Soft Path Integrated Water Resource Management

Update on

- Training, Research and Development Activities of the NDWRCDP
- Opportunities for New Projects and Collaboration

National Decentralized Water Resources Capacity Development Project

Soft Path Integrated Water Resource Management

Update on Training, Research, and Development Activities of NDWRCDP and Opportunities for New Projects and Collaboration

National Decentralized Water Resources Capacity Development Project (NDWRCDP) Research Project

Final Report, November 2003

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CITATIONS

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1 INTRODUCTION

In February 2002, the National Decentralized Water Resources Capacity Development Project (NDWRCDP) co-sponsored a national workshop, "Distributed and Nonstructural Water and Wastewater Systems: Charting 'Soft Paths' to Integrated Water Resource Management." Two reports based on the discussions and conclusions of the workshop have already been released; the first outlines recommendations for federal policies, and the second describes funding, and training, research, and development needs.[1] This third report summarizes the training, research, and development activities funded by the NDWRCDP and related National Community Decentralized Wastewater Demonstration Projects funded by the U.S. Environmental Protection Agency (EPA). This report also describes opportunities for new projects and collaboration with other organizations related to soft path integrated water resource management. These potential projects have been identified by the author subsequent to the workshop and have been reviewed and discussed by the NDWRCDP Project Steering Committee (PSC).

Alternative Scenarios for Soft Path Development

Thirty-five experts from across the country participated in the workshop, including engineers, government officials, environmental advocates, and others knowledgeable about decentralized wastewater, distributed stormwater, low-impact development, non-structural flood control, and other "green" infrastructure solutions to water quality or quantity problems. Several different scenarios and motivated actors in an emergence of soft path practices were described at the workshop, including:

- **Scenario A**—Leadership by small communities in blending water and wastewater into a pragmatic, long-term vision of development
- **Scenario B**—Adoption by urban utilities, motivated by water shortages and high costs of replacing hard path infrastructure, of integrated approaches to restore and preserve a natural water "mass balance"
- **Scenario C**—Refinement of innovative technologies for rainwater retention/filtration, wastewater treatment, and reuse on individual properties or in cluster systems
- **Scenario D**—Reform of planning and regulations to promote more flexible, integrated water and infrastructure development

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[1]Nelson, Valerie I. and Christopher Serjak. 2002. "Distributed and Nonstructural Water and Wastewater Systems: Charting 'Soft Paths' to Integrated Water Resource Management: Recommendations for Federal Policies and Funding." Coalition for Alternative Wastewater Treatment. Gloucester, MA.

Nelson, Valerie I. And Christopher Serjak. 2003. "Soft Path Integrated Water Resource Management: Training, Research and Development Needs." National Decentralized Water Resources Capacity Development Project. Washington University, St. Louis, MO.

- **Scenario E**—Advocacy by environmentalists of an ethic that supports restoration and preservation of natural ecosystems

Training, Research, and Development Needs

High priority training, research, and development needs for advanced integrated water resource management and use of soft path technologies and management emerged during the workshop, including:

- "Micro-scale" designs and technologies that integrate wastewater, stormwater, landscape and other low-impact development tools, and reuse/reclamation and water conservation systems at the individual site or cluster system level
- "Macro-scale" cumulative impact models that integrate wastewater, stormwater, landscape and other low-impact development tools, and reuse/reclamation, and water conservation systems at the community, watershed or regional level, and that accurately predict water hydrology and fate and transport mechanisms for pollutants that cause public health and environmental risks
- True cost calculations comparing monetary and non-monetary costs of soft path and hard path infrastructure
- Utility and other management models and approaches to integrated hard and soft path water infrastructure, and new tools such as asset management and environmental management systems
- Innovative policies, regulatory and management mechanisms that integrate soft path and hard path solutions across water resource sectors and other aspects of public interest, including:
  - Sustainable community initiatives
  - Total Maximum Daily Loads (TMDLs)
  - Trading programs and other market incentives
  - Environmental stewardship projects
  - Innovative utility and management structures
- Approaches to engaging the public and key stakeholders, such as engineers, realtors and builders, elected officials, environmental organizations, and others, in building a stronger water quality ethic and stewardship

2 TRAINING, RESEARCH, AND DEVELOPMENT PROJECTS AND OPPORTUNITIES

Participants were asked to describe training, research, and development needs to advance each of the five scenarios generated during the workshop. These needs were related to or derived from the particular information, tools, or models that the key leaders in each scenario would need to mobilize or implement soft path integrated changes. Needs were also related to the barriers or obstacles to implementation. Key change agents who provided leadership under each scenario were as follows:

Scenario	Key Change Agents
A	Local elected officials and engineering firms
B	Regulators, government bureaucrats, and economic development interest
C	"Visionaries" in government, academia, engineering firms, and environmental organizations
D	Same as C
E	New coalitions of environmentalists and soft path professionals and technology entrepreneurs

The needs of the change agents in each of the scenarios overlapped in some key respects and were unique in others. In order to identify the highest priorities for future funding, topics were listed for each of the scenarios separately. These topics were then sorted into the major categories and subcommittees utilized by the NDWRCDP, which include:

- Environmental Science and Engineering
- Management and Economics
- Regulatory Reform
- Education and Training

High priority topics were subsequently defined as those topics that were listed for four or five of the scenarios. Other priority topics were defined as those that were listed in two or three of the scenarios. Topics listed for only one scenario were not included in the remaining discussions.

