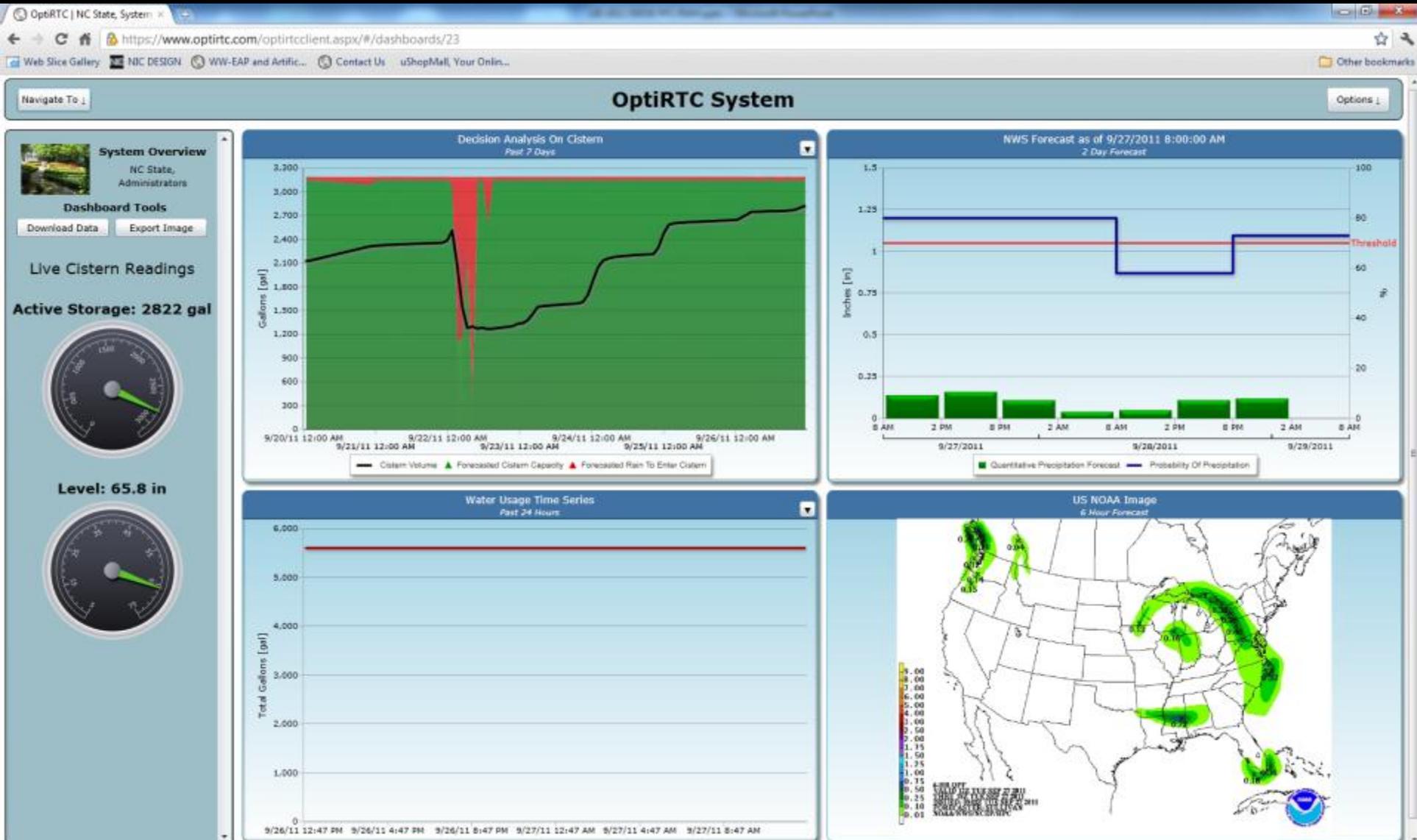
- 10,000 rain gardens
- CSO mitigation planning
- Stormwater management
- Green space
- Revitalization projects

