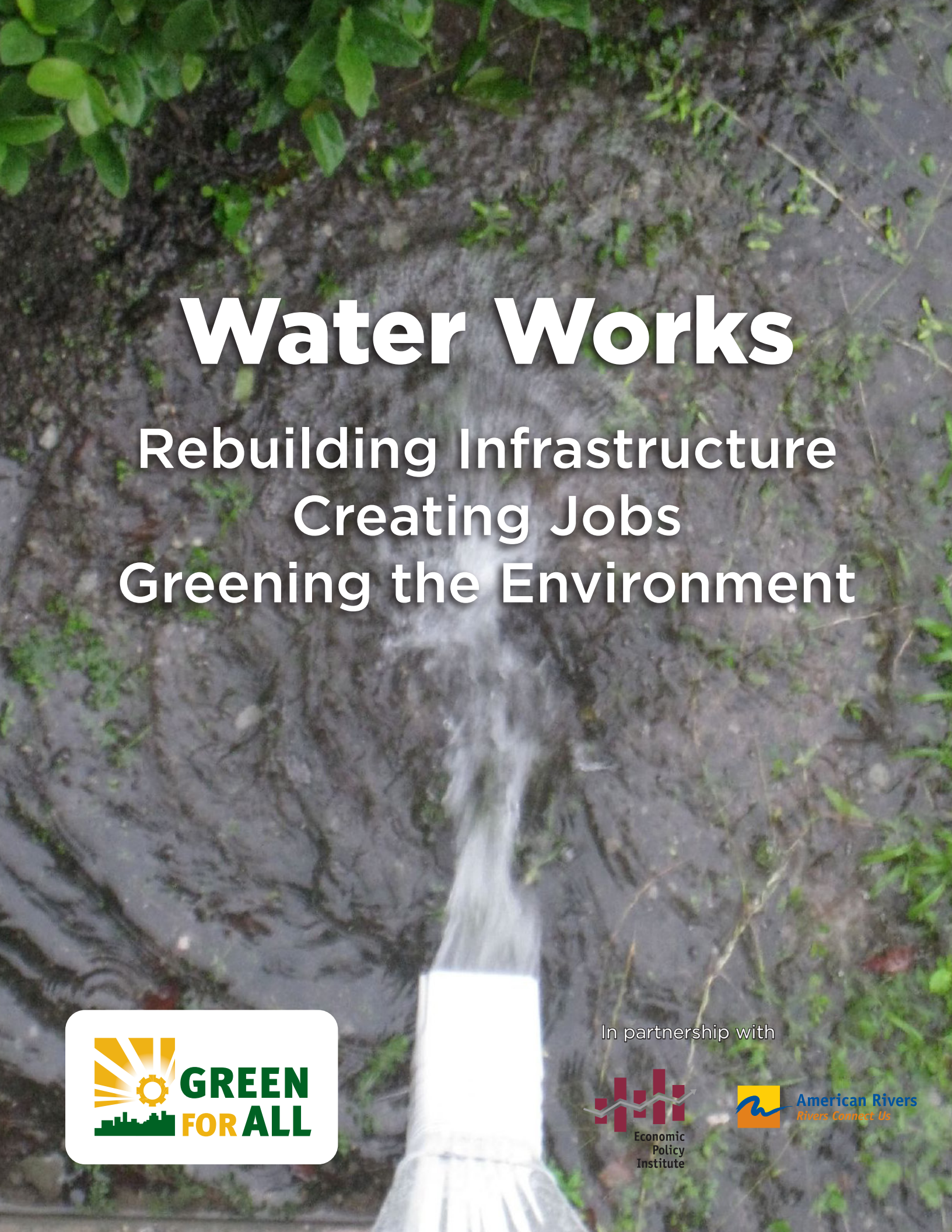

Water Works

Rebuilding Infrastructure
Creating Jobs
Greening the Environment

GREEN FOR ALL

In partnership with

Economic Policy Institute

American Rivers
Rivers Connect Us

Written by Emily Gordon, Jeremy Hays, Ethan Pollack, Daniel Sanchez, and Jason Walsh with special thanks to Matthew Lewis for invaluable research assistance.