The training, research, and development priorities for each of the four substantive areas are listed in the following sections. A discussion of the NDWRCDP projects and National Community Decentralized Wastewater Demonstration Projects (demonstration projects) that are already responsive to these needs follows the priorities lists. The projects are described in the two phases

of the NDWRCDP. The first phase focuses exclusively on decentralized wastewater systems. The second phase is broader and includes the full spectrum of soft path technologies and integrated water resource management. Remaining gaps and suggested new projects are also discussed, including potential collaboration with EPA and others.

Environmental Science and Engineering (ES&E)

High priorities for ES&E include:

1. Solid evidence at the "micro" or individual site or cluster system level that soft path technologies, designs, and management work reliably—performance data and monitoring of systems

2. Solid evidence and models at the cumulative "macro" level that soft path approaches will protect water quality and quantity at the community, metropolitan, or regional level—water quality data collection, assessment, and fate and transport models

3. Telemetry or remote, real-time monitoring systems for individual systems and in the environment

Other Priorities for ES&E include:

4. Standardized designs and customized approaches tailored to different climates, soils, site conditions, and other characteristics

5. Solid scientific basis to technologies and approaches, modeling and other methodologies

6. Demonstration that public health risks from use of soft path approaches are low

Phase I—NDWRCDP Projects and National Demonstration Projects

A significant portion (approximately 40%) of Phase I funding of the NDWRCDP has been directed at ES&E topics for on-site and cluster wastewater treatment systems. A Colorado School of Mines (CSM) project is focusing field and laboratory research on transport/fate of microbes and chemicals in individual soil-based systems (priorities 1 and 5), as well as analysis of cumulative impacts of on-site systems in a watershed model (Watershed Analysis Risk Management Framework or WARMF) developed by the Electric Power Research Institute (EPRI) (priority 2). Related work by the US Geological Service (USGS) in Oregon focuses on coliphage (surrogate for viruses) fate/transport in conventional and innovative systems and groundwater, and on pharmaceuticals as well (priorities 1, 2, and 5). This project builds on USGS research on nitrate fate and transport in the La Pine demonstration project site, the goal of which is to protect a sole source aquifer from on-site system nitrate contamination.

Engineering studies recently funded by the NDWRCDP include two projects on phosphorus removal. The first study, to be conducted by Lombardo Associates, Inc., will document the current understanding of sources of phosphorus and soil removal mechanisms in saturated and

unsaturated conditions, and identify further research gaps (priority 1). The second, by Stone Environmental, will review phosphorus removal technologies (priority 4) in terms of

- Removal capability
- Costs
- System robustness
- Secondary benefits
- Maintenance requirements

Washington University researchers will also be funded to evaluate chemical and biological "tracers" for phosphorous sources in surface waters. The project will focus on mechanisms to distinguish four potential phosphorous sources:

1. Centralized wastewater treatment plants
2. Decentralized wastewater treatment systems
3. Runoff of animal wastes from feeding operations or fields to which wastes were applied
4. Runoff of inorganic phosphate fertilizers

A fourth project, by CSM, will identify and describe appropriate hydrogeological investigation and analysis methods for siting and design of large cluster and high-density individual wastewater soil absorption systems (priority 4). A fifth, complementary study by North American Wetlands Engineering, will test and evaluate these hydrogeological investigation and analysis field techniques on five different large-scale systems (priority 4).

The NDWRCDP also supports the National Onsite Wastewater Recycling Association (NOWRA) in the development of a set of matrices for categorizing the treatment capability of various soil conditions under differing loads and methods of distribution of effluent to the soil (priority 1). This information can be used by designers to determine the need for pretreatment units or other components in a treatment train predicted to meet the performance standards required for a given site. This study also highlights substantial gaps in knowledge on treatment in soils.

Recently-funded initiatives proposed under an Open Request For Proposal (RFP) process include:

- A USGS-Deschutes County, Oregon collaboration to evaluate simulation-optimization methods for predicting the optimal distribution and rate of non-point source loading from septic systems that achieves groundwater quality protection goals and land-use objectives. This project builds on model development included in the LaPine national community demonstration project.
- A CSM project that will assess the effects of pretreatment on biozone formation in soils and system purification efficiencies. This project will provide critical information for regulators setting the parameters for use of pretreatment units, followed by soils treatment.
- Funding of the Onsite Corporation to develop a methodology for failure rate study design, sample preparation, and field survey methods, along with a detailed assessment of the published and unpublished failure rate and system survivability data in public and private sector datasets.