Pilot Technology: Advanced Rainwater Harvesting

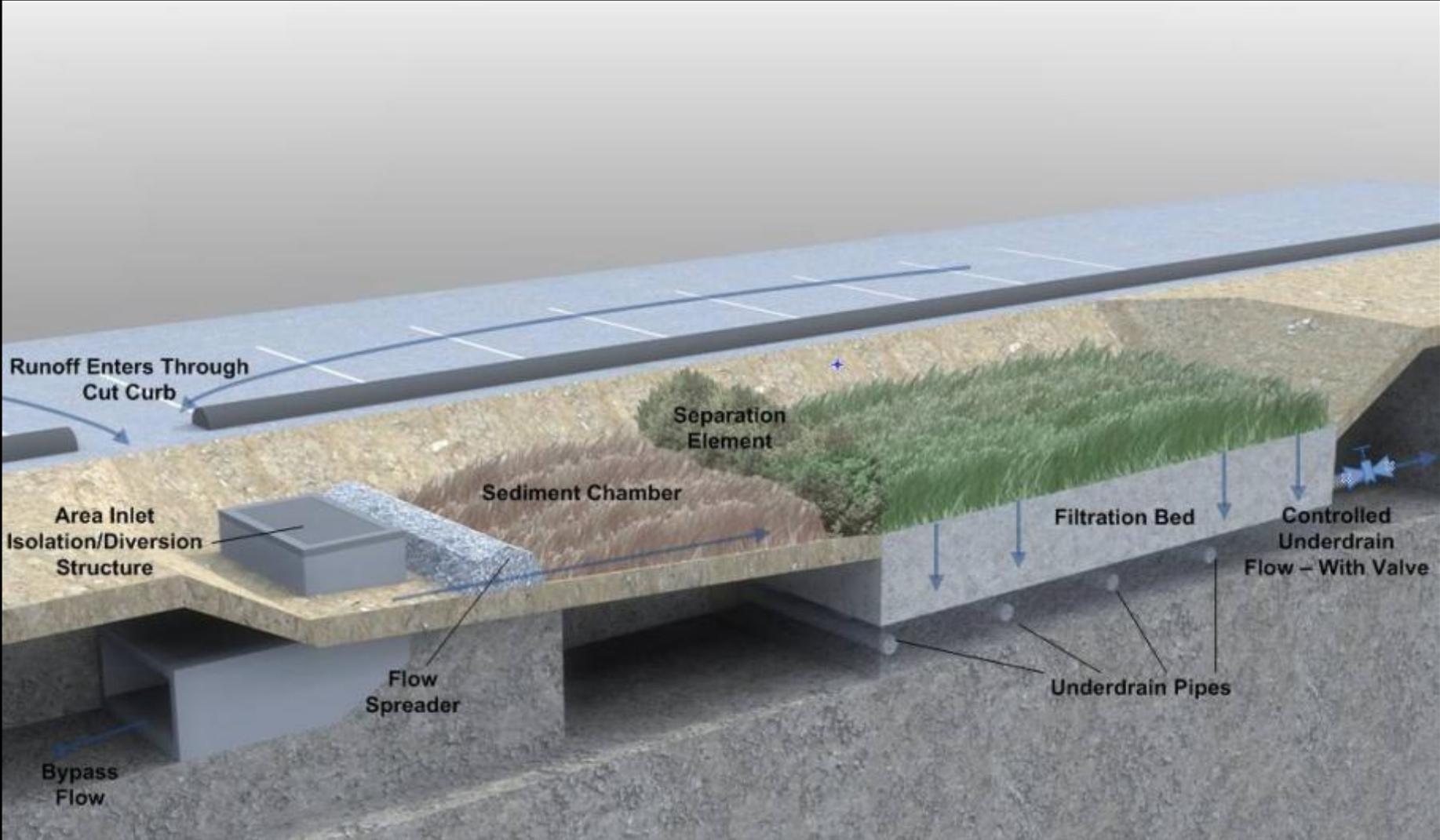


Simplest Definition: Drain storage in advance of predicted rainfall or other trigger

User Experience: Task Specific User Dashboards



Pilot Technology: Controlled Under Drain Bioretention



Rainwater / Graywater



New Reports

- Stormwater Non-Potable Beneficial Uses and Effects on Urban Infrastructure (2012)
- Guidance Manual for the Separation of Graywater from Blackwater (2011)
- Long-term Study on Landscape Irrigation Using Household Graywater – Experimental Study (Oct 2012)

