The National Community Decentralized Wastewater Demonstration Project Value Summary

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September 2005

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Overview

In 1999, the United States Congress began funding a National Community Decentralized Wastewater Demonstration Project, with 21 sites designated around the country so far. Until recently, the onsite wastewater field has operated under a house-by-house prescriptive sanitary code paradigm for septic systems. Management of these systems has been left to the homeowner. The central challenge of the demonstration projects has been to develop the tools to shift to a more complex paradigm including:

- Community-wide planning for use of advanced technologies and cluster systems designed under performance codes
- Centralized professional management of distributed systems
- Protection of water quality and the environment
- Public health

Over time, the Project has been expanded into a broader integrated water resources context, including distributed storm water management and low impact development practices. The Project has supported the exploration of innovative management techniques, such as asset management, self-help approaches, utility models, and others. This paper draws preliminary lessons from an informal survey of and site visits to the earliest sites designated by Congress.

Demonstration Projects Are Vital to Advancement of Decentralized Wastewater Technology and Management

The value of these projects is evident in:

- Technology demonstrations as a means to achieve acceptance from regulators of new equipment and designs for advanced treatment, cluster systems, etc.
- Exploration and development of groundbreaking methods of planning and management, water quality assessment, public outreach, training, regulation, and financing
- Complementary high-quality research emerging from the demonstration projects in related questions such as creative community design and fate and transport modeling

A Paradigm Shift to Decentralized Wastewater Management in the Demonstration Projects Is Multi-Faceted and Time-Consuming, and Federal Funding Is Essential to Cover These Costs

A shift to decentralized wastewater management requires adoption of new regulations and ordinances, creation of public or private management structures, development of new facilities, planning, and community development structures, establishment of standards and rules of technologies and management, training of practitioners, development of revenue streams, and financial assistance to homeowners.

Without federal assistance, these communities are unlikely to have prevailed in trying to institute lower-cost approaches that were heretofore untried in their states and counties.

Preferences of the Public Need to Be Better Understood

If decentralized wastewater management is to expand as a viable permanent solution in the US, then concerns of the public must be better understood and the means to draw them early on into the decision-making process must be adopted.

Demonstration projects have identified preferences and values of the public, including:

- Need for a demonstrated link between decentralized wastewater management and a water quality problem, such as drinking water protection or lake cleanup
- Concern for protection of private property rights and consumer choices
- Desires to minimize costs and help low-income homeowners
- Concerns about impacts on growth and development

Continued work in identifying concerns of the public and development of community decision-making tools and processes is needed.

Professional Re-Training and Higher Compensation for Decentralized Water Resource Managers Are Essential

Management of decentralized water and wastewater infrastructure requires an unusual blend of public outreach, planning, engineering, environmental science, financial, and managerial skills. Yet salaries are low and educational programs are not in place. Communities should recognize the high level of professional skills required for managerial positions, and compensate staff accordingly. Multi-disciplinary education and training programs also need to be developed.

Additional Research and Documentation Should Be Conducted on All Aspects of the Demonstration Projects

Background

In the spring of 1997, the United States Environmental Protection Agency (US EPA) responded to a request from Congress to assess the benefits, costs, and applicability of decentralized wastewater technology and management as a means to address the nation's water quality problems. In a landmark report, "Response to Congress on Use of Decentralized Wastewater Treatment Systems" (US EPA 1997), US EPA wrote that "Adequately managed decentralized wastewater systems are a cost-effective and long-term option for meeting public health and water quality goals, particularly in less densely populated areas." This endorsement by US EPA became a significant turning point in thinking in the US—from the concept that onsite septic systems are primarily about public health or "sanitation" concerns for the individual family, to a concept of using a suite of conventional and advanced onsite treatment units and cluster systems to solve a broad array of water quality problems in a community or watershed context. Instead of thinking of septic systems as only a temporary solution to be replaced eventually by sewers, decentralized systems could become a viable long-term or "permanent" solution to protect both environmental water quality and public health.

The US federal government has not set national standards or requirements for decentralized wastewater codes or practices, but rather leaves these regulations to the individual states or counties. However, the US EPA "Response to Congress" set the stage for a number of initiatives at the federal level to support advancements in the field and to provide guidance to state and local officials and experts throughout the country. Recent US EPA projects have included the updating of an onsite system design manual (US EPA 2002) and the development of voluntary management guidelines (US EPA 2003a). New EPA guidance describes various levels of centralized management which would be responsive to increasing levels of risk, ranging from simple programs of public education of homeowners on how to maintain their systems, to requiring periodic inspections of systems to full utility ownership and maintenance of all systems (US EPA 2003b). A new research and development program, the National Decentralized Water Resources Capacity Development Project (NDWRCDP), was also initiated by Congress in 1996 and is funded through the US EPA budget (http://www.ndwrcdp.org/). A more recent initiative by Congress has been to encourage the states to direct federally-seeded State Revolving Loan Fund grants and loans to decentralized and nonstructural approaches.

