HIGHLIGHTS *OF*

NEW APPROACHES IN DECENTRALIZED WATER INFRASTRUCTURE

By
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Introduction

Our current water infrastructure is on the path to failure. Many big pipes transporting water to and wastewater away from our cities are old and under capacity. Existing methods of water use and wastewater treatment are wasteful and environmentally disruptive. Ultimately, as climate change exacerbates droughts and storm events, the system is not sustainable.

Decentralized water technologies and designs are the keys to enhancing the performance of the nation's aging centralized water, stormwater, and sewer systems and to assuring adequate water supplies and healthy ecosystems into the future. These technologies will beautify our cities and towns, stimulate our local economies, and improve our health and environment. However, implementing these ideas will require a major change in the way society approaches water systems.

A variety of experts met and developed solutions and strategies to tackle these problems. These Highlights present the key ideas the author developed as a result of the 2005–2007 project. The project report contains complete details and is available on a CD and the website at www.sustainablewaterforum.org.

This Project

The purpose of this project was to explore the institutional issues and tease out various new strategies for jump starting and easing a transition from centralized to decentralized water infrastructure.

Approach

The Coalition for Alternative Wastewater Treatment (CAWT) convened two series of workshops, which included experts in decentralized systems and a broad range of other constituencies, including:

- Researchers
- Engineers
- Architects
- Homebuilders
- Environmental non-government organizations (NGOs)
- Community activists

Advocates and experts from across the country provided case study presentations, wide ranging discussions on policy and markets were held, and recommendations were developed for reform strategies. The author then developed a report synthesizing the insights of the workshops and four White Papers on the topics of financing; institutional challenges and opportunities; education and outreach; and levels of service.

Dates of Workshops

- **March 17–18, 2005—Viable Business Models for Decentralized System Management**
- **November 10, 2005—Science and Technology Needs and Opportunities**
- **December 12, 2005—Funding, Planning and Regulatory Reform**
- **December 13, 2005—Public Awareness and Action**
- **January 19, 2006—Final Synthesis Workshop**

Discussion Topics

The following main topics were discussed during the workshops:

- Various pressures or drivers—as well as impediments—for change in the water infrastructure paradigm
- Key strategies to amplify the pressures for change and to leverage the critical tipping points of cascading effects or crystallizing impacts
- Science and technology development, market restructuring, and public participation
- New ways of thinking about biomimicry

Final Workshop

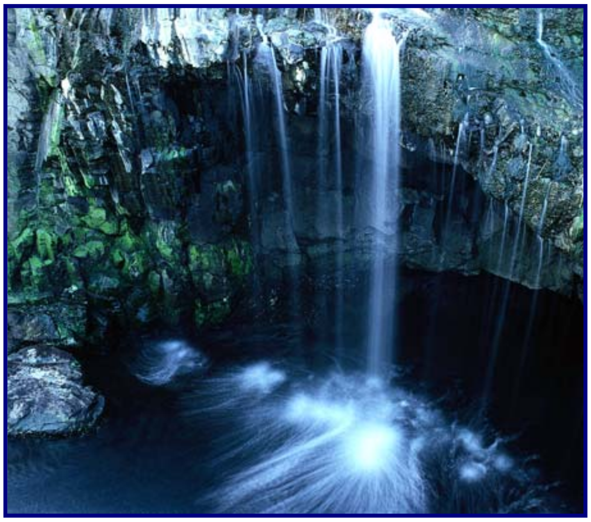
In a final workshop in January 2006, the core group of organizations re-convened to develop an agenda of priority short-term research and development and outreach projects. This list was based on two criteria:

- Areas of effort and activities that will have the greatest short-term impact in advancing the field
- Projects that have a high likelihood of being accomplished

Six Priorities

Participants in the final workshop identified the following six priorities:

- Linkage of the decentralized water field to the **green building** movement and development of similar standards and ratings
- Support for **pilot and demonstration** projects in federal facilities and in local communities
- Support for a **network of local advocates and experts** through education, tools, and capacity-building
- Work with **federal leadership**, or champions, to provide guidance on the benefits of decentralized approaches to federal agencies and to the nation
- Research on **full monetary and non-monetary benefits and costs** of decentralized and centralized approaches and pricing or other mechanisms to better align local decisions with long-run environmental and economic sustainability
- Exploration of how to tie federal subsidies and permits to an **integrated water supply and water quality plan** in a watershed