Funding of a preliminary investigation of concepts, methods, and tools to predict and manage the "reliability" or life-cycle costs of decentralized wastewater systems (priority 4). This project will parallel EPA's efforts to bring reliability methodologies into the water and wastewater sector more generally, and will build on the experiences of New Zealand and Australia, in particular. The report will also include recommendations for data collection and analysis methodologies necessary to predict life-cycles and to optimize management strategies.

Several of the national demonstration projects have provided substantial opportunities for field-testing of innovative on-site wastewater treatment systems (priority 1). The La Pine, Oregon project involves installing a variety of systems of different types, and monitoring the systems for several years. The Block Island/Green Hill Pond, Rhode Island project also involves installing and monitoring a wide range of new technologies that are needed to provide additional treatment in sensitive water resource zones or to compensate for non-conforming soils or site conditions. The Table Rock Lake, Missouri project involves installing and monitoring systems with an emphasis on phosphorus removal, which is the key threat for the lake. The Mobile, Alabama project involves installing and monitoring three different cluster system technologies with effluent redirected from an existing sewer line. The Skaneateles Lake Project involves monitoring of composting and other waterless toilets.

Phase II—NDWRCDP Projects and National Community Decentralized Wastewater Demonstration Projects

Several projects under consideration for funding under the FY03 NDWRCDP appropriation are responsive to the need for new soft path designs and rigorous performance monitoring (priority 1). A project by the Dakota County Soil and Water Conservation District in Minnesota focuses on development of design guidance, performance data and management strategies for urban bioretention technologies (rain gardens) in cold and snowy climates. In Pennsylvania, monitoring of green roof technologies and development of design guidelines at Penn State University is supported. In Pierce County, Washington, a Washington State University residential demonstration project involves monitoring low impact development systems, such as rain gardens and stream buffers for effectiveness.

Several of the newly-funded demonstration projects involve monitoring of systems and cumulative impacts. A project in Lincoln County, West Virginia involves fecal-source typing tests to identify hot spots of septic system contamination and, following system upgrades, to assess the effectiveness of remediation (priority 2). The Rodale Institute Experimental Farm in Pennsylvania will install and monitor an integrated wastewater and stormwater system at the visitor's center, with reuse in toilets or irrigated landscape or crops (priority 1). The colonias project in Texas will explore reuse of treated effluent for habitat protection, crops, and possible resale back to a regional irrigation district (priority 1). The Upper Patuxent River Watershed project in Maryland involves the installation and testing of integrated wastewater and stormwater systems on individual lots (priority 1).

Discussion: Opportunities for New Projects and Collaborative Efforts

Several additional areas of research would be responsive to priorities identified in the February 2002 workshop, and would leverage current efforts of the NDWRCDP and others. These additional areas of research include:

- **Reliability studies** (priority 4)—The Phase I NDWRCDP-funded handbook of life-cycle and reliability concepts and methods is intended to serve as the first step for subsequent studies to collect data and refine specific models, as well as to explore asset management approaches more broadly. In this process, a broadening of scope to include distributed stormwater treatment/retention and reuse/recycling technologies should be considered. While the technologies differ, the structure of centralized risk analysis and management of decentralized systems on individual properties will be similar.
- **Integrated "micro-scale" or site-level designs** (priority 4)—As discussed most extensively in scenario C, there is a need for integration of wastewater, stormwater, landscape design, and other low-impact development tools, and reuse systems at the individual lot or cluster system level. Decentralized wastewater experts also recognize that they should be taking account of stormwater designs, because even properly-functioning on-site systems are typically overwhelmed during storm events. In addition, soils suitable for on-site wastewater treatment may be less suitable for stormwater retention and vice versa. Standardized designs for different climates and soils would speed adoption. Similarly, models and pilot projects exploring integrated technologies at the cluster system level would also be useful.
- **Survey of data on efficacy of distributed low impact development techniques** (priority 1)—There is a widespread perception among the engineering community that rain gardens and other distributed stormwater systems are not adequately removing some pollutants. A survey of the published and gray literature and identification of research gaps for subsequent field work would be a cost-effective contributions to this discussion.
- **Telemetry** (priority 3)—The ability to conduct real-time monitoring of systems and receiving waters is a priority based on earlier NDWRCDP workshops and the February 2002 workshop. Private companies are developing new systems to monitor mechanical components; costs for these systems are falling rapidly. In addition, the Water Environment Research Foundation (WERF) is working with EPA to advance the development of technologies to monitor water samples remotely for potential biological or chemical terrorism. These efforts should be tracked due to their applicability to the decentralized field. EPA is emphasizing the development of environmental indicators, bio-criteria, and monitoring and assessment methodologies as underpinnings to TMDLs, trading, and environmental performance tracking systems.
- **Public health risks** (priority 6)—The Centers for Disease Control (CDC) will release an assessment of public health risks from septic system malfunction based on existing, but sparse data sets, and will consider funding epidemiological studies to assess risks more rigorously. Support for and collaboration with this work by the CDC is responsive to concerns raised in the workshop, and has also recently been identified as a key concern of EPA administrators.

