funders' network
FOR SMART GROWTH AND LIVABLE COMMUNITIES

Translation Paper
#14

Edition
#2

The Funders' Network exists to inspire, strengthen and expand funding and philanthropic leadership that yield environmentally sustainable, socially equitable and economically prosperous regions and communities.

Fresh Water and Smarter Growth: Restoring Healthy Land-Water Connections

This second edition translation paper was commissioned by the Funders' Network for Smart Growth and Livable Communities. This paper, written by Ruth Goldman, addresses the impact of poor development decisions and storm water run-off on the nation's water supplies and water quality and offers suggestions for more sustainable water management approaches. The first edition of this translation paper was written in 2004 by Dana Beach with the South Carolina Coastal Conservation League.

Abstract

The paper begins with a description of water resources in the United States, discusses the principles of the land-water connection, outlines the current regulatory framework, and explains the impact of climate change on water resources. The second section introduces the concept of low impact development and many of the green infrastructure tools, with examples of sustainable water management practices at the site, neighborhood, city and regional levels. Next, the paper highlights how funders are having an impact on sustainable water management. Throughout, the paper spotlights case studies of foundation initiatives across the country in urban and rural areas at city and regional scales. The final section touches on entry points into sustainable water management for smart growth funders engaged in a variety of other areas, such as transportation, energy or green buildings.

Introduction

Water quality and quantity issues are approaching crisis levels in many parts of the United States and Americans are worried about the state of water resources. A 2009 Gallup poll identified "pollution of drinking water" and "pollution of lakes and streams" as the country's top two environmental concerns, and "maintaining the nation's water supply" as the fourth most troublesome issue.[1] Current land use patterns combined with aging water infrastructure make a sustainable supply of clean water one of the most critical economic, public health and environmental concerns of this century. The sprawling developments of the last 50 years, as well as the concrete jungles of the city, have separated water from land, disrupting the natural cycle of water (see diagram, pg. 2). Traditional water infrastructure compounds this disconnection and is in need of expensive repairs and updates. A changing climate exacerbates these challenges by increasing the strength and frequency of precipitation in wet places, while leaving arid areas to become drier. Unfortunately, most of the country's water laws are not founded on principles of restoration, but rather on reducing pollutants and contaminants in the nation's waterways and drinking water supplies.

To ensure that healthy, sustainable supplies of water are available to communities nationwide, foundations, advocates, government agencies, and businesses across the country are developing the plans, technology, regulations, and political will to restore the land-water relationship. To do so, water must be integrated into a comprehensive land use planning equation that includes all the key functions of a healthy community: transit, housing, green space, economic development, etc. Restorative water practices and source water protection and conservation must happen at the regional, state, city, neighborhood, and site scale. The principals of the water cycle – keeping water local, mimicking nature, and demand not outstripping supply – are essential.

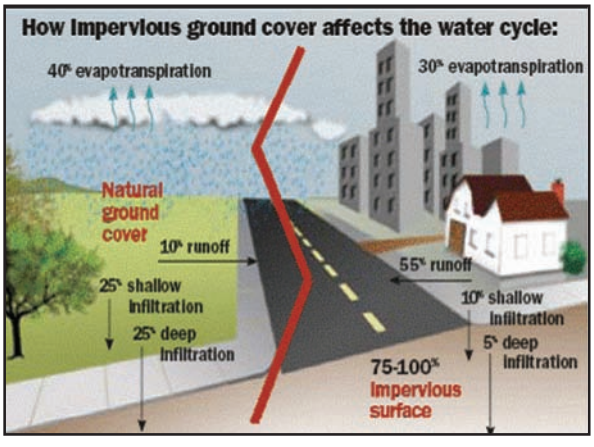
This paper will focus on water run-off, which is at the core of the land-water connection and includes storm water and agricultural run-off. The paper will highlight the emerging movement towards restorative water practices. The goal is to demonstrate that "green" water infrastructure is a key component of smart growth and that making the land-water connection is essential to building healthy, sustainable communities. Whether a foundation is working at the neighborhood or regional scale, focused on policy and regulatory changes, or hands-on implementation, or on any of a myriad of smart growth issues, there is a place to connect to water.

I. The State of Water in the United States

Nearly every region of the United States is facing a distinct water challenge. California is watching the snowpack that is its drinking water supply shrink. In the Southwest, data show that Lake Mead, which supplies water to millions of residents in Arizona, Nevada and southern California, is in danger of becoming a "dead pool" within 50 years, and all along the Colorado River reservoirs are currently at 50 percent capacity from recent droughts.[2] In the south, Atlanta is in a legal battle with Alabama and Florida over the legitimacy of its claim to Lake Lanier, the local reservoir for drinking water, and recent droughts have prompted plans for several desalination plants. Even residents in water rich Massachusetts watch local rivers run dry each summer and experience watering bans on a regular basis. Meanwhile, the dead zones (large oxygen depleted areas unable to sustain aquatic life created by too much nitrogen entering the water) in the Chesapeake Bay and Gulf of Mexico continue to grow, and advocates in Puget Sound and the Great Lakes estimate that irreversible environmental damage to sections of these water bodies may be just moments away if drastic changes are not made.

Current Land Use Patterns and Water

Zoning and development regulations rarely account for the sustainability of the local water supply. Overdevelopment, overuse and inappropriate use of water deplete non-renewable water resources, such as aquifers, and overdraw from rivers, lakes, reservoirs and other renewable resources. Land use and development patterns in the United States exacerbate both water quality and quantity problems. Overdevelopment in regions with limited water resources, disruption of the water cycle through too much impervious surface, untreated run-off entering water bodies, and the destruction of the form and function of rivers, lakes and other water bodies are making the United States increasingly vulnerable to water shortages and poor water quality.



Source: Charles River Watershed Association www.crwa.org

Across the country, vast stretches of pavement from housing developments, roadways and commercial developments in ever-expanding urban and ex-urban areas have so disrupted the natural water cycle that otherwise "water rich" regions are experiencing severe droughts. Infiltration, the process of rainwater seeping through layers of soil and rock back into underground storage areas, is a critical process of the hydrologic cycle. Impervious surfaces such as parking lots, roads and roofs deprive local surface and groundwater sources of the replenishment that comes from infiltration. Impervious surfaces convey large quantities of water across polluted land into local rivers and streams without the benefit of the cooling and cleansing that comes with infiltration. Greater Atlanta, a normally moist area, but also one of the fastest growing, most sprawling and paved areas of the country, recently experienced one of the worst droughts in its history. Reservoirs that once held several years of water nearly ran dry and rivers were unable to recharge. With the lowest green acreage to resident ratios and hundreds of thousands of acres of paved commercial lots, many now vacant,[3] experts believe Atlanta has paved itself into a water shortage.