Three Strategies

The six priorities can be divided into three basic strategies:

- Create spaces for local paradigm models to emerge
- Support conversations, research, and collaborative design
- Build support for major government policy and funding shifts

Big Picture

In the coming years, it will be important for the internal structures of a new paradigm to be more rigorously developed. Moving from a specialized and centralized model of infrastructure to an integrated and localized model means that a host of additional benefits can be achieved for the environment and for society, as well. A systematic search for joint resource efficiencies in water, stormwater, wastewater, and energy has only just begun, and the means and benefits of greening cities and more livable communities are in their early stages. Biomimicry offers lessons for how to harness the creative impulses and energies of new participants as well.

The process of engaging multiple constituencies in solving problems with fresh eyes and in harnessing the motivations of the private sector and civic activists has also just begun. The following table gives a point-for-point comparison of traditional water infrastructure and a decentralized approach.

Traditional	New Sustainable
♦ Rapid conveyance—underground concrete pipes and large treatment plants	♦ Opposite of rapid conveyance—keep a significant portion of the source, use, treatment, and/or disposal at the local level (site or neighborhood)
♦ First goal of public health protection—clean water delivery and wastewater disposal, flood control channels Later—water quality protection in receiving waters	♦ Not just public health and water quality—additional environmental and social pressures for a lighter ecosystem footprint and enhanced community benefits
♦ Industrial model of specialization	♦ Integrate water, wastewater, stormwater in designs, management, planning
♦ Siloed infrastructure, funding, and regulations—water, wastewater, and stormwater independently managed	♦ Multiple uses and reuses (mimic nature)
♦ Economies of scale in treatment costs as the driving rationale—the bigger the better, from financial perspective	♦ True cost pricing—more than just economies of scale—multiple values and internalized environmental costs
♦ Potable water for all uses	♦ Water quality sufficient for the intended use
♦ Community expectations for safe drinking water and protection of lakes, rivers, and beaches	♦ Community tailoring of infrastructure to restore and protect ecosystems, preserve community character and open space, improve quality of life, create jobs, and achieve other local benefits
♦ Public management and oversight of the infrastructure	♦ Private sector also engaged in management, under public oversight
♦ Public infrastructure located in public rights of way	♦ Installations on private, as well as public, property
♦ Federal regulations and funding oriented around centralized delivery and collection and point-source discharges	♦ Federal subsidies and tax incentives allow for decentralized alternatives, and federal regulations are re-oriented around resource efficiencies and reduced discharges

While students of paradigm shifts acknowledge that the process of change is inherently unpredictable, this project suggests several large new strategies for triggering and easing such a shift. In the past, conversations about decentralized systems have been kept on the margins. For a paradigm shift to occur, conversations need to occur amongst diverse groups—academics, entrepreneurs, engineers, activists, public bureaucrats and managers, and the public.

Group	Course of Action
Researchers	Study the imminent water quantity and quality crises the nation will be facing and link those crises to the differential impacts of centralized, decentralized, and hybrid infrastructure alternatives. Dramatically improve the performance of membranes, telemetry, and ecosystem monitoring
Engineers	Develop collaborative design processes that generate creative, multiple benefits solutions
Activists	Question their continuing support for the traditional infrastructure and explore the benefits of decentralized alternatives
Public Bureaucrats and Managers	Take a larger, holistic view of water management and begin to collaborate with the private and non profit sectors in identifying higher-value alternatives
Private Sector	Profit from installing decentralized systems or inventing new technologies while reducing water use and enhancing green space

Integration must be the hallmark of that conversation:

Integration of

- Water quantity and water quality concerns
- Water, stormwater, wastewater, energy and other infrastructure planning
- The trio of decentralized systems at the building and neighborhood scale
- Environmental services with other community benefits, such as job creation and quality of life improvements
- The private sector and civil society into the creation of a more resilient and more productive infrastructure paradigm
- Surface water, groundwater, rainfall, soil moisture, and climate interactions

Any strategy that attempts to leverage the drivers and new ideas in the field must also consider a process for breaking down the impediments to change in the paradigm. Large structures of government at all levels were built around siloed, single-purpose infrastructure. Within this framework, the interrelated water challenges and the potential benefits of decentralized systems are neither recognized nor permitted and funded. The system is also highly risk-averse and minimizes incentives for private sector engagement. Broad groups of stakeholders have supported this traditional infrastructure model, in general looking to more funding and enforcement as the mechanisms for water quality improvements.