Congressional Intent for Demonstration Projects

In 1999, the US Congress began funding a National Community Decentralized Wastewater Demonstration Project, with 21 sites designated at funding levels ranging from $700,000 to $5.5 million. These demonstration projects are intended to "jump start" technology transfer of improved methods and approaches, and have been selected to provide a diversity of climate, soils, and ecosystems, as well as a focus of each one on a different challenge or aspect of innovative technology and management. To be eligible, each project has also been required to involve appropriate state and county regulatory agencies and to assure the participation of training centers, universities, or other experts.

The projects have been designed, in part, to serve several generally-accepted purposes for government-funded “technology” demonstration projects in “infant industries” in the US, including (Porter 1980; Shapiro and Varian 1999):

- Absorbing financial risks of using new technologies
- Creating a critical mass in the market for new technologies
- Demonstrating product and service innovations
- Helping set proper standards

The rationale and need for demonstration projects in the decentralized wastewater field was developed in a Massachusetts ad hoc Task Force for Wastewater Management report (Nelson 1999) and in a decentralized wastewater market “scoping” study (Nelson, Dix, and Shephard 2000).

A key feature of the demonstration projects has been the installation of innovative onsite and cluster system technologies and designs. Most are not yet widely permitted across the US. The project in Rhode Island, for example, has installed and monitored 25 advanced onsite treatment units. The project in Oregon has installed and monitored 49 systems of 17 different types, including several imported from Europe. Research papers presenting performance monitoring and cost data from the projects are just starting to appear in National Onsite Wastewater Recycling Association and other professional conferences and proceedings (Rich *et al.* 2003, Clark *et al.* 2002). Lessons from these technology installations will not be discussed in this report.

However, the objectives of the demonstration projects have extended far beyond just the technology. Federal funds are also to be used for the development of planning methods, creation of management and maintenance programs, and monitoring and evaluating the cumulative water quality impacts of the projects. This broader concept of a “community demonstration project” reflected a growing understanding in the US that new and more complex technologies could not be widely put to use in the US without a parallel and multi-faceted approach to planning and management. In particular, management of advanced treatment units in sensitive resource areas could not be left to the individual homeowner, but would rather require professional oversight and operation and maintenance. Additional elements in the demonstration project include:

- Identification of environmentally critical resource areas
- Risk-management methods of targeting advanced treatment standards in those “hot spots”
- Stakeholder and community participation in integrated wastewater and land-use planning
- Long-term monitoring programs
- New regulatory structures that support innovation and accountability at the community level

As a result of these multiple purposes in the federal legislation, the community demonstration projects have been functioning as centers of important research and development activities, not just demonstration of existing techniques. The demonstration project team in Rhode Island, for example, has produced guidance materials on GIS methods for decentralized wastewater management and on creative community design and wastewater management (Joubert *et al.* 2003; Joubert *et al.* 2004). The Oregon project has leveraged USGS work on fate and transport modeling of septic system contributions to groundwater contamination. Other examples are the recent Maryland and North Carolina projects, which will be researching and developing integrated water resource designs.

In a wide variety of areas, the demonstration projects have been developing and "pilot testing" new approaches, and passing lessons learned along to neighboring towns, states, and the country at large. While formal evaluations have not yet been conducted on even the earlier projects dating back to 1999, nevertheless, there are some emerging insights on the needs for and solutions provided by decentralized wastewater approaches that are proving to be instructive for the broader field. These conclusions are drawn from an informal survey by the author of "Lessons Learned" by the early demonstration project leadership and from several site visits conducted by NDWRCDP Steering Committee members. A more formal summary of lessons will be available following a workshop of community demonstration project leadership to be convened by the NDWRCDP in July of 2004.