Consider the typical supermarket mall on a hot day – several acres of pavement and buildings covered in a thin film of fuel oil and dust from nearby vehicles. A small rainstorm washes across this landscape sending gallons of warm, dirty water into nearby streams or storm drains where it is whisked away to settle in a local river, lake or bay. Wet weather events always precipitate increased pollution loads in local water bodies, primarily from polluted run-off overwhelming the systems and flowing directly into water resources. Intensive use of land for food is also one of the main sources of water pollution. Industrial-scale agriculture that uses large amounts of fertilizer and animal farms that contain piles of untreated waste contribute unmanageable quantities of nitrogen and phosphorus (or "nutrients") to streams, lakes and ocean bays through polluted farm run-off. The marine dead zones in the Chesapeake Bay and the Gulf of Mexico and the toxic algal blooms occurring in many rivers are just some of the ecological destruction resulting from this "nutrient loading." Disruption of the natural riparian boundaries between farms and water bodies, including wetlands, increases the direct flow of fertilizers and animal waste into freshwater and marine systems.

Water Infrastructure

Much like the transportation system in the United States, the nation's water infrastructure is old and failing, especially in the former industrial cities of the East and Midwest. Leaky pipes, illicit water hook-ups and sewer overflows ensure that enormous amounts of raw sewage and industrial waste enter the country's waterways on a daily basis. Traditional water infrastructure – for drinking water, wastewater and storm water – disrupts the land-water connection, depletes water resources, and promotes overuse. This steel and concrete infrastructure is also energy intensive to build and maintain. The massive investments now required to maintain

systems in a state of good repair are prohibitively expensive. Estimated gaps in water infrastructure financing over the next two decades range from $150 - $400 billion.[4]

Current water infrastructure is primarily a "single use" system characterized by large underground pipes, pumping stations, storage tanks and treatment centers. Clean water is harvested from reservoirs, aquifers, rivers and other sources, treated and transported for consumption in homes and businesses, and then flushed away into pipes. Wastewater is captured in large, centralized locations where it is treated and transported once again before being discharged, often into water bodies at some distance from the original source. In this system there is no differentiation made for water uses: whether for drinking or watering the lawn, it is all potable water and there is little reuse.

Rain or storm water is conveyed away from development through a system of storm drains and pipes and disposed of in the nearest body of water, oftentimes without treatment. In this system, water never returns to its original source, groundwater and other water sources in urban areas rarely have a chance to recharge, and polluted and warmed run-off enters locals rivers and streams with little opportunity for cleansing. The result is the depletion of groundwater, rivers, aquifers and reservoirs across the country in even the most water rich areas.[5]

Climate Change

A changing climate is having an enormous impact on the quality, quantity and availability of water resources and, unfortunately, only increases the degradation of water resources caused by current land use patterns and today's water infrastructure. A changing climate means steeper peaks and troughs in the drought-flood cycle, triggering increased desertification of arid areas, more severe and frequent storms in wetter regions, rising sea levels, decreased snowpack and receding glaciers.

Traditional water infrastructure and highly developed, impervious land areas exacerbate the effects of climate change on water in communities. In urban areas during even the smallest wet weather events, thousands of gallons of run-off washes across acres of pavement dumping into storm drains, rivers and combined sewage systems. Storage areas are overwhelmed with overflows of polluted water dumping into local water bodies. Backed-up storm drains allow polluted water to run unchecked into local streets and sewage systems back up into people's homes. For example, the Boston area experienced two 50-year storms in a 10-day period in March 2010. A local watershed organization estimated that over 60 million gallons of untreated sewage and polluted water was discharged into the Mystic River during the first storm alone.[6]

Conversely, the same systems and development conditions that exacerbate flooding, also lead to more extreme drought conditions. Because the local water cycle is disrupted, rainwater is not able to infiltrate into the ground, depriving rivers, lakes, reservoirs and groundwater sources of enough water to fully recharge. This leaves regions without adequate stored supplies of water to weather a drought cycle. Surface water storage, unlike underground supplies, is a less effective system, allowing too much water to evaporate during times of drought.

The Great Lakes

The Joyce Foundation is committed to protecting the Great Lakes by promoting clean energy, combating global warming, restoring river ecosystems, and advocating investment in Great Lakes restoration. The Foundation seeks to promote sound public policy at the state and federal level through direct funding of advocacy as well as support for innovative demonstration projects that will leverage regulatory changes. Joyce is particularly focused on building effective collaborations of non-traditional stakeholders with the goal of creating broader political and community support for restoration efforts. Joyce identifies three main areas of concern in the Great Lakes region: reducing non-point source urban and agricultural run-off; restoring critical habitat; and improving coastal health.

The Wege Foundation initiated the 110 member Healing Our Waters (HOW)–Great Lakes Coalition (www.healthylakes.org) which has been instrumental in making the case for restoring the health of the Great Lakes, garnering political support, and amassing considerable resources for on-the-ground restoration projects. The Joyce Foundation and others have also supported this critical work. A key first step by HOW was to commission a research paper by leading scientists to determine the critical challenges facing the Great Lakes and to outline solutions. Prescription for Great Lakes Protection and Restoration: Avoiding the Tipping Point of Irreversible Change, published by the EPA in 2005, served as an advocacy tool for HOW and others as they helped shape what would become the $20 billion plan to restore the Great Lakes. With support from Joyce and other funders, HOW has continued to leverage resources. The Coalition helped secure several billion dollars in State Revolving Funds (SRF) for wastewater treatment and $108 million to clean up toxic hotspots. President Obama pledged $5 billion for Great Lakes Restoration during his campaign, with a first installment of $475 million authorized in the 2010 federal budget; Obama recently announced a $300 million commitment for 2011. An announcement about the Great Lakes Restoration Initiative grants from the EPA is imminent.

Regulation at the Land–Water Intersection

The Clean Water Act (CWA) and the Safe Drinking Water Act (SDWA) are the primary laws governing the nation's waterways and drinking water at the federal level. While enforcement falls under the jurisdiction of the Environmental Protection Agency (EPA), each state can apply for the authority to oversee its own regulatory systems, which most states have done. Implemented in the 1970s and expanded at various points over the past four decades, both laws set and maintain standards for keeping pollutants out of the nation's waterways and drinking water primarily through implementation of best management practices and improved treatment systems. With the exception of the source water protection program, these laws do not focus on conservation or restoration of the land as a vehicle for ensuring water quality. While there are considerable challenges on the enforcement front, advocates and regulators would agree that these laws have been effective in cleaning up the nation's waterways and providing clean drinking water to nearly 300 million Americans.[8]

NPDES System

Under the CWA, the National Pollutant Discharge Elimination System (NPDES) permit program is the main vehicle for regulating water quality under the CWA and was designed primarily to address point source pollution from large industrial style facilities such as factories and municipal wastewater treatment plants using end-of-pipe solutions. First implemented in 1972, NPDES has eliminated most of the egregious discharges that contributed to the heavily polluted rivers of the early 1970s. Currently, there are about 100,000 NPDES permits for point source polluters across the country under the jurisdiction of state environmental agencies and the EPA.[9] The EPA now provides a list of these permits and the state of compliance (http://cfpub.epa.gov/npdes/stateinfo.cfm) as part of its transparency initiative. In 1990, the CWA was expanded to include storm water and the EPA began issuing NPDES permits to large entities such as highway systems, multi-acre construction sites, industrial plants and large municipalities. In 1999, the EPA began requiring storm water permits of smaller municipalities, as well as other smaller industrial and roadway sites. The agency estimates that more than 500,000 storm water permits have been issued across the country.[10]