Drivers for Decentralization

- Water crises and other new societal demands on the infrastructure
  - Droughts and water supply shortages
  - Water quality and habitat degradation
  - Climate change and resilience
  - Aging infrastructure costs—repairs and expansion
  - Alternatives to sprawl development (promoted by sewers and large-lot septic systems)
  - Quality of life in urban and rural communities—pervasive gray infrastructure
- New ideas and design concepts—natural, social, economic systems
- Niche innovations by advocates and entrepreneurs

Institutional Challenges and Impediments to Decentralization

- Government policies, funding, regulations built around centralized infrastructure
- Classic market failures–fragmentation, no information
- Distorted pricing of water
- Balkanization of agencies
- Municipal authority and a limited role for private sector
- Civil society support for conventional infrastructure
- Pervasive risk aversion and minimal research funding
- Lack of local models that combine technology, management, financing, and customer acceptance
- Continued segregation (siloing) of advocates, entrepreneurs, and professionals into the three separate spheres of water supply, stormwater, and wastewater

Another concern, therefore, is timing. In a Catch-22 situation, the large structures of government block the consideration and use of decentralized systems. With few openings for innovation, the field is held back into scattered, expensive, and siloed examples, with minimal incentives for technology development and institutional reform. With so few examples and so little documentation of the decentralized potential, there is no capability of mounting the arguments and constituencies for a fundamental change in government policies and practices.

In the short-term, then, workshop participants argued for as much innovation as possible at the local level. Over time, as knowledge and experience grows with the new paradigm, a concerted effort can be mounted to reform government, both in restoring federal research funding, and in restructuring federal research funding and regulatory approaches to support integrated planning and design, private sector engagement, multiple community benefits, and continuous innovation.

Promising opportunities for testing innovative designs are in Green Building projects, where a variety of new technologies can be embedded in new construction and infill developments. Other targets for experimentation are in parts of the country where stresses on water quantity or quality have already created a perception of crisis in the public, and there is a greater willingness to try something new.

Potential Hybrid (Decentralized and Centralized) Infrastructure of the Future

A birds-eye view of the future infrastructure in cities would be substantially greener. Rain gardens and trees would be used to retain stormwater. Streams and habitat would have been restored by reducing the groundwater flows into sewers, minimizing stormwater runoff into streams, and by reducing the overall demand for potable water.

The actual infrastructure would be a combination of enhanced performance of the aging centralized infrastructure and multiple decentralized installations across the city. Water-efficient appliances might be found in scattered homes or buildings across the city, while integrated water/stormwater/wastewater/reuse systems might be found in urban infill developments designed around the specific challenges and opportunities of the site.

A trio of decentralized technologies and designs would be used to reduce the flows of water in the aging water lines by stressing efficiencies and reuse of stormwater and wastewater and to reduce the flows of stormwater and wastewater in the drainage and sewer systems as well.

A birds-eye view of rural and suburban areas would be of continued reliance on onsite and cluster water, stormwater, and wastewater systems. Water-centric subdivision planning, in particular, would push toward "off-the-grid" efficiencies and a minimal impact on natural water flows and hydrologies in the watershed.

Both the urban and greenfield infrastructure would be integrated with energy and nutrient recovery from the wastewater. The following table outlines patterns of decentralization.