Produced in partnership with American Rivers, Economic Policy Institute, and Pacific Institute.

THE ROCKEFELLER FOUNDATION

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Executive Summary

This report estimates the economic and job creation impact of a major investment in water infrastructure in the United States. This number—$188.4 billion—is based on the level of investment necessary, as estimated by the Environmental Protection Agency, to manage stormwater and preserve water quality across the country. **We find that an investment of $188.4 billion spread equally over the next five years would generate $265.6 billion in economic activity and create close to 1.9 million jobs.**

We argue that maximizing the use of **green infrastructure—infrastructure that mimics natural solutions—is essential to meet the stormwater management needs of our communities** while also providing a number of additional co-benefits.

We provide job creation estimates for each of the 50 states and review the workforce opportunities that would result from such an investment, analyzing a representative set of occupations in industries related to water infrastructure. We find that new jobs generated by these investments could be good jobs that are broadly accessible to American workers.

A green roof.

Water Works examines why a significant level of investment in water infrastructure and, in particular, stormwater infrastructure, is so necessary right now. It reviews evidence of a water and wastewater infrastructure in the U.S. that is outdated, overextended, and in crisis.

We find that our decaying water infrastructure pollutes our waters, sickens our children, and wastes natural resources. **Every year, sewer overflows contaminate U.S. waters with 860 billion gallons of untreated sewage, an amount that could fill 1.3 million Olympic-size swimming pools or cover the entire state of Pennsylvania with one inch of sewage.** This sewage contains pathogens such as bacteria, parasites, and viruses, as well as pharmaceuticals, synthetic hormones, and personal care products.

As our water infrastructure deteriorates, we also find that investment is not keeping pace. **Total public investment in water infrastructure as a share of the economy is estimated to have fallen by over one-third since peak levels of investment in 1975.** As new challenges emerge and systems deteriorate further, we are seeing a growing gap between our clean water needs and annual investment.

In this report, we argue that the decline in America's water infrastructure, and its associated economic, health and environmental costs, must be reversed. To achieve this reversal will require significant new investments that ensure the highest return possible and provide a multitude of benefits to our communities. This kind of strategic approach requires not only making traditional infrastructure upgrades but also pursuing new approaches, in particular green infrastructure techniques. **Although an increasing number of cities are implementing green infrastructure strategies, these opportunities have not been realized as extensively as their multiple benefits warrant.**

Water Works examines why now is best time in a generation to tackle our water infrastructure investment gap, for three key reasons: (1) Water infrastructure investments would create jobs now, when they are most needed; (2) The cost of financing this investment is at historic lows; and (3) The current economic climate can reduce the costs of infrastructure projects.

The report also provides analysis demonstrating that investments in water and other infrastructure are one of the most efficient methods of job creation in the current economy, particularly when compared to other policy prescriptions that often claim the political center stage. **Infrastructure investments create over 16 percent more jobs dollar-for-dollar than a payroll tax holiday, nearly 40 percent more jobs than an across-the-board tax cut, and over five times as many jobs as temporary business tax cuts.**

Water Works analyzes the quality and accessibility of jobs created by an investment in water infrastructure. We find that most of these occupations do not require high levels of formal education, but rather typically require a high school degree plus some post-secondary education or training. We argue that this labor market dynamic provides an important opportunity to counteract income inequality, by opening up job opportunities with family-supporting wages for "middle-skilled" workers, including low-income people and people of color who have struggled during the current recession.

However, women and people of color are under-represented in many of these occupations, highlighting the need to couple investments in water infrastructure with an economic development strategy to build a society characterized by environmental sustainability and shared prosperity.. This "high road" approach, which we detail in the report's conclusion, creates family-sustaining jobs, access to economic opportunities for diverse businesses and workers, and supports quality training programs that connect workers to career pathways.