There are a number of problems with the current storm water regulatory system,[11] not the least of which is the lack of capacity at the EPA and state agencies to monitor and enforce this enormous program. The EPA estimates that there has been a 30 percent reduction in staff levels at the agency and state agencies since the peak levels in the early to mid 1990s.[12] Other challenges include: a reporting structure that

The Mississippi River

The effects of human activity on the shores of the Mississippi have re-characterized the river almost completely: half the length of the river is controlled by dams; 80 percent of the river's edge has been altered to facilitate navigation, and more than 56 percent of its wetlands have been lost. Additionally, two-thirds of the fertilizer in the country is used on land in the upper-basin states, contributing to nitrogen loading that has led to an 8,000 square mile annual "dead zone" in the Gulf of Mexico.[7]

The McKnight Foundation funds in a 10-state river corridor and has refocused its strategy several times, most recently in 2002, to focus on water quality, land conservation and citizen advocacy (www.mcknight.org). The Foundation's achievements are significant and include: the creation of several effective regional advocacy networks to reform the Army Corps of Engineers, to improve water quality across state jurisdictions, and to unify communications about environmental improvements in 10 states; ground-breaking reports on the Army Corps of Engineers and the effectiveness of the Clean Water Act; conservation of 121,000 acres of wetlands and floodplains; changes to the Farm Bill; and mobilization of residents and elected officials to support restoration and leverage $50 million in new dollars.

While McKnight's strategies have been successful in their own right – building important capacity on the ground, preventing large scale destructive projects from taking place, initiating restoration efforts, creating important data resources, and improving the policy framework – water quality on the Mississippi and in the Gulf of Mexico remains troublesome. In fact, in 2008 the dead zone was the largest it's been since record keeping began, and it is becoming clear that climate change will accentuate the declining quality of the water.

In 2008, McKnight undertook a 10-year retrospective to assess the effectiveness of its programs and to identify future projects with the greatest potential for impact. The Foundation determined that a new strategy must hit at the root cause of current problems. To that end, the Foundation's 2010 focus areas address the key impediments to improved water quality: reducing agricultural run-off, the source of up to 80 percent of the nitrogen that fuels the dead zone; restoring and expanding wetlands and floodplains that mitigate pollution and help sustain a healthy river; and ensuring the cross-boundary coordination and enforcement of existing federal and state policies governing water and agriculture as well as advocating for improved regulation. McKnight is building on the success of established coalitions and the capacity of long-term grantees to focus on these three areas.

delegates authority to the dischargers; best management practices that have not been evaluated for effectiveness; a system that measures pollutants, rather than impervious surface, which is easier to calculate; and individual permits that do not account for cumulative impact.

Water Body Standards and the TMDL

The main tool created by the CWA to address the cumulative impact of pollutants on a water body is the TMDL or "Total Maximum Daily Load." This sets a maximum amount of a pollutant that a water body can tolerate (such as nitrogen or phosphorus) and still preserve established water quality standards. This gives advocates a foothold to force polluters to tighten up discharges when pollutant levels exceed those set by the TMDL. Establishing a TMDL is an extensive, multi-year process requiring considerable water quality data, scientific modeling, and extensive advocacy. In a groundbreaking endeavor, the EPA is creating a TMDL for the Chesapeake Bay in an effort to deal with the long-term, chronic water quality issues. Advocates are hoping it will finally give them the teeth to regulate agricultural run-off in the region, known to be the largest contributor to the Bay's dead zone.

Limits of the Clean Water Act

The authority of the Clean Water Act is confined to surface waters, leaving out such critical issues as overdrawn aquifers, polluting discharges to groundwater and inter-basin transfers. Advocates and regulators alike have known for some time that run-off from agriculture uses and impervious urban areas contributes to at least 50 percent of water pollution in this country. Both fall outside the CWA. With the exception of large concentrated animal feeding operations, agricultural uses of land are not required to have permits, although the Department of Agriculture is focusing more efforts on incentive-based initiatives to support more sustainable agriculture practices.[13]

In the vacuum, local laws have prevailed, frequently with unforeseen and dire consequences. In the West and Southwest, underground water resources are often included with land rights, giving existing or historic use priority over recent arrivals. Older farms have the right to essentially "irrigate the desert" while newer urban residents face water shortages.[14] In the interstate "water war" between Alabama, Florida and Georgia, Atlanta may find itself completely cut off from its primary water source because of interpretations of upstream/downstream water rights.[15] In the most famous of regional agreements, all eight states bordering the Great Lakes, home to 20 percent of the world's fresh water supply, have created the Great Lakes Compact to restrict export or inter-basin transfers (www.cglg.org/projects/water/CompactImplementation).

II. Green Infrastructure Tools: Land Use Planning, Low Impact Development and Water

"There is a direct relationship between land cover and the biological condition of downstream receiving waters…. Although not every degraded water body is a product of intense urban development, all highly urban watersheds produce severely degraded receiving waters."

(2009 National Research Council Report on Urban Storm water Management in the United States).

This 2009 National Research Council report on storm water summarized the challenges with regulation at the land-water interface by reflecting that water management and land use planning are rarely integrated under any government authority. Federal and state authorities are responsible for water management, while planning is the purview of municipalities. Water management projects, such as dams, treatment plants and sewage systems, are often large-scale and multi-jurisdictional, while cities and towns focus on zoning and other local land use regulations. City and town officials are often looking to create jobs and increase the tax base, while federal or state environmental agencies are looking out for water resources. Although the two are deeply connected – many businesses require access to water for operation and new residents require adequate amounts of water – there are few incentives for the different parties to cooperate.

Recent polls demonstrate that Americans connect availability of clean, fresh water to satisfaction with where they live,[16] and have some basic understanding about the contribution of development and industrialization to water degradation.[17] However, it will require a paradigm shift in planning and development practices, water management technologies, individual behavior and regulation to become a society that both values water and implements restorative practices. Both advocates and government agencies have articulated the need to integrate water resource management into local development and to elevate planning to the regional or watershed scale. Development needs to take into account the cumulative impact on regional water resources. Regional water systems need to be protected by local, restorative solutions that keep water resources replenished. Gaps in regulation at the land-water interface need to be addressed through stricter interpretation and enforcement of current

Chesapeake Bay

The Chesapeake Bay, whose waters meet quality standards barely 24 percent of the time, is currently ground zero for reforming the Clean Water Act. Funders, notably the Keith Campbell Foundation and the Chesapeake Bay Funders Network, have played a key role in making this happen by attracting federal attention and resources to the Bay and establishing the Chesapeake as the nation's testing ground for stronger regulatory enforcement. In May 2009, the President signed an Executive Order (www.executiveorder.chesapeake.net) that recognized the Chesapeake as a national treasure and pledged renewed support to restore the Bay. In response, the Chesapeake Funders launched the Choose Clean Water Coalition, (www.choosecleanwater.org) to ensure the regulatory reform and resources necessary to reduce pollution flowing into the Bay, with a focus on storm water and agricultural run-off.