- **Cumulative "macro" impact modeling** (priority 2)—Research funded by the NDWRCDP at CSM and USGS to date has been focused on fate and transport modeling for nutrients, coliphage, and pharmaceuticals coming from on-site wastewater systems. A broader effort should be organized to establish research and modeling capabilities and needs for integrated soft path approaches. A particular concern is to establish methods to assess and predict water quality and quantity impacts from different land use development patterns and integrated technologies at the site level. Currently, on-site septic system codes serve in many areas as a de facto zoning tool, but as advanced systems are increasingly being permitted, development will be allowed to occur in previously unbuildable areas. The creation of roads, impervious cover, and stormwater runoff often leads to water quality degradation in spite of adequate wastewater treatment. The degree to which distributed stormwater retention and treatment technologies can compensate for or address these runoff concerns is not well-established.

As has been learned in efforts to implement TMDLs for surface water quality protection, the data and science requirements for assessing point and nonpoint sources loadings are daunting. A National Academy of Sciences report has cautioned policymakers that assessment and modeling techniques need to be substantially improved if TMDLs are to be developed appropriately. The problem of inadequate data and modeling is magnified when drinking water, groundwater, low-impact development, and flood control measures are integrated into the analysis.

Management and Economics (M&E)

High-priorities for M&E include:

1. True cost comparisons of soft path and hard path approaches (including growth, quality of life, and other non-monetary considerations)

2. Integrated community water resource decisionmaking tools—planning, assessment, public participation and other tools

3. Creation of multi-disciplinary teams in engineering firms, including:
   - Engineers
   - Planners
   - Natural resource specialists
   - Financial analysts
   - Public outreach specialists

Other priorities for M&E include:

4. New rate/fee structures, variable demand and supply curves for different potable and non-potable water quality and use

5. Utility or other integrated water resource management models for rural or metropolitan areas, including public-private partnerships and other institutional arrangements

Phase I—NDWRCDP and Demonstration Projects

The NDWRCDP has been directing resources at a number of projects to build capacity in community decision making about decentralized wastewater approaches to solving water quality concerns (priority 2). The University of Rhode Island (URI) has been funded to develop guidance to communities on how to plan for decentralized technologies to meet land uses and development visions of communities. A second URI project will help communities utilize Geographic Information System (GIS) data sources and mapping in identification of sensitive environmental resources and treatment needs, and in the prediction of impacts of alternative decentralized wastewater projects on these resources. A guidance manual will be prepared for the NDWRCDP by Lombardo Associates about when to consider and how to manage cluster systems in new and existing developments. The demonstration projects have also been developing and testing models for community planning and public participation, in particular the first-round projects in Vermont, Oregon, and Rhode Island.

A project selected for funding under the recent Open Request For Proposals (RFP) is by the Ocean Arks International (OAI). OAI will evaluate analytical tools and methods that have the potential to capture the environmental consequences of wastewater alternatives in non-monetary units. These include life cycle assessment, environmental impact assessment, exergy evaluation, and the sustainability process index. These methodologies are more widely used in Europe, and the appropriateness for U.S. communities will be assessed.

Two projects in Phase I are particularly responsive to the high-priority issues of true cost comparisons of the broad range of centralized versus decentralized infrastructure beyond just wastewater treatment (priority 1). The Rocky Mountain Institute (RMI) is being funded jointly with EPA to develop a catalogue of the full range of benefits and costs of decentralized wastewater systems to a community, including such typically under-researched concerns as hydrologic impacts, incremental financing, and growth and land-use impacts. The San Francisco Public Utilities Commission (PUC) is also being funded to assess the feasibility of a satellite stormwater wetlands that would utilize treated wastewater during dry months of the year.

Phase II—NDWRCDP and Demonstration Projects

In Phase II, several priority topics will be addressed. A U.S./European workshop sponsored by the Coalition for Alternative Wastewater Treatment (CAWT) is proposed to review community decision making tools that assess and portray potential wastewater infrastructure choices for the public (priority 2). European research has focused on more formal analytic tools, such as linear programming, while U.S. tools have been oriented more to basic community outreach and evaluation of choices. The National Rural Electric Cooperative Association (NRECA) will sponsor a project to evaluate business models and cost structures for electric co-ops and other not-for-profit organizations to provide decentralized wastewater management services (priority 5).