Finally, as cities and municipalities prepare to make these critical investments, **we offer guidance in the form of three criteria to ensure a sustainable water future. We conclude that in order to have maximum impact these investments must (1) Create accessible and quality jobs; (2) Maximize environmental gain; and (3) Use financing that is stable, fair, and scalable.**

Philadelphia uses next generation green infrastructure to reduce sewage overflows into its rivers

Introduction

Water is essential for all life. In addition to the water we drink, we use water to grow our food, to make concrete and steel, and to create nearly everything else we produce, consume, buy, and sell. Ecosystems require water in order to continue serving as the foundation of our economy and our way of life. Water is also of critical importance to energy production, while water treatment and distribution demands large amounts of energy, an interrelationship referred to as the "energy-water nexus."

Yet water scarcity is an increasingly critical challenge. In the United States (U.S.), 36 states anticipate water shortages by 2013. These shortages can cause economic, environmental, and social harm.[1] Ongoing trends in urbanization, population growth, and climate change heighten the imperative to address the challenges of water scarcity.

The quality of water is as important as its quantity. Water quality is threatened by pollution, aging infrastructure, and mismanagement. Forty percent of rivers and 46 percent of lakes in the U.S. are

Water Crisis Statistics

- The average American directly uses 80-100 gallons of water each day, but supporting the average American lifestyle requires over 1400 gallons of water each day.[6]
- Agriculture is the largest consumer of freshwater: worldwide, about 70% of all withdrawals go to irrigated agriculture.[7]
- Only 1 percent of the world's freshwater is accessible to humans.[8]
- Forty percent of America's rivers and 46 percent of its lakes are too polluted to support fishing, swimming, or aquatic life.[9]
- Power plants in the U.S. use 136 billion gallons of water per day, more than three times the water used for residential, commercial and all other industrial purposes.[10]

too polluted for fishing, swimming, or aquatic life.[2] Every year, sewer overflows contaminate U.S. waters with 860 billion gallons of untreated sewage, an amount that could fill 1.3 million Olympic-size swimming pools–enough to cover the entire state of Pennsylvania with waste one-inch deep.[3] Twenty million people in the U.S. become sick each year from drinking contaminated water.[4] These issues, as with many environmental quality concerns, disproportionately impact low-income communities and communities of color across our nation.

Meeting the water challenge—building a sustainable water future—will require a national effort. The U.S. must strive to increase efficiency of water use, restore waterways and groundwater tables, repair decaying water infrastructure, decrease polluted runoff, and prevent contamination. These actions, and many more, are essential to maintain healthy freshwater ecosystems and provide safe drinking water to all.[5]

Cleaning up our water will also create opportunities. Investing in water infrastructure can create jobs, reduce pollution, improve human health, and promote economic growth. As the national unemployment rate hovers around 9 percent, and with unemployment and underemployment significantly higher among communities of color, family-supporting jobs are sorely needed. Creating good green jobs in the water sector that reduce both pollution and poverty can, and should, be a national priority.

These jobs are in many industries, such as the manufacturing of water conservation products and the installation of water infrastructure. Importantly, many of these jobs can provide career pathways and good wages while promoting regional economic development.

This report focuses on the need to invest in a more sustainable stormwater management system. It explores the numbers and types of jobs created by smart investments in stormwater management, including combined sewer overflow (CSO) correction and pipe repair and replacement. The report also focuses on investments in green infrastructure—infrastructure that mimics natural solutions—to clean our waters and strengthen our communities. Managing stormwater and ensuring adequate wastewater treatment are essential to our nation's environmental and health goals. Additionally, making these investments strategically will catalyze economic growth, develop local industries, and create jobs for workers who have borne the brunt of the Great Recession.

What is Green Infrastructure?