The Coalition is in an important battle to pass federal legislation known as the Chesapeake Clean Water Act. The bill would establish a precedent setting framework for reducing pollution in the Bay by: using science to set "hard cap" limits to the pollution entering the Bay from the 64,000 square mile watershed; coordinating efforts among the six states and the District of Columbia; mandating strong state implementation plans backed up by federal oversight and funds for regular monitoring; and rewarding market based approaches. The legislation comes with $1.5 billion for implementation. Of note, is the Coalition's sophisticated messaging and communications strategy, undertaken with the guidance of ActionMedia. With support from funders, the Coalition conducted focus group research that helped frame the issues and target the key audience.

The EPA is moving ahead to establish a TMDL for the Bay, which will require reductions in pollutants from all sources and close the loophole for animal agriculture, the most significant contributor of pollution to the Bay. The new storm water rules, expected by 2011, will also positively impact water quality. In May 2010, the EPA released the Strategy for Restoring the Chesapeake Bay and the guidance for managing federal lands in the watershed. Both feature ecosystem based approaches and rely heavily on restoration projects, riparian buffers for managing nutrients from agriculture, land conservation and other green infrastructure techniques (http://executiveorder.chesapeakebay.net/).

policy and, most likely, new laws governing unregulated areas like agriculture and urban run-off. Development must also account for the real cost of water – and the cost of polluting water. When implemented effectively, this strategy should not only produce cleaner water, but also, greener, economically more efficient communities.

Evidence of a shift in strategy is beginning to emerge. Regional level planning and resources are beginning to flow towards large, multi-state and international water bodies like the Great Lakes and the Chesapeake Bay. Policy decisions that mandate regulation of the cumulative impacts of pollution, such as the new TMDL in the Chesapeake Bay, are piloting coordinated, regional solutions that will require expanded regulation. Solutions that integrate low impact development technologies, regulatory reform and inter-agency cooperation are starting to gain traction at the local level. In Milwaukee, a regional alliance of watershed organizations, businesses and government agencies are creating and implementing watershed restoration plans that employ green technologies for managing agricultural and urban run-off, saving millions of dollars in infrastructure costs, and creating recreation amenities for residents and economic development opportunities for businesses. While state and federal resources are necessary for large-scale planning and projects, local design and implementation is critical to ensuring that monies are utilized effectively

Green Infrastructure and Low Impact Development

Green infrastructure includes everything from naturally occurring wetlands or parklands to designed solutions like rain gardens, swales, green roofs and other techniques that utilize soil and vegetation. Green infrastructure provides

many social, economic and environmental benefits and is an important component of building sustainable communities. In urban areas, engineered and natural green infrastructure cleans and restores groundwater, supports in-stream flow, improves water quality for aquatic species and human uses such as swimming and boating, reduces flooding, and cleans and cools the air. In more rural areas, green infrastructure, such as riparian zones, wetlands and floodplain restoration, protects source water, helps clean and restore surface and groundwater supplies, reduces sediment run-off and pollution from run-off, and prevents flooding. In a report produced for the city of Philadelphia, the researchers documented the "triple bottom line" effect of integrating green infrastructure into the management plan for the Combined Sewer system. The conclusions are significant: this approach resulted in a 20-fold increase in value including such social benefits as local, green jobs, more parkland and decreased heat related mortality. Environmental benefits include reduction in energy use, ecological restoration, and improved air quality, and reduced noxious emissions. The economic benefits range from fewer disruptions from construction and maintenance activities to higher property values and lower overall costs.[18]

Green infrastructure is a critical component of low impact development (LID), defined by the EPA as a "comprehensive storm water management and site design technique whose goal is to produce a hydrologically functional site that mimics pre-development conditions." LID is an important tool for planning and development at the regional/watershed or local/parcel level. These design techniques operate at the land-water interface, preventing development from harming local water resources and safeguarding the water cycle. LID practices support the core functions of the water cycle and help capture and reuse storm water close to its source. LID techniques can be applied at the parcel and subdivision scale and emphasizes use of on-site natural features (wetlands, streams, trees) integrated with small-scale engineered systems (drainage pits, swales) to more closely mimic predevelopment water flow[19]

The Center for Neighborhood Technology has begun to quantify the health, climate change mitigation, economic values, and a variety of other social, environmental and economic benefits derived from a range of green infrastructure techniques such as green roofs, bio-swales, urban forest, constructed wetlands, etc. On almost any scale, green infrastructure far surpasses traditional infrastructure in providing social, economic and environmental benefits.[20]

Green Infrastructure and the EPA

The EPA is a strong proponent of green infrastructure through its storm water programs. The EPA-commissioned 2008 National Research Council report on urban storm water regulations found them lacking in many areas described above. However, it concluded, "Control

Milwaukee & Toledo

The Joyce Foundation is piloting watershed level planning work in two urban areas, the Maumee River in Toledo, Ohio, where the focus is agricultural run-off, and the Southeast Wisconsin watersheds in Milwaukee, Wisconsin, where the focus is primarily urban run-off. In Toledo, Joyce aims to advocate for stronger federal and state policies limiting agricultural run-off. In Milwaukee, the Foundation is funding a pilot watershed planning process to leverage EPA planning policies.

Advocates on the Maumee are working with state agency staff to employ many of the incentive-based conservation programs at the Department of Agriculture for managing agricultural run-off. Joyce funded American Rivers to write a comprehensive Low Impact Development (LID) Manual that provides a framework for a watershed-based approach to mitigating run-off in rural, agricultural and urban areas using green infrastructure and other best management practices. The manual demonstrates the economic, regulatory and social benefits to using LID and green practices and is designed for the technical staff at city, town and state agencies.

In Milwaukee, Joyce is focused on making Southeast Wisconsin a model for watershed restoration using green infrastructure that it hopes will leverage a watershed permitting process at the EPA. In 2008, Joyce helped convene the Southeastern Wisconsin Watersheds Trust (www.swwtwater.org) a multi-stakeholder collaboration focused on restoring Milwaukee-area rivers. The goals of the Trust are to restore water quality through better land use practices, regulatory reform and leveraging of resources. Trust partners will create watershed management plans, design and analyze best management practices, engage volunteers in water quality monitoring, and help remove regulatory and institutional barriers to implementing watershed restoration plans. The Trust also has been charged with employing a communications strategy to advance its work with the public and decision makers.

