



The Role of Distributed Approaches in Sustainable Water Resource Management

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Presentation outline

- Definitions
- Approaches and principles for sustainable water management
- WERF research project introduction
- Drivers for and benefits of distributed approaches
- Example case studies

"Distributed"

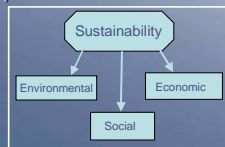
- *Integrated* resource management at various scales based on an equitable, situation-specific consideration of system appropriateness and *sustainability*
- For wastewater: onsite to cluster to centralized
- For stormwater: low-impact design, BMPs
- Centralized oversight generally preferred

"Integrated"

- Consider and balance all elements of the system
- Water
 - Natural sources (surface, ground, precipitation)
 - Produced/processed sources (waste, storm, potable)
 - Needs (drinking, cooking, process, irrigation, aquatic ecosystems)
- Carbon
- Nutrients
- Energy

"Sustainability"

- Clean and abundant water supply
- Healthy ecosystems (aquatic, terrestrial)
- Clean air
- Safe and secure food supply
- Strong and equitable economy
- Climate stabilization
- Clean and stable energy supply
- Healthy and enjoyable living, working, recreational space
- Stable aquifers and dry weather baseflows in streams/rivers
- Social connectedness
- Other community-specific goals

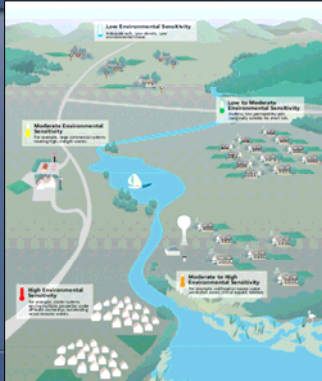


Approaches and principles for sustainable management

- Appropriate management scale
- Appropriate system scales
- Multi-level integration
- Protection and restoration
- Mass balance approach
- Full cost accounting

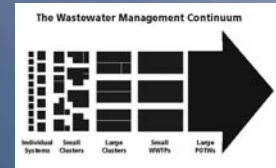
Approaches and principles

- Appropriate management scale
 - Project/site
 - Development/community
 - Municipal
 - Watershed
 - Region/ecosystem
 - State
 - National
 - Global



Approaches and principles

- Appropriate system scales: distributed
 - Onsite
 - Cluster
 - Regional/satellite
 - Central



Approaches and principles

- Multi-level integration
 - Systems
 - Objectives
 - Disciplines
 - Regulatory/programmatic

Approaches and principles

- Protection and Restoration
 - Water quality, air quality
 - Terrestrial/aquatic ecosystems
 - Hydrology
 - Communities

Approaches and principles

- Systems or Mass Balance Approach
 - Across project, across watershed, globally
 - Water, carbon, nutrients, energy
 - Match the resource (e.g., water source) to the use or value
 - Sustainability auditing: water, carbon, ecosystem, community footprints

Approaches and principles

- Full cost accounting
 - Life cycle costing
 - Secondary impacts
 - Avoided costs
 - Natural resource/ecosystem valuation (natural capital and services)

WERF Project DEC3R06



When to Consider Distributed Systems in an Urban and Suburban Context



Objectives

- Identify and analyze appropriate examples of distributed water management systems in traditionally centralized service areas
- Define key attributes of successful and unsuccessful applications of distributed systems
- Develop decision support instruments that help decision-makers and stakeholders determine whether distributed systems are a viable solution in their community

WERF DEC3R06 products

- Database of case studies
- Detailed case study summaries
- Decision-support, planning and implementation tools
- Guidance compendium
- Other targeted communications products

Drivers for and benefits of distributed management

- Infrastructure funding
- Treatment system efficiencies
- Integrated water/watershed management
- Sustainable design/green building

Drivers for and benefits of distributed management

- Infrastructure funding
 - Pay as you go/grow
 - New users pay their way
 - Cost equitability
 - Potential capital contribution by developers as component of building/site costs
 - Favorable full cost life-cycle accounting
 - Emerging service delivery mechanisms, funding approaches, business opportunities

Drivers for and benefits of distributed management

- Treatment system efficiencies
 - Lower energy for collection, treatment
 - Easier retrofits for urban/suburban reuse
 - Security against catastrophic failure
 - Robust collection and treatment technologies
 - Minimal infiltration/exfiltration
 - Energy recovery potential within facilities (thermal, kinetic, biochemical)

Drivers for and benefits of distributed management

- Integrated water/watershed management
 - Facilitates integration of stormwater and wastewater management
 - Address scarcity issues through alternative sources of supply
 - Promotes hydrologic, ecological restoration
 - Can achieve multiple watershed objectives

Drivers for and benefits of distributed management

- Sustainable design/green building
 - LEED points
 - Water reuse/conservation
 - Facility and landscape integration
 - Microclimate energy and comfort benefits
 - Multifunctionality

Example case studies

- Off-grid: Earthship model
- Integrated Decentralized Wastewater: Jordan Lake Business Park
- Managed Onsite (EPA Models 1-4): Rose Run Watershed Project
- Managed Cluster (EPA Models 3-5): Preston Community Cluster
- Integrated WW/SW: The Solaire
- Distributed: Mobile, Alabama (MAWSS)

Off-Grid: Earthship model

- Self-sustaining home
- Requires 10 inches of rain per year
- Water is used several times before put back into ground