CAWT will conduct a workshop on market and business models in integrated soft path management, including discussions of potential market failures, such as monopoly abuses, and regulatory remedies to ensure that businesses and utilities are operating to maximize the public interest at the least cost (priority 5). This workshop will be held in California and will provide an

opportunity to learn more about how municipalities and utilities in the arid Southwest have already begun to integrate water, wastewater, stormwater, and reuse projects on a regional basis. Most of these projects have utilized hard path infrastructure approaches. CAWT will also prepare two white papers related to financing and customer service issues (priorities 4 and 5); the first concerning public finance principles for structuring federal support of decentralized wastewater systems; and the second exploring the implications of "levels of service" approaches to regulatory requirements and customer preferences in the emerging asset management paradigm.

EPRI's Phase II project will be a workshop and other research to understand the role of engineering firms in design of centralized versus decentralized infrastructure and to define potential roles for engineering firms in adopting integrated soft path approaches to water resources management (priority 3). Several issues to be covered include:

- The multidisciplinary talent that engineering firms will utilize to manage projects
- Obstacles to engineering firms embracing distributed technologies and approaches
- Business models for services required to build both centralized and distributed water treatment infrastructure including:
  - planning
  - construction
  - design
  - operating
  - permitting

The newly-funded Chittenden County, Vermont demonstration project will include the development of a stormwater utility for South Burlington (priority 5), and the Town of Colchester. This project is currently focused on developing a strategic water quality plan (priority 2) and an integrated loan program to residents upgrading their wastewater or stormwater systems (priority 4). The colonias project in Texas will explore the utilization of "self-help" contributions by residents of the construction of wastewater and reuse facilities as a means to lower costs (priorities 4 and 5). Finally, the West Philadelphia demonstration will involve installing and assessing the environmental effectiveness, stakeholder acceptance, and watershed-based life cycle costs and benefits of urban low impact redevelopment approaches, such as on-site management and reuse of stormwater runoff, retrofit of deteriorated water supply and drainage systems with modern conservation devices, and other approaches (priorities 1, 2, and 5).

Discussion: Opportunities for New Projects and Collaborative Efforts

Additional areas of research include:

- **True cost calculations comparing soft path and hard path alternatives** (priority 1) – RMI's current project cataloguing benefits and costs is oriented to decentralized wastewater solutions, but is taking account of related hydrologic and land use impacts. WERF will also sponsor a project to array the benefits and costs of low-impact development practices compared to conventional subdivision development. Additional true-cost comparisons that incorporate economic valuations of the full range of environmental, financial, social, and cultural impacts from soft path versus hard path approaches, would be a major contribution

to advancing the soft path water resource field. Research could include catalogues of benefits of costs, models for estimating costs and benefits, and pilot tests and examples. EPA is also attempting to develop the capacity to assess non-monetary costs and benefits of various regulatory and policy approaches, and the soft path field should collaborate with this effort.

- **Pricing, variable supply and demand curves** (priority 4)—EPA has begun to focus on higher rate structures and fees as a means to increase funding for water and wastewater infrastructure. This topic was featured during EPA's January 31, 2003 conference on "closing the water gap." The General Accounting Office and the Congressional Budget Office have also analyzed various issues related to fees and subsidies in water and wastewater, including:
  - Incentives to conserve
  - Internalization versus externalization of costs
  - Disincentives to manage cost-effectively
  - Other issues

  This analysis will be reviewed for relevance to integrated water resource management and soft path infrastructure as part of a CAWT white paper, but additional pilot studies would also be advisable.
- **Utility and other management models** (priority 5)—One way to integrate water resource management is to create a single metropolitan or regional agency that covers all water, wastewater, stormwater, flood control, and low impact development functions. This single utility would have the incentive to manage infrastructure cost-effectively, because all costs are internalized to the same organization. EPA has begun to promote consolidation of agencies as one of the "innovative" means to promote efficiencies and to "close the gap." Draft reauthorization of the Clean Water State Revolving Fund (SRF) will require analysis of regionalization, consolidation, and public-private partnerships. Australia and New Zealand, for example, have demonstrated substantial cost-savings from integrated utilities, and are beginning to integrate water/wastewater functions with an even broader array of transportation, school, and other infrastructure functions. If a single agency is not created, then mechanisms would need to be explored for how separate bureaucracies can be coordinated more efficiently and effectively.
- **Community decision-making tools** (priority 2)—EPA's 2003 Strategic Plan encourages support for "community sustainability" and recognizes that environmental regulations and projects should also reflect economic, social, and cultural needs. EPA's stated goal is to have assisted 220 communities in developing sustainable plans by 2010. Several NDWRCDP-supported project researchers and demonstration project leadership have realized that wastewater issues should not be segregated from the larger decisions that a community should be making about growth and development patterns, community character, open space, and other issues. Other initiatives supported by EPA in recent years have included support for "watershed initiatives" and "sourcewater protection" initiatives.