Funding will come from various sources. For instance, the Milwaukee Metropolitan Sewerage District, a Trust partner, has just begun to implement its $1 billion Regional Water Quality Management Plan. It recently awarded $3.7 million in green infrastructure grants to 14 groups in the area. The grants will support a range of green roof projects, as well as an education center focused on Best Management Practices in green infrastructure. Trust partners have also applied for Great Lakes Restoration Funds.

measures that harvest, infiltrate, and evapo-transpirate storm water are critical to reducing the volume and pollutant loading of storms." That same year, the EPA together with a group of advocates and other key stakeholders created an Action Strategy to promote the use of green infrastructure to reduce run-off, manage overflows from combined and separate sewage systems as a part of municipal storm water programs, and in non-point source and watershed planning efforts.[21]

The EPA is currently in the process of integrating green infrastructure standards, requirements and recommendations into many aspects of the storm water program. The Clean Water State Revolving Fund (SRF), the EPA's largest water quality financing program, supports drinking water and wastewater projects, as well as non-point source pollution control and watershed and estuary restoration. In 2010, the SRF will provide approximately $3.5 billion in loans and grants for water infrastructure projects. The EPA encourages use of green infrastructure for these projects (/www.epa.gov/owm/cwfinance/cwsrf/innovations.htm). In 2009, as part of a $6 billion allocation to the SRF for the American Reinvestment and Recovery Act, the EPA instituted a 20 percent set aside for green infrastructure projects. In many cases, these became outright grants, not loans. This has continued under the 2010 reauthorization, providing $700 million for Green Reserve projects across the country, and the non-profit American Rivers has documented both the successes and challenges of the program. While many states have made use of the programs to leverage green infrastructure projects, others have encountered regulatory problems and resistance by local agencies.[22] The EPA is also working with communities to integrate green solutions into storm water control plans, especially to mitigate overflows. Cleveland, Philadelphia, Kansas City, Chicago, Milwaukee and Toledo, to name a few, are working to incorporate engineered and natural green infrastructure solutions, often alongside traditional grey structures, to better manage run-off.

At the policy level, the EPA has integrated green infrastructure into management of federal properties in the Chesapeake Bay region, requiring managers to employ best practices for reducing nutrient loading and sediments into the Bay. The EPA is considering integration of green infrastructure into current rule-making efforts on storm water.[23] This will affect municipal permits, new and existing developments, and may include a larger number of regulated discharges. The EPA is also considering more stringent standards for sensitive areas, such as the Chesapeake.

Green Infrastructure and Climate Change

Green infrastructure can help communities manage a changing climate. A changing climate means disruptions in the water cycle, with more frequent and severe precipitation events followed by longer periods of drought. Engineered (porous pavement, swales and drainage pits) and naturally occurring green infrastructure (wetlands, parklands) provide a greater ability to absorb and store surface waters and support infiltration to sustain groundwater, thus softening the extreme flood/drought cycle.

A 2009 report by American Rivers documents how eight communities across the country increased resilience to climate change through sustainable water systems.[24] Green infrastructure also mitigates the two primary public health impacts of global warming: an increased number of heat days and poor water quality. Green roofs, swales and street trees reduce the heat island effect, providing cooler and cleaner air for residents, especially those most at risk from higher temperatures, like the elderly and low-income families. As mentioned previously, wet weather events increase pollution load to local water bodies. By reducing impervious surfaces and allowing rainwater to infiltrate more quickly, these tools also help clean and restore surface and groundwater supplies.

Green Infrastructure and Sustainable Development

At the building, neighborhood and city scale, funders, advocates, elected officials and developers are exploring ways to conserve, reuse and restore water resources to solve water quality and quantity issues. Utilizing green infrastructure tools, conservation techniques and new technologies for wastewater treatment, developers, city planners and others are creating and implementing a variety of innovative pilot projects that greatly increase the sustainability of a community and preserve and restore water resources.

The EPA Chooses Kansas City as a Demonstration Site for Green Solutions

To solve significant sanitary sewer overflow and combined sewer overflow problems in an aging system, Kansas City has committed to spending $2.5 billion over 25 years to retrofit the 420 mile sewer system that serves more than 650,000 people in 28 communities. The system has experienced more than 1,200 back ups and overflows since 2002. The EPA has provided resources for the extensive modeling undertaken by the Kansas City water department, and the EPA Office of Research will provide funding to evaluate the water quality improvements, create models for predicting the value of green infrastructure to water quality and quantity improvements, and develop economic models for the cost effectiveness of green infrastructure moving forward.*

*Source: Demonstration of Green/Grey Infrastructure for Combined Sewer Overflow Control. National Risk Management Research Laboratory, Environmental Protection Agency, October 2009.

Philadelphia

The William Penn Foundation has a long history of funding water restoration and protection projects in the Delaware and Schuylkill River watersheds of Greater Philadelphia, with a strong record of supporting efforts to advance green infrastructure, including communication of best management practices, model projects promoting regional collaboration, and state and federal advocacy. The Foundation is also deeply committed to the vibrancy of Philadelphia's urban core, with a major strategy being environmental revitalization. The Foundation's longstanding commitment to urban parks, community gardens and vacant land transformation comes out of this strategy.

For the William Penn Foundation, and Philadelphia residents, the city's storm water problems are connected to community wellbeing and a healthy, vibrant future. In 2007, as a lead-in to the mayoral election, the Foundation helped initiate Next Great City, a community coalition to develop a sustainability agenda for Philadelphia. Five of the 10 action items identified (www.nextgreatcity.com/actions) related to improved green infrastructure in the city (trees, parks, accessible waterfront) and better storm water management (reduced flooding and sewage back-up). Since Mayor Michael Nutter's election in late 2007, the Foundation has been instrumental in maximizing his commitment to a green Philadelphia, including support for Greenworks, the blueprint for achieving a sustainable Philadelphia, which includes metrics for storm water management and green infrastructure. As a result of its efforts, the Next Great City coalition successfully advocated for the city to implement a new commercial storm water rate structure that charges businesses based on the amount of impervious surface they own. Philadelphia's system is not the first, but it is significant because the rates are creating a market incentive for green infrastructure to capture the first inch of storm water. Essentially, it will become cheaper to "go green."

Last year, the Philadelphia Water Department released its Green City, Clean Waters plan (www.phillywatersheds.org), a 20 year, $1.6 billion investment by the City of Philadelphia in green water infrastructure that will enable the city to meet its compliance goals under the Clean Water Act. Plagued by the crumbling infrastructure endemic to older cities and pollution to local rivers from combined sewage overflows, Philadelphia is proposing a comprehensive land and water management approach that includes focuses on addressing rain or wet weather where it falls instead of speeding it to the sewer system through techniques such as street trees, open space amenities, and green streets. "We aim to integrate water resource management into the socioeconomic fabric of the City" declared Howard Neukrug, Deputy Commissioner, Philadelphia Water Department. To make the case, the city commissioned a study that articulates the social, environmental and economic benefits of green vs. conventional infrastructure for the community. Despite the enthusiasm for the plan from residents, advocates and elected officials, the regulatory and financing challenges are significant and complex.

Much of William Penn Foundation's support related to the plan has gone towards research and advocacy for informing the regulatory approvals process, innovative financing strategies, and state and federal funding sources for implementation.