Pattern	Description
Onsite and Neighborhood Use and Reuse	Closed-loop water systems in residential and commercial buildings, where water is used efficiently and where stormwater and wastewater are treated and reused for landscape irrigation, toilet flushing and cooling
Green Infrastructure	Rain gardens that trap stormwater and sustain trees and plants. These plants restore beauty and improve air quality, moderate energy flows, and provide potential food sources
Smart Growth	Patterns of neighborhood development that interconnect nature and the built environment, preserve open space, and respect natural drainage flows
Green Cities	Restoration of natural cycles of water infiltration and evaporation in cities and towns through localized treatment and groundwater recharge, trees, parks, and roof gardens, and stream daylighting and restoration
Watershed Restoration	Restoration of natural watershed flows and functions through localized water use and recycling into natural wetlands, groundwater, and air. These systems will restore and preserve habitat and wildlife
Climate Moderation	Slowing of global warming through rehydration of soils and vegetation that absorb heat and increase water vapor in the atmosphere

Trio of Decentralized Technologies and Designs

The trio of decentralized technologies that can reduce dependence on large-pipe approaches involves the following three concepts:

Concept	Idea	Collaboration
Water Efficiency and Conservation	Water-efficient appliances and conservation practices reduce the demand for new water supplies, particularly in arid regions of the country. Like similar energy-efficiency programs, the new appliances and landscaping have often been of higher quality and design for the customer, as well	The EPA has established a program to advance labeling and standards, called Water Sense One of the EPA's "Four Pillars for a Sustainable Infrastructure" is to help municipal utilities advance water-efficiency in their systems
Stormwater Retention and Reuse	Water quality protection can be enhanced by reducing the impact of new development in rural and suburban areas and by reducing stormwater overflows and runoff in urban areas with combined sewers	The EPA has established a green infrastructure program in collaboration with municipal utilities and environmental organizations The EPA has funded Sustainable Cities, a partnership of landscape architects and other non-governmental organization (NGOs)
Decentralized Wastewater Treatment, Reuse, and Resource Recovery	Small-scale technologies that mimic natural membranes and filters and that utilize soils and smart localized controls can lower costs of wastewater treatment, replenish aquifers, and avoid sewer-induced sprawl New ideas have included energy and nutrient recovery from wastewater and the use of decentralized wastewater treatment in urban redevelopment projects, such as the Solaire building in Manhattan	The EPA has a decentralized wastewater program, which has produced technical guidance documents and promoted the concept of system management by utilities and others The National Onsite Wastewater Recycling Association (NOWRA), as a collaborative of manufacturers, academics, and regulators, has been the primary advocate for decentralized systems in unsewered areas

Benefits of Decentralized Systems

The following is a list of just some of the benefits of decentralized systems:

- ♦ Sustainability
- ♦ Beautification
- ♦ Restored streamflows and habitats
- ♦ Stimulus for new green companies and jobs
- ♦ Recovered energy and nutrients
- ♦ Improved air quality
- ♦ Saved money
- ♦ Enhanced performance of existing infrastructure

Biomimicry—Designs to Work With and Mimic Nature

Biomimicry offers useful lessons on how a more sustainable infrastructure can be created, both in lightening the environmental footprint and in creating a higher quality of life in communities. Until now, our centralized big-pipe infrastructure has relied on a brittle industrial model of specialization and economies of scale. Nature can offer many lessons for how to create more value and resilience in an integrated and localized infrastructure.

Nature

- ♦ Fits form to function
- ♦ Recycles everything
- ♦ Rewards cooperation
- ♦ Banks on diversity
- ♦ Demands local expertise
- ♦ Creates beauty and abundance and no waste
- ♦ Uses only the energy it needs
- ♦ Taps the power of limits
- ♦ Rebuilds from disturbances
- ♦ Can collapse from extreme stress

Localized and integrated capture, use, treatment, and reuse of water would mimic how nature itself uses water. Nature moves water and minerals through large cycles of cloud formation, rivers, and groundwater flows, but it also uses, stores, reuses, and cleans water at the local level to support complex and abundant webs of life.

Mimicking complex interdependencies of species in nature applies to the way that society can restructure its decisions and actions in water, as well. By expanding the participation of the private sector, community organizations, and the public, a significantly richer set of alternatives emerge. Conversations among diverse groups typically lead to much more creative and productive solutions than leaving the issues to a specialized profession.

In nature, individual species survive by “opportunistically” finding a niche in the changing web of life. Similarly, participants in a biomimicry model of infrastructure would find ways to take value from the model and simultaneously create value for other participants. For example, the private sector can make money from installing green roofs, inventing new membranes, or building green subdivisions, while helping to reduce runoff and rehabilitate neighborhoods as they do so.

