Sustainable Water Systems

The Baltimore Charter

2007

Sustainable Water Systems

The Baltimore Charter on Sustainable Water Systems was drafted as a commitment to design new water systems that mimic and work with nature. These systems will both protect public health and safety and will restore natural and human landscapes. Principles of design in nature and examples of these new approaches include the following.

Principles of Design in Nature

Nature operates with patterns and principles that we can adapt to our treatment of water:

- Nature creates order and builds from the bottom up with modular units
- Nature is multi-functional in its forms
- Nature adapts and adjusts to changing conditions
- Nature is cyclic and recycles, uses and reuses
- Nature creates beauty and abundance and no waste

Engineered Ecologies of Water, Land, Energy, and Climate

Nature and man can cooperate to rebuild healthy communities and restore natural ecologies through incorporation over time of sustainable infrastructure designs and principles, with water at the center of these designs. Emerging examples of these concepts include:

- *Onsite and neighborhood treatment* – small-scale technologies that mimic natural membranes and filters and that utilize soils and smart localized controls

- *Onsite and neighborhood reuse* -- Closed-loop water systems in residential and commercial buildings, where stormwater and wastewater are treated and reused for landscape irrigation, toilet flushing and cooling, and where minimal waste leaves the site

- *Green infrastructure* -- Rain gardens that trap stormwater and sustain trees and plants. These plants restore beauty and improve air quality in cities, 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 vegetation and wildlife, and minimize climate changes and warming.

America's Water and Wastewater Infrastructure Crisis and Opportunities

Communities across the country are facing a growing crisis in water resource protection. Water and sewer systems built over the last one hundred years are deteriorating, and estimates for the "gap" in available funding for repair and replacement are in the hundreds of billions of dollars. New developments in suburban and rural areas also require water supply enhancements and new infrastructure. Statutory requirements for source water protection, stormwater and combined sewer overflows, TMDL's, groundwater protection, and flood control will add billions more in spending.

In the past, engineers have designed "rapid conveyance" centralized water distribution and sewer and stormwater collection networks that are managed by central authorities. Unfortunately, these conventionally-engineered piping networks have also been highly-disruptive of natural ecologies of water and land. Centralized infrastructure projects have seriously drained aquifers and led to saltwater intrusion along coastlines, reduced normal streamflows, increased flooding, and degraded natural habitats.

The signatories to the Baltimore Charter intend to introduce designs and institutions that mimic or work with nature into a "hybrid" system of centralized and decentralized infrastructure. Future research into micro-ecologies of bacteria and macro-ecologies of watersheds, and transformational examples of institutional innovation and cultural change will shift the optimal mix more and more towards nature's localized, multi-functional and abundant forms.

Benefits of Decentralized Systems

Decentralized water and wastewater infrastructure creates the following benefits:

- *Lower costs for water supply* – costly water supply enhancements can be avoided through onsite water use efficiencies, wastewater reuse, and rainwater harvesting. Impacts of droughts can be moderated.

- *Lower costs of maintaining existing infrastructure* – flow rates in existing water and sewer systems can be reduced through decentralized efficiencies and reuse in office buildings and infill developments

- *Lower costs for new infrastructure* – new developments can be accommodated with targeted small-scale infrastructure that is cheaper than centralized infrastructure.

- *Greater resilience* – small-scale treatment units are more resilient than centralized systems in hurricanes and floods, and less vulnerable to accidents and terrorism.

- *Ecological restoration* – decentralized systems can reduce the discharge of pollutants and replenish aquifers, restore streamflows and habitats.

- *Resource efficiencies* – small-scale treatment units can save on energy costs and recycle nutrients into landscaping and agriculture.

- *Community benefits* – green infrastructure has been shown to improve air quality, preserve open space, and create local jobs.

- *Private financing* – small-scale treatment units on individual properties can be financed privately, thereby saving money for municipalities.

- *International competitiveness* – American advancements in sustainable water systems can be utilized in developing countries, such as China and India, and high-tech research, manufacturing and engineering jobs can be created in the U.S. to serve these markets.

Government Policies to Promote Sustainable Water Systems

National, state, and local agencies can promote the development and adoption of sustainable water systems by the following measures:

Short-term Strategies

The public sector can help to promote innovation through a series of low-cost, short-term measures to facilitate and coordinate better information to assist local decisionmakers and community stakeholders in the water sector. These include:

- Pilot and demonstration projects
- Guidance manuals
- Evaluations of new products and designs
- Education through conferences, newsletters, and training
- Labeling and standard-setting initiatives

Long-Term Research

The public sector is uniquely positioned to take the lead in support long-term research in the following areas:

- micro-scale biology that over time will facilitate breakthroughs in treatment technologies and controls
- macro-scale ecological studies to improve watershed-scale management.
- social and economic studies and large-scale demonstration projects that will support the evolution of institutions and practices, such as expansion of green building and sustainable water system markets, private sector management and maintenance of decentralized systems, adaptive and performance-based approaches to regulations and ordinances, collaborative neighborhood design, and greater participation by individuals and communication networks in the adoption and diffusion of sustainable practices.