III. Foundation Leadership at the Land-Water Interface

Foundation leadership at the land-water interface is coming from many local and regional funders whose primary goal is restoration of the ecological health of water bodies and the communities that surround them. The case studies highlighted in this report illustrate some of the effective strategies foundations have employed – in many cases as part of a funder collaborative or as strategic partners with other foundations and public agencies. Most of the funders do not have a "smart growth" framework for their water work, but they do believe sustainable water management is critical to the health and vitality of communities and local economies, as well as to the water resource itself.

Current Strategies

Progress at the land-water interface requires that foundations employ several strategies simultaneously. As mentioned above, a big challenge with run-off is the cross boundary aspect of water resources and regulating across city and state boundaries. Foundations continue to be especially helpful in creating regional or watershed level coalitions and partnerships with the capacity to advocate and implement projects beyond the usual political boundaries. Nearly all the case studies illustrate this strategy. Another significant challenge is the gap between government policies and programs on paper and enforcement or implementation on the ground. The case studies describe many examples of ways to connect regulation to demonstration. To summarize, here are some of the successful foundation strategies highlighted in the case studies:

- Partner with other foundations to fund projects, research and advocacy efforts (Chesapeake Bay, Great Lakes);
- Create/catalyze regional, multi-sector coalitions that can leverage significant resources and policy change at the state, regional and the federal levels (Chesapeake Bay, Great Lakes, Mississippi);
- Fund all aspects (research, science, citizen engagement, advocacy, etc.) of innovative, place-based work that expands current or pushes new policies (Chesapeake Bay, Boston, Philadelphia, Milwaukee, Puget Sound);
- Fund advocacy for federal and state policy change emerging from and linked to strong demonstration projects (All);
- Support local collaborations engaging business, residents, municipalities, advocates and public officials to create multi-sector opportunities that provide multiple benefits beyond water restoration in green jobs, economic development, public health, etc. (Philadelphia, Milwaukee).

Each foundation highlighted is also pursuing a number of specific opportunities to advance policies and practices to manage storm water and agricultural run-off. Many of these are in response to or in support of EPA programs or proposed areas of regulation. Others seek to create more general understanding of, support for, and funding of watershed restoration efforts utilizing green infrastructure such as:

- Developing green infrastructure implementation manuals, best practices for watershed restoration, and training of municipal officials and other key stakeholders;
- Researching and developing financing models (incentive, fees, tax structures) to generate funds for green infrastructure investment;
- Gathering the scientific data and computer modeling necessary for the TMDL designation, which can be used to implicate urban run-off and storm water as pollutants (similar to Chesapeake Bay process);
- Undertaking economic development studies that make the case for green infrastructure by accounting for community benefits;
- Advocating with state and federal governments to spend State Revolving Fund set asides on green infrastructure projects;
- Advocating for integration of green infrastructure as part of the solution for new and updated storm water permits;
- Urging federal and state officials to include green infrastructure solutions as part of the compliance plans for urban areas under enforcement orders;
- Educating the public about storm water and green infrastructure.

IV. Smart Growth Funders and Water

This section discusses how foundations with a commitment to smart growth and creating sustainable, healthy communities can make the connection to restorative water practices and especially green infrastructure.

Energy: Increased awareness about the interconnectedness of energy and water has spurred a plethora of new studies in the past few years, including work by the Natural Resources Defense Council, the Pacific Institute and River Network.

Water utilization is highly energy intensive and, conversely, the energy extraction process requires huge amounts of water. On average, 13 percent of the annual energy use in the United States is used for water consumption, with large variation by region. For example, California estimates that 19 percent of the state's electricity and 33 percent of its natural gas consumption goes towards pumping and treating water.[25] In southern parts of the state, a glass of water may travel 444 miles and climb 3,000 feet to reach its customer. The Alliance for Water Efficiency estimates that water efficiency and conservation measures alone could save communities enormous amounts of money in energy and avoided infrastructure costs without compromising quality of life. Conversely, 39 percent of annual water withdrawals in the country support energy production.[26] Many of the alternative solutions being contemplated by the energy community require large amounts of water and contribute to increased water pollution. Crop-based bio-fuels are especially problematic, requiring significant irrigation and large amounts of fertilizer.[27]

Climate Change and GHG Reduction: Moving, treating and cleaning water is currently responsible for 5 percent of the nation's carbon emissions.[28] However, a changing climate is rapidly increasing this number.[29] Desalination, the most energy intensive method of fresh water extraction, is coming on-line. California is on tap to build 20 ocean desalination plants and Atlanta up to five, with two built in the last five years. Even water rich Massachusetts has two desalination plants.

Green infrastructure can play a key role in reducing greenhouse gases through avoided costs. By restoring local water supplies it prevents the need for more water extraction and transport infrastructure. By helping to cool local communities, it reduces the need for energy intensive cooling systems. In California, the NRDC estimates that implementing green infrastructure strategies to restore and protect groundwater is 10 times more energy efficient than current inter-basin transfers and 20 times more efficient than building desalination plants.[30] Because energy intensity varies by region, areas that would benefit from analysis include calculating the carbon footprint of projected water infrastructure needs locally and calculating future energy costs for cooling systems related to a changing climate.[31]

Land Use Planning: While storm water management is impacted by sprawl, wastewater and drinking water systems can be huge drivers of sprawl. Zoning for large acre lots in rural and suburban communities is often instituted to avoid centralized water systems necessary with denser development. Adding capacity to sewage systems in already sprawling areas can further spread greenfield development. Conversely, fixing aging systems in town centers, while expensive, can prevent greenfield development. The key is to make it economically feasible. An emerging advocacy and technology sector is promoting decentralized systems and "smart sewering" – less expensive local wastewater treatment, perfect for small town centers, which is capable of capturing methane from waste to generate the energy needed to treat the water.[32] Incorporating innovative water treatment systems may be critical to getting local support for denser, smarter development.

Transit Oriented Development (TOD): Many foundations are supporting development near transit that incorporates housing, public transportation, parks and open spaces, and often, green buildings. Restorative water practices at the site and neighborhood scale, like those described in the examples, can and should be included in TOD planning and implementation. Green infrastructure will make communities more healthy and livable and save money that would otherwise be spent on pipes, storage tanks and energy.

Green Buildings: With increased adoption of LEED for Neighborhood Development standards and the Living Building Challenge, on-site water conservation and reuse strategies are becoming much more prevalent. Making buildings water neutral is a key part of making them carbon neutral. The utilization of external green infrastructure, such as green roofs and rain gardens, also contributes to reducing energy demand and capturing water on-site for reuse. The challenge is to reform local regulations regarding grey water, reuse rainwater harvesting, and on-site wastewater treatment.