A Phase I Planning and Outreach workshop of NDWRCDP project investigators involved with community decision making tools should include discussions of how the separate analyses and tools can be blended, so that the public develops a thorough understanding of long-term options for sustainability. A second workshop goal should be the identification of gaps in tools and methods, so that pilot projects and new tools can be supported in the future.

Regulatory Reform (RR)

High priorities for RR include:

1. Development of streamlined, flexible, and accountable policy and regulatory structures that support integrated water resource management

2. Design of performance-based codes and building codes that facilitate innovative soft path infrastructure development

3. Design of federal requirements for **ONE** water resource-related plan from communities and regions, and consistency among different federal regulations and funding sources

Other priorities for RR include:

4. Reuse regulations that enable greater reuse/reclamation of treated wastewater and stormwater

5. Design of adaptive management approaches that encourage continuous review and innovation, including Environmental Management Systems (EMS)-based and asset management approaches

Phase I–NDWRCDP and Demonstration Projects

Two Phase I NDWRCDP-funded projects focus on development of performance-based codes for decentralized wastewater treatment (priority 2). The California Wastewater Training and Research Center at California State University–Chico is being supported to prepare a model ordinance for onsite sewage treatment and management, within a performance-based context. NOWRA has been partially funded by EPA to develop a National Model Performance Code for Decentralized Wastewater Systems, and NDWRCDP contributes to that effort as well. This effort includes development of classification matrices for treatment system outputs, quality assurance measures, and for varying performance standards for treatment and management, along with soils tables (see ES&E). An additional part of this project is the identification of ongoing activities throughout the country to develop performance codes at the state or county level, and research on the challenges and/or barriers to adoption of these codes by regulators and policymakers.

One element of the Block Island/Green Hill Pond, RI demonstration project is the development of advanced wastewater treatment standards for nitrogen and pathogen removal in critical resource areas and for lots with limiting soil or site conditions. New ordinances have established inspection requirements, fees, and other requisites. An earlier NDWRCDP-funded project for the Town of Tisbury on Martha's Vineyard, MA recommended a similar approach to differential standards for critical resource areas.

The Environmental Research Institute of the States (ERIS) was funded to survey the states and to develop recommendations for improvements to integrate and consolidate existing state and local wastewater authorities and programs, regulations, and environmental and public health responsibilities in on-site wastewater treatment (priority 2). Perhaps because the focus was linked to on-site wastewater only, ERIS concluded that the need for better integration and

consolidation across agencies was not great. However, the fragmentation among **all** the soft path authorities and bureaucracies clearly **is** a problem, that states including Ohio and Kentucky have begun to address.

The New England Interstate Water Pollution Control Commission is being funded under the Open RFP to develop a statistical and sound scientific relationship between test center data and actual field data of installed alternative technology on-site wastewater treatment systems. State regulatory agencies have been concerned with discrepancies between test center data and real world installations. This project will provide guidance to state regulatory agencies in evaluating different types of research data about performance of alternative systems. This project will also further the beneficial use of proven on-site wastewater technology across the nation. Support has been provided to the National Small Flows Clearinghouse for organizing an annual State Onsite Regulators Conference.

Phase II—NDWRCDP and Demonstration Projects

In Phase II of NDWRCDP-funded projects, the State of Pennsylvania is under consideration for funding to develop a technical design manual and codes for decentralized stormwater management (priority 2) that includes:

- Design guidance on the most effective decentralized stormwater management practices
- Procedures for quantifying and approving new technologies or modifications to existing Best Management Practices (BMPs)
- Model local codes and incentives for implementing alternative BMPs that promote water quality protection, watershed management, and aesthetically pleasing site design (priority 2)

The Charles River Watershed Association in Massachusetts is also under consideration for funding to explore the development of flow-based pollution trading in a TMDL context. This project is based on analysis of the potential of flow enhancements associated with stormwater remediation, especially during low flow periods, as a means of increasing the river's loading capacity using both monitoring and watershed models (priority 1). The objective is to determine whether flow enhancements, which also reduce stormwater pollution and increase aquifer sustainability and instream base flow, could be used in lieu of more costly pollution reduction alternatives.

The Mud River, Lincoln County, West Virginia demonstration project will develop an approach to identifying hot spots, utilizing fecal-source typing to distinguish on-site septic system inputs from wildlife and other sources. This project will also develop on-site wastewater treatment and management programs to address those systems that are contaminating the Mud River (priority 1). This approach may obviate the need for a formal TMDL and/or provide a model for how on-site systems can be managed in the context of a TMDL.