Market Transformations

Market transformation occurs when the public sector, the non-profit sector, and the private sector are in alignment that change is needed. This process needs to be based on understanding and leveraging the interests and behaviors of stakeholders, including builders, manufacturers, engineering and architectural firms, environmental non-profits, and municipal, state, and federal agencies.

Much innovation occurs by working with early adopter customers and communities that see added value in new approaches. Disruptive technologies are usually introduced by entrepreneurs outside of the established field.

Over time, a variety of values and behaviors among people, organizations and markets can be merged into an effective new paradigm. The following table describes the diverse stakeholder worldviews:

Color	Cultural Synergies	Social Marketing
Purple	Concern with family security and health	Target their concern for protecting air quality for their children
Red	Values of personal expression, individuality, "beating the system"	Target their desire for self-reliance (off the grid), unique use of straw bale construction
Blue	Traditional values of law and order, "Doing the right thing"	Market energy efficiency as saving money, good for society
Orange	Achievement goals for status and affluence	Green building for greater profits, real estate appreciation, status
Green	Concerns for equality, community, consensus decisionmaking	Market products to further environmental goals
Yellow	Global concerns, balancing of ecosystems and human development	Appeal to planetary health and the future, transcend the ordinary through holistic solutions

If new markets and alliances can break down the institutional impediments to change, a long process of trial and error will eventually clarify the optimal patterns and scaling of the new infrastructure. Some elements of centralized piping or treatment may be retained in the future, but the internal logic of design will drive more and more of the system to a decentralized approach.

Decentralized approaches will emerge as preferable when more and more functions are required of the infrastructure. For example, it costs less to use and reuse water at the local site than to pipe water in, wastewater out, and treated water back in for reuse. In addition, many of the new values being discovered from decentralization, such as green space, are by definition localized and dispersed throughout the community.

Four White Papers

Four White Papers focus on key areas in the development of more sustainable wastewater structures:

- Institutional Challenges and Opportunities
- New Federal Financing Directions
- Public Education and Outreach Strategies
- Sustainable Infrastructure Management

Institutional Challenges and Opportunities

Advocates of decentralized systems have argued that small-scale, integrated technologies work and are more sustainable in the environment. The failure of mainstream institutions to adopt these technologies is increasingly attributed to institutional and market barriers. The framework of institutions needs to be altered and expanded in the following key respects if decentralized and closed-loop systems are to be adopted over time:

- **Integrated water resource management**—management and regulations need to be integrated across the water chain. Much of the demand for closed-loop reuse of treated effluent, for example, will stem from reducing demand for new water supplies and the avoided cost of loadings to wastewater conveyance and treatment
- **Enhanced role of the private sector**—since most decentralized systems are on private property, the role for the private sector can be much enhanced. Private property owners generally prefer to choose a private contractor to construct and manage their system, rather than a public utility. So, the market model for decentralized systems will likely involve:
  - Myriad small companies or utilities regulated by public authorities
  - Greater involvement of homebuilders and developers in adopting new approaches
  - Leadership from Cleantech investors and companies
- **Multiple community benefits and stakeholders**—many of the benefits of decentralized systems are outside the water field:
  - Creation of parks and green space
  - Regeneration of neighborhoods and local jobs
  - Restoration of habitat and healthy ecosystems
  - Recapture of energy and nutrients from wastewater Engineers and communities need to develop systems engineering approaches to triple bottom line planning, capital budgeting needs to be integrated across all municipal infrastructures, and multiple constituencies need to be involved in decisions

- **Continuous innovation**—as in all transitions to a new paradigm, the precise technologies and applications are still evolving and often higher in price than they can eventually be. All parties need to incorporate greater experimentation and innovation in their practice, including:
  - Government funding of demonstration projects
  - Municipal funding of pilot programs as part of responsible asset management
  - Early adoption by green customers of technologies that are new and more expensive

- **Streamlined institutional tools**—new, robust models need to be developed, where a package of installation, maintenance, financing, regulatory oversight, and customer acceptance have been shown to work for a given technology. For example:
  - Green roofs can be installed, managed, and financed by the private developer, and the municipality can provide financial incentives, social marketing, and oversight inspections.
  - Cluster wastewater systems can be managed by private utilities.
  - Water-efficiency appliances can be sold directly to homeowners, developed, and marketed by large corporations.