Water Independence in Buildings: Central City Concern in Portland, OR

A community development corporation with 23 buildings and over 1,400 units of affordable housing, Central City Concern (CCC) decided to pursue the Living Building Challenge (www.cascadiagbc.org/lbc/) for its new 175 unit low-income, family development. With funding from the Bullitt Foundation, CCC put together a development team to explore the water independence goal. Using water efficient fixtures could achieve 30 – 40 percent water savings, but additional uses of rainwater and recycled wastewater would bring efficiencies to 70 percent. The team concluded that harvesting rainwater and reusing wastewater were critical components to meeting its water independence goal, but these technologies were impossible under current Oregon regulations. CCC and partners determined that regulatory change to allow reuse of "grey" water (the term for recycled wastewater) and rainwater in buildings was the single most important determinant for water efficiency. With over 100 partners, CCC pursued a reform strategy that led to changes in Oregon's state laws. Use of grey water and rainwater is now allowed in buildings without special permits. CCC received an award from the Sustainable Buildings Industry Council in 2010 for this precedent setting accomplishment.

Puget Sound

In 1988, Puget Sound was designated one of America's Estuaries of National Significance. Yet by the early 21st century, the Sound was judged by advocates and elected officials alike to be in dire condition. In 2007, the newly formed Puget Sound Partnership (www.psp.wa.gov) identified pollution, primarily from non-point sources, and habitat loss or alteration, as the two most significant threats to the Sound. The Sound has attracted nearly $150 million in federal funding over the past two years, and the Puget Sound Recovery Act was introduced in Congress, passage of which would guarantee a reliable stream of funding. In May 2010, the state came remarkably close to passing storm water legislation. As consolation, the legislature set aside $50 million as a "down payment" for retrofits, low impact development and other storm water projects.

The restoration of the water in Puget Sound has been the central focus of The Russell Family Foundation's environment program for years and its support has underwritten many important achievements by advocates in the region. Worried about the slow rate of progress, the Foundation conducted a program review, which concluded that "polluted run-off is, by many orders of magnitude, the biggest threat to the health of Puget Sound." (Presentation to the Trustees, Spring 2010. The Russell Family Foundation internal document.) The projections for continued regional population increases (from 3.5 million in 2000 to 5 million by 2020) led the Board to realize that changing how people live on the land is critical to preserving the health of Puget Sound.

The new environment program strategy will focus primarily on storm water and promoting green infrastructure as a solution. The Foundation also will support demonstration projects and collaboration in a single watershed to create a road map for how best to invest in local community-based efforts to curb polluted run-off and encourage green infrastructure. In addition, the Foundation is looking to create a new research capacity, such as a new facility at the Washington State University Extension center in Puyallup, which can test the effectiveness of low impact development technology. Believing that "macro policies are important, but the fixes are at the local level," the Foundation is committed to making a difference in the water quality and the lives of people living in Puget Sound. It will do so by supporting green infrastructure projects and connecting these successes to local, state and federal policy efforts, such as the efforts underway to re-write storm water regulations at the state and federal levels. Russell is very focused on building regional collaboration through communications and messaging. In May 2010, the Foundation partnered with the Bullitt Foundation and Northwest Fund for the Environment to host a Storm Water and Green Infrastructure convening for 50 plus grantees and partners. Resource Media gave an eye opening presentation that highlighted the enormous vacuum around public engagement with this issue. The firm stressed the need for straightforward, non-technical communications delivered by respected messengers in a non-technical way that connects to people's values about water.*

*Source: Storm water and Puget Sound. Resource Media, May 2010.

Water Restoration at the City Scale: Natural Storm Water Management in Portland, OR

Portland has embraced a combination of traditional engineering solutions and innovative green approaches to solving its storm water and sewage problems. Portland's natural storm water management programs, while still relatively new, have already demonstrated their effectiveness in controlling storm water runoff. The Downspout Disconnection Program removes more than 1.2 billion gallons of storm water from the sewer system every year. Green Street projects have been shown to retain up to 94 percent of rainfall and to reduce pollutants by 90 percent. Citywide, Green Street projects currently retain and infiltrate 36.9 million gallons of storm water per year and have the potential to manage 7.9 billion gallons, or 80 percent of Portland's runoff annually. Ecoroofs in Portland have shown similarly impressive results, reducing peak storm flows 81 to 100 percent and retaining an average of 60 percent of the runoff.*

*Source: Hewes, W. and Pitts, K. Natural Security: How Sustainable Water Strategies are Preparing Communities for a Changing Climate. Washington, D.C.: American Rivers, 2009.

Parks and Open Space: Parks and open spaces are essentially the green infrastructure of cities and this infrastructure can be exploited for restorative water management. Park advocates and funders should be eager to encourage green infrastructure development because of its double benefits – water management and green space amenities that residents often demand, such as street trees, pocket parks, community gardens, day-lighted streams and greenways.

Green Jobs: The connection between water restoration and green jobs is very much in the emergent stages, yet, the potential is enormous. The Alliance for Water Efficiency and American Rivers produced a report detailing the kind and quantity of jobs produced through just three areas of green water infrastructure: green roofs, water efficient appliances and wetland restoration.[33] Building and maintaining green infrastructure is a way to support the new green economy with high road career pathways. Instead of engineering cement and steel, green technology requires an understanding of hydrology, plant science and biological interactions at many levels.

Environmental Justice: Funders interested in equity and environmental justice communities have a substantial stake in water restoration efforts. There is no question that those who suffer the most from degraded water quality, flooding and polluted water bodies are the poor, especially those in urban areas. Restoration of urban water systems using green infrastructure provides not only clean water, but public health, recreation, and the active transportation benefits that come with green streets, such as those in Portland.

Water Independence at the Neighborhood Scale: Dockside Green in Victoria, B.C.

Dockside Green is a 15-acre mixed residential, commercial and retail development on former industrial harbor land in Victoria, B.C. (www.docksidegreen.com). Through on-site wastewater treatment, water reuse and, water efficient fixtures, Dockside Green expects to achieve 70 percent water savings in its commercial and residential buildings. Surrounding the building, green infrastructure works to manage storm water through green roofs, gardens, swales and other infiltration features built into the active transportation features of the development.

Boston

While the waters of Boston Harbor are much improved as a result of a 1985 Clean Water Act case against Massachusetts, the three rivers draining into the Harbor remained impaired. In 1995, when Federal officials started rating rivers, the Charles River earned a D. It was safe for boating and swimming only 39 percent and 19 percent of the time, respectively. That year, the head of EPA's New England Office, John DeVillars, pledged that the Charles would be safe for swimming by 2005. To some, this seemed an impossible goal for the famously fouled river that inspired the 1960's song "Dirty Water." Yet, a unique partnership between two area nonprofits - the Charles River Watershed Association (CRWA, www.crwa.org) and the Conservation Law Foundation (CLF, www.clf.org) – helped make this vision a reality. The partnership was supported by the Barr Foundation (www.barrfoundation.org), a private family foundation whose mission is to support gifted leaders and networked organizations working in Boston and beyond to enhance educational and economic opportunities, to achieve environmental sustainability, and to create rich cultural experiences – all with particular attention to children and families living in poverty. While many nonprofits were already focused on the Charles River, Barr hypothesized that transformative change could only occur with a networked approach.