Green infrastructure (GI) works to restore, preserve, or mimic natural hydrological systems. It utilizes the ability of natural systems to soak up water and filter out pollutants. Green infrastructure techniques include using permeable pavements to let the ground absorb more stormwater, using trees and green roofs to store water or convert it to vapor, and capturing rainwater in cisterns and barrels for later use. In dry climates, green infrastructure can serve the added function of reducing water waste.[11] Combined with "gray," or traditional, infrastructure (such as deep tunneling and pipe rehabilitation), green infrastructure can help communities improve their management of water systems.

Examples of common GI techniques include:[12]

Green Roofs: Green roofs, also known as vegetated rooftops or eco-roofs, are rooftop areas on which living vegetation has been installed.

Urban Tree Planting: Planting trees that are indigenous to an area can reduce air pollution and stormwater runoff. A mature tree with a 30-foot crown can intercept 4600 gallons of water a year.[13]

Rain gardens: Rain gardens, also known as recharge gardens, are small water detention and infiltration areas that use native vegetation to reduce stormwater runoff. Rain gardens can take the place of traditional landscaping.

Bioswales: Bioswales, also known as vegetated swales, are shallow vegetated depressions that receive stormwater and redirect it while detaining the water and allowing it to infiltrate into the soil. They are often used in parking lots or along roads.

Constructed wetlands: Constructed wetlands are wetlands created to mimic the stormwater benefits of natural systems. They can effectively reduce peak flows and prevent flooding, and can also attract wildlife to an area. (cont'd)

Permeable pavements: Permeable pavements are pavement surfaces that allow water to pass through them. The four main types of permeable pavements are porous asphalt, pervious concrete, grid pavers, and grass pavers.

Rainwater harvesting: Rainwater harvesting is the collection and storage of rainwater. It includes the use of rain barrels and other storage devices to collect and recycle rainwater and to help control stormwater runoff.

Greenways or green alleys: Greenways or green alleys reduce paved or impervious surfaces and replace them with vegetation that can increase infiltration and reduce stormwater runoff.

This report begins by describing the current state of our nation's wastewater and stormwater infrastructure, analyzing long-term trends, and assessing investment needs. From there, it sets forth a vision for a sustainable water future that emphasizes green infrastructure techniques. Using economic modeling, we then estimate the job and economic impact of water infrastructure investments, as well as the workforce opportunities in a representative cross-section of occupations for which employer demand would be created. Finally, we recommend a "high road" model for investments in water infrastructure.

This study is the first in a series of initiatives on water and green jobs. Water conservation, water use efficiency, and wastewater management all present opportunities for jobs and investments that can help rebuild the American economy. Taking an integrated view of these investments and their associated public policies can transform water management and maximize the economic as well as the environmental benefits of investing in a sustainable* water future for all Americans.

* For the purposes of this paper we define "sustainable" as the integrated pursuit of environmental, economic, and equity outcomes.

Our Crumbling Water Infrastructure

Water and wastewater infrastructure in the U.S. is in crisis. Much of our infrastructure is a relic of post-World War II investment—in many older cities, it pre-dates World War I—and is now outdated and overextended. The American Society of Civil Engineers' 2009 Report Card for America's Infrastructure gave a D- to both the nation's drinking water infrastructure and its wastewater infrastructure, the lowest grades given to any public infrastructure.[14] On the international stage, the World Economic Forum will soon downgrade America's overall infrastructure ranking to 16th in the world, from 6th just a few years ago.[15]

Our decaying water infrastructure pollutes our waters, sickens our children, and wastes natural resources. The U.S. Geologic Survey estimates that the U.S. wastes six billion gallons of clean drinking water each day, or 14 percent of total use, through leaky pipes in need of repair.[16] This is enough water to supply our ten largest cities with drinking water daily.