The Chittenden County, Vermont demonstration project will involve the development and implementation of a "strategic water quality plan" for the Town of Colchester. This plan will move the town from a reactive response to new state regulations for stormwater and decentralized wastewater, upcoming TMDL requirements, and new federal Phase II stormwater

requirements, into an integrated planning approach (priority 3). The goals of the demonstration project are to:

- Reduce nonpoint source pollution
- Protect sourcewater
- Address stream impairments
- Preempt future TMDL mandates
- Reduce the need for expensive infrastructure

The CAWT workshop in California will be an opportunity to learn about the approaches that the State of California and water and wastewater utilities in the state have developed to integrate various water resource plans and projects (priorities 1 and 3). The pressures of limited water supplies in the arid Southwest have already been forcing reuse and reclamation efforts, and other integrated water resource planning. CAWT will also explore, through a workshop and a White Paper, the challenges of flexible/accountable regulatory and policy structures, and in particular, will attempt to identify the areas of disagreement and conflict in developing new approaches (priority 1).

Discussion: Opportunities for New Projects and Collaborative Efforts

All five soft path workshop scenarios rest on the principle that water, wastewater, stormwater, and other soft path systems are installed in a complex, interdependent water quantity and quality system of surface and groundwater. Traditional policies and regulations that deal separately with each type of infrastructure typically fail to take account of these interdependencies. The result is a highly-inefficient approach, where indirect costs and impacts are imposed on future generations or on other people downstream, for example, and may cost a great deal to correct. Policies and regulations need to be changed to reflect these interdependencies.

Ideally, infrastructure decisions for water, roads, power, schools, and other infrastructure would be made in a broad, integrated process, where all direct and indirect impacts on the environment, the economy, and the community fabric would be taken into consideration. The overarching goal then is to maximize public welfare by spending money on the infrastructure that achieves the greatest benefits at least cost.

There are several challenges to developing flexible, integrated policy and regulatory structures, including:

- The need for data and modeling to be able to accurately predict all direct and indirect impacts from any infrastructure alternative (see topic in ES&E)
- Resistance by local governments and constituencies to being absorbed into larger regional decision-making structures (see topic in M&E)
- Resistance by “siloed” bureaucracies concerned about losing “turf” (M&E)
- Intense political debates about such major decisions as land use controls
- The absence of models and demonstrated successes in integrated policies and regulations

Major funding of research and pilot testing is necessary to develop new policy and regulatory structures, including the following:

- Review efforts by states, regions, and towns to integrate water resource planning, regulations, and management (priorities 1 and 3)—Examination of goals, lessons, successes and failures of existing efforts, including efforts in states such as California, Kentucky, Ohio, Florida, and Massachusetts, that have attempted integration
- Collaborate with EPA to assure that soft path technologies and management are appropriately developed in EPA initiatives outlined in the new strategic plan, including (priorities 1 and 3)
  - Sustainable communities (tools to assess, plan, and manage public health and environmental protection, local economics, social well-being, and cultural quality of life and sustainability)
  - TMDLs (and development of minimum standards)
  - Watershed planning and management
  - Trading programs
  - Other market incentives
  - Environmental stewardship
  - Public participation, transparency of decision making
  - Innovative technology and management

  Specific projects in these areas should be designed to complement and enhance EPA's current efforts. A broad overview of this subject will be part of a CAWT workshop, but a follow-up conference of experts might also be advisable to lay out high-value research and pilot projects.
- Collaborate with the National Science Foundation, which is exploring the need to integrate analysis of separate environmental, engineering, and social systems (priority 1)
- Support pilot projects at the local, regional, and state levels to integrate water resource policy and regulations (priority 1)
- Develop a model wastewater and stormwater reuse code that would help minimize conflicts among the variety of state rules

Training and Education (T&E)

High priorities for T&E include:

1. Means to enhance public awareness and willingness to support water quality protection via soft path approaches, for example, value of clean water, willingness to pay for open space, wildlife habitat, and knowledge of successful integrated soft path projects
2. Training and education of professionals and practitioners, including:
   - Engineering, design, maintenance
   - Multi-disciplinary approaches

  - Asset management and reliability techniques
  - Public participation, integrated management

3. Education of important constituencies, including:
  - environmental organizations
  - land conservation groups
  - watershed groups
  - national associations for governors
  - counties
  - cities
  - homebuilders associations
  - engineering and public works professional organizations
  - other non-governmental organizations

4. Development of public participation procedures

Other priorities for T&E include:

5. Clearinghouse of information for technology and management

6. Accreditation of professionals and practitioners

7. Outreach to professionals and practitioners

Phase I—NDWRCDP and Demonstration Projects

The Consortium of Institutes for Decentralized Wastewater Treatment (Consortium) is funded to develop consistent, state-of-the-art on-site wastewater training materials for use by all state on-site training centers that reach a broad range of constituencies, including designers and installers, public officials, and homeowners (priority 2). The Consortium is developing curricula for professional education in colleges and universities where the concepts of decentralized wastewater management are inadequately covered. The Consortium has developed a student design competition in decentralized wastewater management to motivate and engage undergraduates in the challenges of this emerging field.