CRWA's expertise at scientific analysis and advocacy complemented CLF's core competencies in law and policy. Together, the organizations sought: 1) to prove that non-point source run-off, primarily from large tracts of impervious surfaces, such as office parks and malls, was the main contributor to impairment (nutrient loading) of the Charles; 2) to establish legal precedent for permitting these establishments; and, 3) to promote long-term sustainable solutions, such as green infrastructure.

Utilizing scientific data from extensive volunteer water quality monitoring and computer modeling, the partnership proved that over 65 percent of the total nutrient load came from non-point run-off. Then, through a variety of legal strategies, the partnership convinced Region 1 EPA and the State to use the Clean Water Act's Residual Designation Authority to begin permitting storm water from non-point sources. This use of Residual Designation is a first in the nation ruling, with potential for impact across the state, the rest of Region 1 and the country.

In 2008, following dramatic success on the Charles, and similar gains on the Neponset, public attention turned to the Boston Harbor's third river – the Mystic. Highly industrial, densely populated, and home to eight of the state's fifteen communities considered "intensely overburdened" by environmental hazards, clean up of the Mystic represents an enormous challenge. As it had with the Charles, Barr put its resources behind a network strategy. CRWA and CLF were joined by community-based and environmental justice groups in a new network, called the Mystic River Collaborative. The Collaborative's goals for water quality are similar to earlier work on the Charles. Yet, the expanded network helps ensure other goals are advanced as well – access to the river, community empowerment, and environmental justice. Starting with legal advocacy and a robust water quality program, the toolbox for change now includes community organizing, youth leadership, public education, and citizen engagement. A first win came soon after the Collaborative began. In 2009, the group secured oil settlement funds for the Mystic from the North American Wetlands Conservation Act. These funds were allocated for two "Blue Cities" projects that will build park spaces and plant trees, while also managing storm water.

V. Conclusion

Traditionally, there has not been much conversation between water funders and smart growth funders. However, the regulatory imperatives to better manage storm water in cities and the demonstrated impact of storm water and agricultural run-off on national water bodies is changing this dynamic. The message is clear: now is the time to fully integrate sustainable water practices with a smart growth agenda. The incentives are clear on both sides. Water advocates understand that preserving greenfields, maximizing density, and promoting sustainable agriculture help preserve and restore water resources. Smart growth advocates are learning that green infrastructure can be an important addition to housing and transit projects that maximizes benefits for communities. The looming costs of cleaning polluted waters, fixing decaying infrastructure and managing climate change are arguably providing just the crisis needed to catalyze transformational change.

There is a role for both water funders and smart growth funders and it is important to work together. There is a need for more in-depth conversations between funders about how to balance smart growth and water issues, build alliances, and advocate for the right regulatory sticks and economic incentives, like those underway in Philadelphia, that drive dramatic behavior change. Effective communication that educates communities about the challenges and engages them in solutions is essential. People need to understand how smart, sustainable restorative development will create healthier communities and promote prosperity for all residents.

Endnotes:

1. Gallup Environmental Survey conducted March 5 – 8, 2009. As sited on Gallup website March 25, 2009. www.gallup.com/poll/117079/Water-Pollution-Americans-Top-Green-Concern.aspx.

2. Stacker, David. "Water Scarcity and Urban Growth." On Common Ground, Summer 2010, pp. 34 – 39.

3. Hughes, Joseph (et al). Red Fields to Green Fields: Parks Solve the Urban Real Estate Crisis. Atlanta: Georgia Institute of Technology, January 19, 2010.

4. Sustainable Water Resources Management, Volume 3: Case Studies on New Water Paradigm. EPRI, Palo Alto, CA and Tetra Tech: 2009. 1020587.

5. Ibid.

6. Kassell, John and Khalsa, EkOngKar Singh. "Rain Delay." The Boston Globe Op-Ed, April 26, 2010.

7. The Headwaters Group. Plotting a Future Course on the Mississippi River: An Assessment of the McKnight Foundation's Mississippi River Program. Minneapolis, MN, 2009.

8. Holman, Bill. "Considering the Clean Water Act." The Johnson Foundation at Wingspread Conference on the Clean Water Act, October 2009.

9. Urban Storm water Management in the United States. National Research Council of the National Academy of Sciences, 2009.

10. Ibid.

11. Ibid.

12. Conversation with Curt Spalding, Administrator, EPA Region 1. Boston, March 5, 2010.

13. Low Impact Development Manual for the Lower Maumee and Ottawa River Watersheds. Prepared by Tetratech for American Rivers, 2010.

14. Stacker, David, op cit.

15. Stacker, David, op cit.

16. 2009 Gallup-Healthways Well-Being Index. As sited on Gallup website April 22, 2010. www.gallup.com/poll/127496/Portland-Leads-Easy-Access-Clean-Safe-Water.aspx

17. Upstream – Downstream: Voter Perspectives on Clean Waterways. ActionMedia, March 2010.

18. Triple Bottom Line Assessment of Traditional and Green Infrastructure Options for Controlling CSO Events in Philadelphia's Watersheds. Prepared by Stratus Consulting Inc. for the City of Philadelphia Water Department, 2009.

19. Low Impact Development Manual for the Lower Maumee and the Ottawa River Watersheds, op cit.

20. Wise, S. et al. Integrating Valuation Methods to Recognized Green Infrastructure's Multiple Benefits. Chicago: Center for Neighborhood Technology, 2010.

21. Managing Wet Weather with Green Infrastructure: Action Strategy 2008. Environmental Protection Agency and others.

22. Conference call with Katherine Baer from American Rivers, March 16, 2010 hosted by Consultative Group on Biodiversity for Stormwater Working Group.

23. Ibid.

24. Hewes, W. and Pitts, K. Natural Security: How Sustainable Water Strategies are Preparing Communities for a Changing Climate. Washington, D.C.: American Rivers, 2009.

25. Beckman, D. et al. A Clear Blue Future: How Greening California Cities Can Address Water Resources and Climate Challenges in the 21st Century. San Francisco: Natural Resources Defense Council, 2009.

26. Sustainable Water Resources Management Volume 3, op cit.

27. Water: Still Ethanol's Achilles Heel. River Network Blog by Travis Leipzig. July 6, 2010.

28. Sustainable Water Resources Management Volume 3, op cit.

29. Griffin – Sattenspiel, B. et al. The Carbon Footprint of Water. Portland: River Network, 2009.

30. Beckman, D. et al. op cit.

31. Griffin – Sattenspiel, B. et al. op cit.

32. Using Water Infrastructure to Promote Smart Growth. Charles River Watershed Association Concept Letter to the Barr Foundation, June 2010.

33. Hewes, W. Creating Jobs and Stimulating the Economy through Investment in Green Water Infrastructure. Washington D.C.: American Rivers and Alliance for Water Efficiency, 2008.

1500 San Remo Avenue | Suite 249 | Coral Gables, FL 33146

www.fundersnetwork.org