Sewer overflows and leaks are a grave health threat to our communities. The U.S. Environmental Protection Agency (EPA) estimates that up to 3.5 million Americans fall sick each year from swimming in waters contaminated by sanitary sewer overflows (SSOs).[17] This sewage contains pathogens such as bacteria, parasites, and viruses, as well as pharmaceuticals, synthetic hormones, and personal care products.[18] There are between 23,000 and 75,000 SSOs in the U.S. annually.[19]

Investment is not keeping pace as our water infrastructure deteriorates. As shown on page 11, the Congressional Budget Office (CBO) calculates that total public investment in water infrastructure as a share of the economy has fallen by over one-third since peak levels of investment in 1975.[20]

Conservative estimates place our water investment needs around $630 billion over the next 20 years, while others estimate the need is as much as $4.8 trillion. As new challenges emerge and systems deteriorate, we are seeing a growing annual investment gap (or "needs gap").[21] Reports by the EPA, the Water Infrastructure Network, and the CBO place this needs gap as high as $59.4 billion dollars per year over the next twenty years.[22]

What are CSOs, SSOs and Polluted Runoff?

Improving America's water infrastructure requires addressing specific problems that threaten our water resources. One such problem is **polluted runoff**. As communities develop, large areas become covered in impervious surfaces such as pavement and roofs. Impervious surfaces prevent rainwater from percolating into the ground. Instead, runoff water is channeled through sewer systems or directly back into rivers, lakes, and streams. Runoff can be problematic when it accumulates pollutants, such as oil and salts, from impervious surfaces. These pollutants sicken animals and humans, particularly in communities that rely on sustenance fishing.

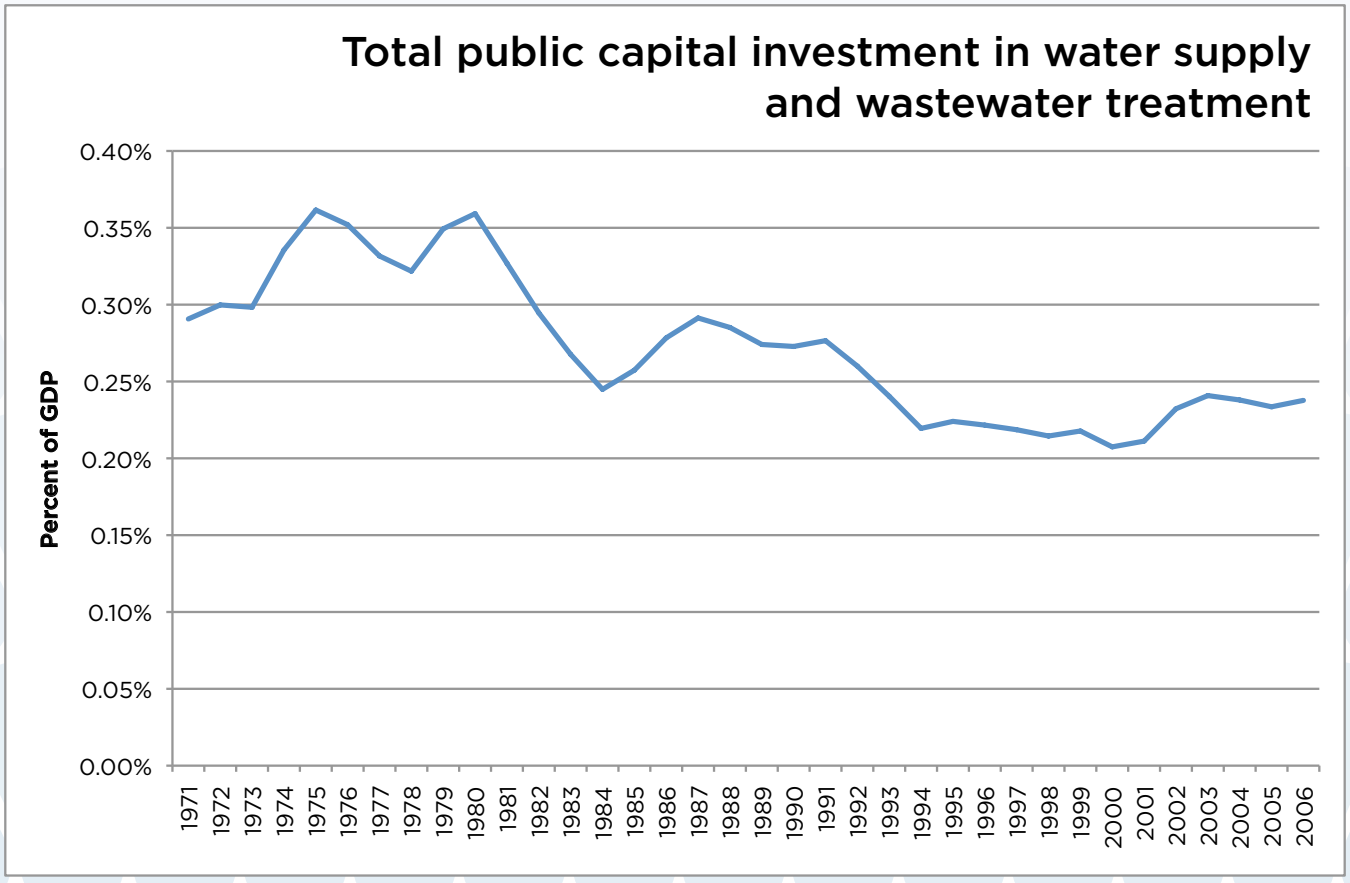
In older cities with combined sewer and stormwater systems, heavy rainfall can cause **combined stormwater overflows (CSOs)**. During these events, stormwater mixed with sewage and other pollutants is discharged into rivers and lakes. Stormwater can also infiltrate sewer pipes even if stormwater and sewer pipes are separated. When stormwater floods a separated system, it can cause a **sanitary sewer overflow (SSO)**, in which stormwater carries raw sewage into local bodies of water. Backed-up sewer systems can also spill into basements and streets, causing property damage and posing health risks. [26]