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Infrastructure

FINAL
REPORT

Stormwater Non-Potable Beneficial Uses and
Effects on Urban Infrastructure

Co-published by
IWA
Publishing



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



SEARCH

WERF Home | Contact Us

ABOUT STRATEGIC THINKING RESEARCH PROJECTS NEWS AND RESOURCES

Decentralized Water Resources Collaborative

Neighborhood and Cluster Systems

NEIGHBORHOOD AND CLUSTER SYSTEMS

Engineers are making advances in remote sensing and monitoring of unmanned facilities. New treatment technologies such as membrane bioreactors are becoming more economical. Neighborhood and cluster wastewater systems are taking advantage of this technological progress and becoming more attractive as long-term, viable alternatives to traditional centralized wastewater treatment. Decentralized Collaborative is providing information on case studies, monitoring, performance, cost, and other aspects of these systems so we can learn from the past and improve the future.

SEPTIC TANKS AND ONSITE SYSTEMS

GREEN STORMWATER INFRASTRUCTURE

WATERSHED-SCALE SOLUTIONS

URBAN APPLICATIONS

Photo courtesy of InnoFlow Technologies

Keeping it Local

Individual and neighborhood wastewater treatment systems. Rain gardens and green roofs. Water-efficient appliances and landscaping. These are examples of decentralized water technologies in action. These systems can beautify cities and towns, enhance water supply, recover energy and nutrients, provide local reuse opportunities, and improve health and the environment.

The Decentralized Water Resources Collaborative (DWRC)

Featured Projects:

- » Influent Constituent Characteristics of the Modern Waste Stream from Single Sources
- » New Approaches in Decentralized Water Infrastructure
- » Guidance for Establishing Successful Responsible Management Entities
- » Hydrologic Bioretention Performance and Design Criteria for Cold Climates

Register for Updates

First Name:

Last Name:

Organization:

Email Address:

Award Winning Website:
www.decentralizedwater.org

Outreach



Quick Guide

Quick Guide to Research and Products from the Decentralized Water Resources Collaborative (DWRC)						
Key to Product Audience:	Engineers/Designers	Scientists/Researchers/Academics	Regulators/Elected Officials/NGOs	Utility Managers/Service Providers/Responsible Management Entities (RMEs)		
	Developers	Planners/Resource Managers	Vendors/Suppliers/Installers			
Product Title	Description	Year	Project #	Audience	Tags	
ENVIRONMENTAL SCIENCE AND ENGINEERING						
Evaluation of GHG Emissions from Septic Systems	Evaluates data and information on methane and other greenhouse gases from septic systems for more accurate GHG inventories.	2010	DEC1R09		onsite systems, energy and climate change, sustainability, unit processes, planning	
Non-Traditional Indicators of System Performance	Describes technologies that can be used in the decentralized field to get relevant real-time information about treatment system performance and water quality.	2010	DEC2R06		emerging applications, regulatory, monitoring, system management, operation and maintenance	
Performance and Costs for Decentralized Unit Processes	Provides guidance on the performance of decentralized unit processes and templates for user-directed cost determination.	2010	DEC2R08		unit processes, system costs, performance, decision-making, operation and maintenance	
Performance Effects of Water Softener Brine on Onsite Systems: Workshop	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.	2010	DEC2W09		onsite systems, design, soil treatment unit, unit processes, performance, operations and maintenance, wastewater characteristics	
Long-Term Study on Landscape Irrigation Using Household Graywater: Experimental Study (Phase 2)	Provides quantitative data and information to better understand the fate and occurrence of graywater chemical constituents and pathogens and their potential impacts on soil and groundwater quality.	2010	06CTS1C0		water reuse, emerging contaminants, soil treatment unit, wastewater characteristics	

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

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

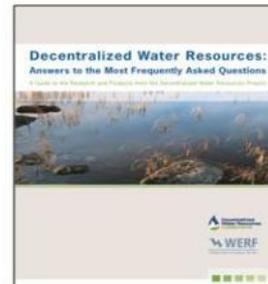
Research and Products from the

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:



A short video tour introduces users to decentralized systems and provides a quick tour of how to access available research.



A Frequently Asked Questions guide highlights key issues and organizes topics by categories for quicker navigation to resources.



The DWRC Web site at www.decentralizedwater.org provides access to all 70+ products.



www.werf.org/decentralizedoutreach

Conclusion



Questions and Discussion

Contact:

- Jeff Moeller

jmoeller@werf.org

571-384-2104

www.werf.org/decentralized