The NDWRCDP has contracted with the Green Mountain Institute (GMI) for Environmental Democracy to conduct workshops to evaluate existing or emerging decentralized wastewater treatment tools and to identify additional tools needed to facilitate the work of community assistance providers, engineers, and others working with small communities (priorities 3 and 4). Concerns include:

- How do local decision makers and the public receive information
- The values of local decision makers and the public
- The best method to maximize willingness to consider decentralized infrastructure alternatives to central sewers and treatment solutions

Primen, an affiliate of EPRI, has analyzed an extensive survey of homeowners in North Carolina and estimated the level of knowledge, buying preferences, and willingness to pay for improved onsite system performance, advanced on-site systems, and sewers (priority 1).

The NDWRCDP Planning and Outreach committee will develop a presentation and materials about decentralized wastewater management and technologies. The purpose of the presentation and materials is outreach to major constituencies, such as National Conference of Mayors, National League of Cities, National Association of Counties, and various stakeholder organizations. Outreach efforts will also involve others in areas less clearly identified with the environmental implementation field dealing with real estate, loans, development-related activities, environmental advocates, and those working in areas such as sourcewater protection, watershed protection, rivers protection and other similar areas (priority 1).

GMI has been recently funded under the Open RFP to develop and test materials that improve the participation of community members in wastewater management decisions.

Tools for community decision making will include:

- Fact sheets to help communities identify hazards and risks from wastewater problems
- Rapid assessment methods to identify systems and conditions
- Short scenarios as a basis for discussion
- A starter's kit for how to proceed in developing a planning and outreach process that will lead to implementation of a wastewater system that meets community needs

Phase II—NDWRCDP and Demonstration Projects

In Phase II, the Consortium plans to develop training materials for operation and maintenance of on-site wastewater systems (priority 2). Funding is also under consideration for the Consortium to develop, in partnership with the Low Impact Development Center, a set of training materials that integrate stormwater designs, technology, and management into the on-site wastewater field (priority 2). A project is also being considered to fund the National Association of Home Builders Research Center to develop web-based information materials (priority 3).

A CAWT workshop exploring new alliances for soft path approaches will begin an exploration of the philosophical and political roots of the environmental movement versus the conservation movement (priority 1). The goals are to identify common soft path values and objectives, and to outline joint grassroots campaigns and approaches to build public awareness and voluntary efforts to protect water resources through soft path approaches.

The demonstration projects all require outreach and education of local decision makers and the public, but three new projects are particularly relevant (priorities 1 and 3).

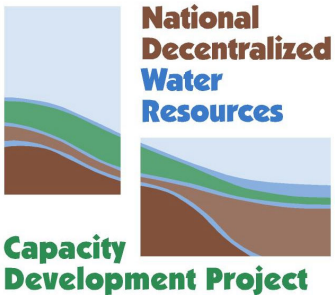
- The Rodale Institute Experimental Farm will install an integrated wastewater/stormwater/reuse system at the visitor's center and will develop educational materials for children and adults. Some of these materials may be published in their national magazines and websites.

- West Philadelphia's demonstration will include low-impact redevelopment technologies at schools and in neighborhoods and efforts will be made to educate students and residents about the values of water resource protection.
- The Mud River, Lincoln County, West Virginia demonstration project will involve 4-H youth and college students in assessing water quality and outreach activities.

Discussion: Opportunities for New Projects and Collaborative Efforts

The following new projects are recommended:

- **Multidisciplinary curriculum** (priority 2)—EPRI's project (see M&E topic) in Phase I will define potential roles of engineering firms in developing integrated soft path water resource management. A follow-up to this research would be a study to recommend and develop undergraduate and continuing education curricula for engineers, planners, natural resource specialists, and others who will be involved in soft path infrastructure planning and management.
- **Environmental stewardship** (priority 1)—Research into the varied philosophical roots and current applications of the environmental and conservation communities would assist in developing appropriate public information and stewardship campaigns. Projects could build upon the initial material generated in the CAWT workshop.
- **Tools and procedures for public involvement and public awareness** (priorities 3 and 4)—The GMI project has identified needs for community resource providers to assist communities dealing with decentralized wastewater issues. Follow-up projects that seek to implement the GMI recommendations should include a broader, integrated soft path approach.
- **Outreach to professionals and practitioners** (priority 7)—Additional outreach and education efforts should be organized at national, regional, and state levels. A particularly important new constituency to involve is the landscape design community, which is beginning to incorporate wastewater and stormwater treatment needs into their designs, and which has access to influential constituencies, such as builders, realtors, and public officials.



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This report is also available online at www.ndwrcdp.org.