Evolving Program: Integrated Water Resource Management

Since initiation of the National Community Decentralized Wastewater Demonstration Project in 1999, the focus has broadened beyond decentralized wastewater systems to include storm water technologies and other land development techniques. This expansion has been reflective of a growing understanding that water resource planning should simultaneously include consideration of the broad range of pollutant sources in any ecosystem. Decentralized or distributed storm water technologies planning and management also share a number of common elements with decentralized wastewater approaches, including the need for new centralized management structures for widely-dispersed systems on private property, development of new financing mechanisms, and regulatory reform. On any given homeowner lot or neighborhood cluster system field, there are also multiple benefits to integrating the water, wastewater, storm water, and landscape designs and technologies. Guidance on expanding the scope of the demonstration projects came from a February 2002 workshop of national leaders convened to discuss the potential for "soft path integrated wastewater management" (Nelson and Serjak 2002).

A guiding principle for both the earlier decentralized wastewater projects and the more recent storm water or "soft path" projects has been the need to elevate the state of planning, management, and design in the soft path sector so as to become a co-equal with conventional, centralized approaches, or "hard path" solutions. In practice, this has meant that the demonstration projects must develop adequate responses to the emerging water quality challenges in the US. These responses should also allow for an easy blending of centralized and decentralized systems in a community. For example, in order to be adopted by traditional water and sewer authorities as "permanent" and not just "temporary" solutions, decentralized methods must be equally reliable and must have shown that they can provide clean water protection.

The emerging problems for water quality protection in the US include concerns about drought and reduced water supplies, land-use development patterns that contribute to runoff and falling groundwater levels, nutrient contamination of coastal estuaries, phosphorus contamination of inland lakes, beach closings and fish advisories, combined sewer overflows, and a large gap in funding for urban water and sewer systems. A wide variety of new regulations and approaches to addressing these problems is being developed, including:

- Watershed planning and "fate and transport" models
- A means to allocate point and non-point source contributions called Total Maximum Daily Load (TMDL) analysis
- Pollutant trading concepts
- Development of nutrient criteria for different types of water bodies
- New storm water regulations for small communities
- Adoption of asset management techniques that have been developed in Australia and New Zealand, in particular

Communities selected for demonstration project funding are attempting to solve one or more of these emerging problems and/or to develop tools for centralized and decentralized approaches to blend into the larger thrust of water quality policy and practice, such as TMDL's.

Examples of these efforts include:

- The Mud River, West Virginia demonstration project will be focused on how identification of straight pipes and other failing onsite systems can be addressed in a "Total Maximum Daily Load" (TMDL) context for a stream corridor

- The La Pine, Oregon project has focused a part of its project on the development of sophisticated fate and transport models for tracing nitrogen plumes from septic systems into a sole source aquifer in a high-desert region

- The Block Island/Green Hill Pond, Rhode Island project has used a simpler land-use model to identify sensitive resource areas, such as coastal ponds and estuaries and wellhead protection areas, to facilitate the establishment of "zones" in which targeted inspections and advanced treatment levels are required

- The Table Rock Lake, Missouri and the Mud River, West Virginia projects are developing and utilizing "source-typing" methodologies for fecal coliform and bacterial sources, as well as phosphorus sources so that the precise contributions of septic systems can be distinguished from agricultural and wildlife sources

- The Block Island/Green Hill Pond, Rhode Island project has developed means to use Geographical Information System (GIS) methods to incorporate various data sources onto maps, in order to facilitate watershed planning

- The Upper Patuxent River Watershed, Maryland project will examine the relationship of drought and water supply issues to wastewater, storm water, and land-use technologies and practices

Innovative Management Approaches and Tools for Decentralized Wastewater Systems

The Community Demonstration projects have become major sites for the development of innovative management approaches for decentralized wastewater and storm water solutions. While the US EPA is promoting the development of management institutions to take over operation and maintenance (O&M) from the homeowner, few models have existed in this regard. Demonstration projects are developing the assessment and planning methods, local ordinances, O&M programs, training programs for local contractors and installers, and extensive public decision-making processes that are needed for all programs to succeed.

In addition, innovative approaches being developed in the demonstration projects include:

- The Seattle, Washington demonstration project will develop asset management approaches for decentralized systems. The demonstration project will develop an innovative business case analysis that evaluates the full life-cycle cost of the distributed approach for storm water and wastewater versus traditional centralized approaches. Use of asset management will help quantify and improve system performance over time, as close monitoring of essential program elements will reveal the effectiveness of capital investments and the level of operations and maintenance costs.

- The Colonias, Texas project is aimed at lowering costs of decentralized wastewater approaches by involving low-income residents in a “self-help” program. Residents will participate in all phases of construction and management of cluster systems, including construction of low-pressure pipe drain fields, constructed wetlands, re-circulating sand filtration and reuse opportunities such as drip irrigation for crops and habitat restoration.