Collaborative funding of research projects can include public agencies, private companies, and academic institutions.

Financing Incentives

Governments are now typically financing large-scale public water supply, drinking water, wastewater, stormwater, and flood control projects without considering decentralized system alternatives or the disruptive externalities of these “siloed” systems. Financial reform should include:

- requirements for integrated water resource management planning and for evaluation of all direct and indirect costs
- subsidies and tax incentives for water capture, conservation, treatment, and reuse, which are usually on private property.

Regulatory Reform

Regulations and ordinances have historically been written to require and set standards for large, centralized systems in separate parts of the water cycle. Regulations need to be reformed to:

- permit decentralized systems to be utilized to meet statutory requirements
- develop integrated standards to meet water supply, water quality, public health and ecosystem needs
- support sustainable development and redevelopment of human settlements through integrated planning of water, energy, and transportation infrastructure which also works in synergy with buildings and landscapes.

The Baltimore Charter
For Sustainable Water Systems

Water is at the heart of all life. In the past, we built water and wastewater infrastructure to protect ourselves from diseases, floods, and droughts. Now we see that fundamental life systems are in danger of collapsing from the disruptions and stresses caused by this infrastructure.

New and evolving water technologies and institutions that mimic and work with nature will restore our human and natural ecology across lots, neighborhoods, cities, and watersheds. We need to work together in our homes, our communities, our workplaces, and our governments to seize the opportunities to put these new designs in place.

Our group of scientists, engineers, environmentalists, government officials, manufacturers, and members of the private sector are part of the solution. We have both the opportunity and obligation to participate with others on this task of transforming how we think and act in relation to water.

We commit to implementing more sustainable water systems by expanding uses and opening new markets for small-scale treatment processes, advancing research on micro-biological and macro-ecological scales, inventing new technologies based on nature's lessons, creating new management and financial institutions, reforming government policies and regulations, and elevating water literacy and appreciation in the public.

Signatories:

This Charter was signed on March 15, 2007 by participants in a long-range planning workshop convened by the Water Environment Research Foundation (WERF).   This workshop followed the international conference, Water for All Life: A Decentralized Infrastructure for a Sustainable Future, which met from March 12-14 in Baltimore, Maryland, USA. The conference was convened by the National Onsite Wastewater Recycling Association, International Water Association, and WERF.

The Baltimore Charter was signed by the following individuals:

Bonnie Bailey – Water Environment Federation, Virginia
Gunnar Baldwin – TOTO USA, Inc., New Hampshire
Cori Barraclough – Aqua-Tex Scientific Consulting, Ltd., Canada
Matthew Byers – Zoeller Pumps, Kentucky
Edward Clerico – Alliance Environmental, New Jersey
Yehuda Cohen – Hebrew University of Jerusalem, Israel
Patrick M. Condon – University of British Columbia, Canada
Edward J. Corriveau – Pennsylvania DEP
Glen Daigger – CH2MHill, Colorado
Todd Danielson – Loudoun County Sanitation Authority, Virginia
Bruce Douglas – Stone Environmental, Inc., Vermont
Ray Ehrhard – Washington University, Missouri
Robert Goo – U.S. Environmental Protection Agency
Mooyoung Han – Seoul National University, Korea
Xiaodi Hao – Beijing Institute of Civil Engineering and Architecture, China
Juli Beth Hinds – City of South Burlington, Vermont
Goen E. Ho – Murdoch University, Australia
Carol Howe, SWITCH, Netherlands
Katsuki Kimura – Hokkaido University, Japan
Chris Kloss – Low Impact Development Center, Maryland
James Kreissl – Water Environment Federation, Kentucky
Bruce Lesikar – Texas A&M, Texas
Patrick Lucey – Aqua-Tex Scientific Consulting, Ltd, Canada
Cynthia Mitchell – Institute for Sustainable Futures, Australia
Steve Moddemeyer – City of Seattle, Washington
Jeff Moeller – Water Environment Research Foundation
Valerie I. Nelson – Coalition for Alternative Wastewater Treatment, Massachusetts
Stacy Passaro – Passaro Engineering, Maryland
David Potts – Geomatrix, Connecticut
Robert Rubin – North Carolina State University, North Carolina
Marco Schmidt – Technical University of Berlin, Germany
Paul Schwartz – Clean Water Action, Washington, D.C.
Sandra Schuler – Huber Technology, Germany
Robert L. Siegrist – Colorado School of Mines, Colorado
Jerry Stonebridge – National Onsite Wastewater Recycling Association, Washington
George Tchobanoglous – University of California at Davis, California
Joseph V. Thanikal – Kumarageoun College of Technology, India
Zaini Ujang – University Technology of Malaysia, Malaysia
Robert Zvara – Architect, Slovakia