These demonstrated packages then need to be broadly disseminated in the field

New Federal Financing Directions

Federal financing programs were designed to support the conventional centralized infrastructure of long-distance water, stormwater, sewer lines, and large treatment plants. For the potential of decentralized systems to be realized in the United States, these programs need to be altered in four fundamental ways:

- **Research and development**—restore research and development and demonstration project funding in water resource infrastructure
- **Integrated planning**—require integrated water supply and water quality management plans as conditions for all federal water project subsidies
- **Triple bottom line financing**—require environmental, social, and economic benefits and costs, as well as embodied life-cycle costs, to be assessed for design alternatives
- **Subsidized private installations**—support the installation of decentralized systems on private property by expanding eligibilities in the public infrastructure pools of funding, as well as in tax and other incentives for property owners

Public Education and Outreach Strategies

The EPA's education and outreach strategies, which have focused on the education of homeowners, should be redirected to include:

- **Searching for values**—explore the multiple benefits of an integrated water resource infrastructure paradigm, enhancing the value proposition
- **Early adopters**—focus on early adopters and champions rather than the general public and mainstream institutions
- **Mediating stakeholders**—work more with mediating institutions, including NGOs and other non-traditional businesses and professions, including environmental and community groups, architects, builders, and others outside the mainstream water field
- **Private property**—respect the public's attitudes about their private property and personal choices and revise management recommendations to reflect those values
- **Non-regulatory approaches**—develop non-regulatory approaches, such as social marketing and incentives

Sustainable Infrastructure Management

The EPA developed the Four Pillars of Sustainability to enhance the efficiency and effectiveness of water infrastructure management. These Pillars should be expanded in the following ways:

- **Pillar 1: Better Management**—managers should be responding more creatively to long-run challenges of environmental sustainability and to the opportunities for increasing community benefits. Managers should also be incorporating innovative institutions and tools, such as leveraging the role of the private sector in system management and green building, and collaborating with multiple agencies and stakeholders
- **Pillar 2: Full Cost Pricing**—the EPA should promote true cost pricing, which goes beyond covering the costs of the infrastructure and includes long-term environmental and community externalities, such as energy savings, green space, and green job creation
- **Pillar 3: Water Efficiency**—this labeling and marketing program should be expanded to include decentralized stormwater and wastewater reuse systems
- **Pillar 4: Watershed Approach**—this largely water quality-oriented program should be expanded greatly to provide models for municipal water, stormwater, and wastewater utilities to work jointly on integrated water and other resource goals and management

These changes, in their overall impact, can begin to redirect the program from one that locks in the traditionally built infrastructure to one that helps utilities move over time to a more sustainable approach.

Workshop Participants

The following is a list of workshops and presenters.

- **March 17–18, 2005—Viable Business Models for Decentralized System Management**
  - Valerie Nelson, Distributed Water Resource Management: *Provider Models, Services, and Markets*
  - Jerry Stonebridge, Stonebridge Environmental Inc.: *Model for Onsite Systems*
  - Tim Bannister, TCW Wastewater Management: *Model for Onsite Systems*
  - Ed Clerico, Applied Water Management: *A Decentralized Public Utility Going Beyond Individual Septic Systems*
  - Kevin White, University of South Alabama Department of Civil Engineering: *Neighborhood (Cluster) Wastewater Management in Mobile, AL*
  - Steve Moddemeyer, Seattle Public Utilities: *Distributed Water Resource Management: Rainwater Harvest and CSO Control in Seattle*
  - Andy Lipkis, TreePeople: *The Case for Integrated Urban Watershed Management, Los Angeles*
- **November 10, 2005—Science and Technology Needs and Opportunities**
  - Julian Sandino, CH2MHill: *Changing Infrastructure Paradigms: An International Perspective*
  - Robert Siegrist, Colorado School of Mines: *Current Research Efforts and Potential New Directions*
  - Mary Hansel, Carollo Engineers: *Biomimicry—Learning from Nature's Consummate Engineers*
  - Keith Carns, EPRI Community Environmental Center: *Current Research Efforts and Potential New Directions*
  - Mike Luzier, National Association of Home Builders Research Institute: *Market Transformation Strategies*
- **December 12, 2005—Funding, Planning and Regulatory Reform**
  - Peter Shelley, Conservation Law Foundation, Boston, Massachusetts Water Initiative: *Water Quality and Supply in Massachusetts*
  - Andy Lipkis, TreePeople Center for Community Forestry, Los Angeles
  - Jim Stebbins, Project Design Consultants, San Diego: *Building Blocks of Sustainable Development*
  - Kyle Dreyfus-Wells, Chagrin River Watershed Partners, Ohio: *Implementing Low Impact Development in the Chagrin Watershed*
  - Craig Lindell, Aquapoint, Inc, Massachusetts: *Distributed Sewer: The Demand Side*