- The Mobile, Alabama demonstration project is exploring the value of satellite treatment plants diverting sewage out of existing sewer lines to reduce flows to the central wastewater plant and to provide services to new developments outside the sewered area.

- The Table Rock Lake, Missouri and Lowndes County, Alabama projects will be developing "rural utility" models for decentralized wastewater management. Each site will be assessing the applicability of US EPA's new management guidelines, in particular for either Level 4 management, which involves utility oversight and maintenance of privately-owned decentralized systems or for Level 5 management, in which the utility actually owns the wastewater systems on private property.

- Many of the demonstration projects have been installing remote monitoring equipment on individual onsite and cluster systems, to allow for continuous monitoring of pump cycles, etc. These telemetry systems will allow regulators to have more confidence in the performance of advanced treatment units, and may allow for cost-savings on maintenance.

Sites for the National Community Decentralized Wastewater Demonstration Project

Descriptions of the demonstration project sites are included in Appendix A. The list of demonstration project sites, their unique focus, and contact for further information are:

- 1999
  - La Pine, Oregon (protection of a sole source aquifer from nitrogen contamination, high-desert climate, monitor and model groundwater quality); Barbara Rich, mailto:barbarar@co.deschutes.or
  - Block Island/Green Hill Pond, Rhode Island (protection of coastal estuaries from pathogen and nutrient contamination, develop watershed-based treatment standards); Lorraine Joubert, mailto:ljoubert@uri.edu
  - Warren, Vermont (village community in mountainous terrain); Kim Crosby, mailto:warrenadmin@madriver.com

- 2000
  - Skaneateles Lake, New York (protection of drinking water reservoir/lake for the City of Syracuse); Eric Murdock, mailto:eemwater@twcny.rr.com
  - Monroe County, Florida (decentralized approaches for the Florida Keys and coral reef protection); still under development
  - Mobile, Alabama (cluster systems in an urban context, reuse in park); David McGough, mailto:dmcgough@mawss.com

- 2002
  - Table Rock Lake, Missouri (phosphorus contamination in lake, development of utility management); David Casaletto, mailto:trlwq@interlinc.net

- 2003
  - Colonias, Texas ("self-help" approaches to reduce costs for low-income residents); Eric Ellman, mailto:eellman@rgv.rr.com
  - Mud River Watershed, Lincoln County, West Virginia (Total Maximum Daily Load framework for targeting "hot spots" and source typing methods); Patricia Miller, mailto:pmiller2@wvu.edu

- Upper Patuxent River Watershed, Maryland (groundwater recharge and protection of water supplies and Chesapeake Bay watershed); Larry Coffman, mailto:lscoffman@co.pg.md.us
- West Philadelphia, Pennsylvania (urban storm water retention and rain gardens to alleviate storm water runoff); Glen Abrams, mailto:glen.Abrams@phila.gov
- Rodale Institute Farm, Pennsylvania (model integrated water/wastewater systems and reuse on experimental farm); Jeff Moyer, mailto:jeff.moyer@rodaleinst.org
- Chittenden County, Vermont (distributed storm water treatment approaches); Juli Beth Hoover, mailto:jhoover@sburl.com
- Colchester, Vermont (integrated water resource management and planning for small communities); Bryan Osborne, mailto:bosborne@town.colchester.vt.us
- Lowndes County, Alabama (rural decentralized wastewater utility in southern "black belt"); Heather Humphries, mailto:Hhumphries@ncne.com

- 2004
  - Seattle, Washington (asset management approaches for decentralized wastewater and storm water); Steve Moddemeyer, mailto:Steve.Moddemeyer@Seattle.Gov
  - Blackstone Watershed, Massachusetts and Rhode Island (integrated methods for groundwater recharge, reduced runoff, protection of aquatic ecosystem health, growth planning, and cultural landscape design); Scott Millar, mailto:smillar@dem.state.ri.us
  - Boise, Idaho (storm water runoff treatments including dual-use pavements and wetlands); Jim Wyllie, mailto:jwyllie@cityofboise.org
  - Pasquotank River Watershed, North Carolina (integrated wastewater and storm water designs at the individual home and cluster system levels); Mike Hoover, mailto:mike_hoover@ncsu.edu
  - Washington, D.C. (water sustaining design and landscape architecture for storm water retention); Uwe Brandes, mailto:Uwe.Brandes@dc.gov
  - Chagrin River Watershed, Ohio (decentralized storm water approaches in a watershed context); Kyle Dreyfuss-Wells, mailto:kdw@crwp.org