For information on the conference and the Charter, go to: www.waterforalllife.org
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Research Challenges
WERF Long-Range Planning Meeting
March 14-15, 2007

SCIENCE, ENGINEERING, AND TECHNOLOGY

Integrated Sustainable Water Infrastructure

Minimize resource utilization and maximize resource recovery through intelligent, efficient, adaptable, sustainable technologies.

- Research and implement new sensing and monitoring control technologies that connect scientists, managers, customers and the community with water infrastructure.
- Create new technologies, systems, and materials for the sustainable infrastructure including water efficient devices and cascading systems (from high to low quality).
- Investigate storage and reuse technologies at various infrastructure scales (including within building envelopes).
- Minimize or eliminate chemical usage in water treatment.

Natural Systems and Water Cycling

Understand the major natural elements and switches controlling the water cycle.

- Define criteria for ecosystem health.
- Understand the structure and function of unseen biological elements and their interactions with the environment.
- Integrate tools to understand systems biology, its network of interactions with the environment, and implications for human health.
- Conduct basic micro-biological and macro-ecological research.

Social Institutions and Decision Making

- Engage communities in integrated design and planning for water sustainability which will result in cost savings, water protection, and healthier people.
- Develop local government management tools, design guidelines, model bylaws, and community education modules.
- Implement simple, practical management tools and design guidelines.

Public Health

- Understand the impacts of all types of water and wastewater systems on human health.
- Document the fate and transport of chemical and biological constituents in water, ultimately to the point of human exposure.

POLICIES, REGULATIONS, AND ECONOMICS

Policies

Create an effective integrated water management strategy and associated policies.

- Define sustainable, integrated water resource management.
- Provide tools, policies, and regulations that allow communities to achieve their own local visions of sustainability.
- Quantify economic, environmental, and societal consequences of integrated water management strategies.
- Invest in data collection, analysis, monitoring, economic analysis, and risk analysis to support an integrated water management infrastructure.

<u>Regulations</u>
Articulate and implement a unified regulatory methodology.

- Craft a methodology of analysis and benefit/cost for water, people, and nature
- Quantify performance- and risk-associated management systems.
- Integrate the importance of water into LEED® and other ‘green building’ initiatives.

- A unified regulation and compliance structure for distributed systems

<u>Economics</u>
Define new economic methods that sufficiently address full cost integrated water pricing

- Account for secondary economic benefits and consequences, including community values and priorities, in cost-benefit analyses.
- Enable communities to use limited resources more efficiently by translating new economic methods into practical, implementable tools.

DEMONSTRATION PROJECTS, MARKET STUDIES, AND EDUCATION

<u>Demonstrate the Integrated Water Systems Vision</u>
Define multiple approaches to a sustainable water system in social, cultural, and environmental contexts as well as at a variety of scales (such as urban, suburban, and on-site).

- Demonstrate the possibilities and benefits of integrated water infrastructure in a way that is meaningful, useful, and desirable to the public.
- Complete cross-sector demonstration projects that include other sectors which impact water, such as transportation and energy.
- Address national and regional needs to improve transferability.
- Engage the “public”, including decision-makers, practitioners, trendsetters, communities, and local government officials, in exploring and adopting these systems.

<u>Market Research</u>
Conduct basic market research across the country to assist in the implementation of cost-effective and sustainable water infrastructure.

- Identify target audience sectors, including societal and employment roles, age groups, socioeconomic status, and subject informational knowledge levels.
- Develop target-specific research tools and informational packets that include issues, questions, and focus group formulas meaningful to each target sector.
- Prioritize targets for effectiveness, determine feedback and accountability metrics, and define outcomes to ensure research is useful and meaningful.

Water Literacy

Develop effective and scientifically accurate messages in a simple and enjoyable (humorous) manner for delivery via trusted community partners.

- Improve communication of research and science to people.
- Conduct supporting hydrologic (climate change) research, including demonstrations of actual change, that answers basic public questions.