- 3 Main Components
 - Water catchment (potable roof, cistern, filter)
 - Grey water treatment and reuse
 - Black water treatment
- Typical Water Path
 - Rainwater collected, filtered, and pumped to sinks, showers, bathtubs
 - Grey water is used and treated in interior botanical cells (greenhouse) for food production and indoor air quality
 - Treated grey water then used for toilet flushing
 - Black water drains to solar heated septic tank and then conventional drain line or exterior botanical cells

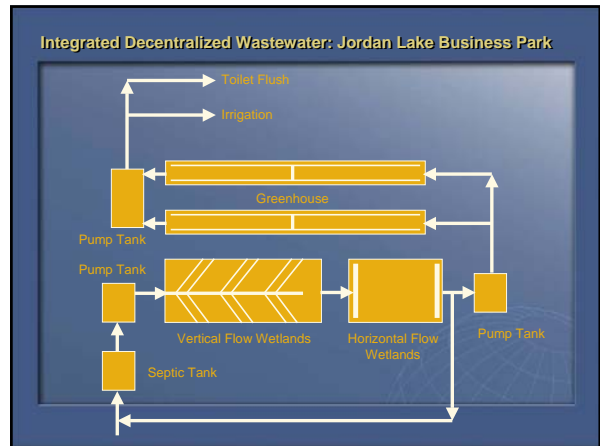
Off-Grid: Earthship model



Integrated Decentralized Wastewater: Jordan Lake Business Park



- Renovation of old dilapidated school into office building
- In Jordan Lake water supply watershed critical area, Apex, NC
- Utilizes vegetated sand filters for treatment which serve as courtyard and interior amenity
- Treated effluent is used to flush toilets and irrigate field and landscape plantings
- Guided tour: <http://oldsite.waterrecycling.com/>
- Additional information: <http://waterrecycling.com/>



Integrated Decentralized Wastewater: Jordan Lake Business Park

	Influent	VF Cell	HF Cell	Greenhouse	% Removal
TSS (mg/l)	46.9	4.7	2.7	0.7	98.5
COD (mg/l)	158	21.8	17.0	6.4	95.9
NH _{3-N} (mg/l as N)	44.8	10.7	2.5	0.1	99.8
TKN (mg/l as N)	56.4	12.5	3.8	0.3	99.6
NO ₃ (mg/l as N)	0.1	12.1	20.4	18.8	—
TN (mg/l as N)	56.5	24.6	24.2	19.1	66.2
TP (mg/l as PO ₄)	8.0	6.0	5.5	4.2	47.5

Courtesy of Drs. Sarah Liehr (NCSU) and C. Halford House (Integrated Water Strategies, Inc.)

Managed Onsite: Rose Run Watershed

- East-Central Kentucky, low income community with clustered and scattered housing
- Community cluster system proposed, but cost-prohibitive (i.e., > \$25k per house, with \$40 per month service charge)
- Selected option: targeted individual system replacement, with small clusters (2-5 homes) as needed
- County sanitation district agreed to serve as management entity
- Funding from CWA Section 319, local contractor support, county HD

Managed Cluster: Preston Community Cluster System (KY)

- Poor soils for conventional septic systems; malfunctioning systems
- Pressure collection, attached growth treatment facility, drip dispersal for 120 homes
- Funding from CWA 319, East KY Power Co, ARC, local HD, others
- High cost per home (~\$20k), with \$35 monthly fee
- Managed by county sanitation district, via subcontractor

Conservation subdivision design

This? Or this?

Illustrations from "A Creative Combination: Merging Alternative Wastewater Treatment with Smart Growth" by Joubert, Loomis, Dow, Gold, Brennan, Jobin, & Flinker, Published by University of Rhode Island, 2005.

Conservation subdivision design



Source: Arendt, *Conservation Design for Subdivisions*

Conservation subdivision design



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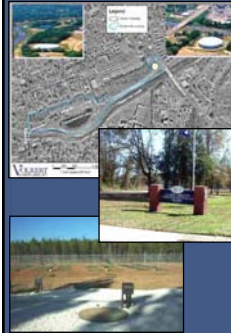
Integrated Decentralized WW/SW: Solaire



- LEED certified, highly urbanized
- Green roof filters and captures stormwater
- Wastewater and stormwater treated for reuse
 - Toilet flushing
 - Cooling tower supply
 - Irrigation of park
- 48% reduction in potable water consumption
- 56% reduction in wastewater discharge

Reference – Battery Park City Authority
 Manhattan Borough, NYC, The Solaire
 – Alliance Environmental, LLC

Distributed: Mobile, AL (MAWSS)



- Service area: 233 mi² includes ~1,300 mi. of gravity sewers, ~200 lift stations, ~120 miles of force main
- MAWSS owns and operates two conventional and five decentralized wastewater facilities
- On-site treatment/dispersal in Tricentennial Park adjacent to Three Mile Creek
 - Demonstrate use of decentralized facilities within centralized infrastructure (partial EPA funding)
 - Wastewater mined from sewer line and treated using one of three different decentralized systems
 - Treated effluent is distributed through subsurface drip irrigation system to nourish the grass and shrubs in the park.

Summary

- Distributed management can include a variety of systems at appropriate scales
- Drivers for implementing distributed approaches are being more acute
- Distributed approaches to water management can yield multiple benefits
- Distributed approaches are increasingly being successfully implemented within traditionally centralized service areas
- WERF DEC3R06 and other projects will continue to provide tools for decision-making and implementation