- **December 13, 2005—Public Awareness and Action**
  - Harry Wiland, Eden's Lost and Found Filmmaker, California: *Grassroots Change*
  - Brent Haglund, Sand County Foundation, Wisconsin: *Promoting Environmental Stewardship*
  - Ken Jones, Green Mountain Institute, Vermont: *Success in Small Communities and Rural Areas*
  - Nancy Lee, Social Marketing Services, Inc., Washington: *Social Marketing and Sustainable Development*
  - David Johnston, What's Working, Colorado: *Engaging Diverse Culture in a Common Project*
- **January 19, 2006—Final Synthesis Workshop**
  - Core group of organizations re-convened. One of the objectives was to develop an agenda of priority short-term research and development, institutional reform, and outreach projects

Stakeholders

Stakeholders who participated in one or more workshops included:

- John Berdes, Shore Bank Enterprise
- Matt Byers and Linda Bonner, National Onsite Wastewater Recycling Association (NOWRA)
- Bill Cagle, Orenco Systems
- Todd Danielson, Loudoun County Sanitation Authority
- Glendon Deal, US Department of Agriculture
- Mark DeKay, University of Tennessee
- Scott Drake, East Kentucky Power Coop
- Alex Duran, National Association of Homebuilders Research Center
- Alex Echols, Conrod Communications
- Ray Ehrhard, EPRI Community Environmental Center
- Steve Ellis and Autumn Hanna, Taxpayers for Common Sense
- Doug Fogel, Butte County Public health
- Sheila Frace, US EPA Office of Water
- Rod Frederick, EPA
- Drew Gangnes, Magnuson Klemenich Associates
- Ron Gold, Mason County Public Utility District (PUD)
- Robert Goldstein, EPRI
- Robert Goo, EPA
- Jim Graydon, Kennedy/Jenks Consultants
- Terry Hull, Puget Sound Action Team
- Scott Johnstone, Stone Environmental
- Chris Kloss, Low Impact Development Center
- Jim Kreissl, Environmental Consultant
- Karen Mancl, The Ohio State University
- Tracy Mehan, Cadmus Group
- Phil Miller, Elsinore Valley MWD
- Tracy Moir-McClean, University of Tennessee
- Phyllis Murdock, Butte County Public Health
- John Murphy, EPRI Community Environmental Center
- Howard Neukrug, Philadelphia Office of Water
- Betsy Otto, American Rivers
- Ron Pate, Sandia National Laboratory
- Glenn Patterson, US Geological Service
- Rick Phalunas, National Environmental Services Center
- Richard Pinkham, Booz Allen Hamilton
- Greg Powell, Commonwealth Wastewater Systems
- Sushama Pradhan, North Carolina State University
- Karl Rabago, Houston Advanced Research Center
- Paul Schwartz, Clean Water Action
- Vance Severin, Butte County Environmental Health
- Frank Shephard, Woods Hole Data Base, Inc.
- Nancy Stoner, Natural Resources Defense Council (NRDC)
- Heather Whitlow, Casey Trees
- Richard Wright, American Society of Civil Engineers

Coalition for Alternative Wastewater Treatment (CAWT)

The CAWT is a national alliance of advocates for and experts in decentralized wastewater treatment and management, and is directed by Dr. Valerie I. Nelson. Formed in 1994, the CAWT has focused on analysis of federal, state, and local policies and funding, and on developing innovative approaches in regulations, markets, planning, and community participation.

This Report was written by Valerie I. Nelson and does not necessarily represent the views of individuals and organizations that participated in workshops and other discussions and reviews.

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