All the while, climate change is accelerating and exacerbating the problem. Increased flooding from more extreme weather events can contaminate water bodies with pollutants and overwhelm water and wastewater treatment systems. More frequent droughts and glacier melt will reduce the amount and reliability of water supplies. Overall, the effects of climate change will increase pressure on water managers to provide safe, reliable drinking water and adequately treat stormwater and wastewater.[23]

An illustration of our possible future was provided recently by Hurricane Irene, which swept up the east coast of the U.S. in August of 2011. While Irene's heavy rains were by no means an everyday event, this collision of climate-change-driven extreme weather and outdated, inadequate water infrastructure should be seen as a figurative shot across the nation's bow. Particularly instructive

was the experience of New Jersey, which has the greatest documented need for water infrastructure of any state (over $32 billion, with almost half of that need for stormwater management).[24] In the immediate aftermath of Irene, the cost of that underinvestment was revealed by press reports: 50 million gallons of sewage from a Bergen County Utility Authority plant spilled into the Hackensack River and about 3 million gallons of partially treated water was discharged into the Hudson River from one of the utility's treatment facilities. There were 26 CSOs on the Passaic River alone and 6 on the Hackensack.[25] These were only initial reports; one can assume that the ultimate price tag for New Jersey's investment gap will be considerable.

Irene's impact on water systems in New Jersey and other eastern states will be repeated over and over in the absence of policy action and political will. As our water system deteriorates and the cost of neglecting it increases, we envision a renewed commitment to a water system that is resilient, which we define as the capacity to cope with ongoing environmental change. Making much-needed investments in water infrastructure, and employing green infrastructure techniques in particular, will promote resilience while also providing extensive social and economic benefits that help meet the goals of a fully sustainable water future.



A permeable street surface.

Case Study: Chicago, IL

Of all U.S. cities, Chicago has arguably the longest history of mitigating stormwater overflows. Built on a marsh at the confluence of the Chicago River and Lake Michigan, Chicago has achieved several engineering breakthroughs to prevent stormwater overflows. In 1972, Chicago became the first city to undertake a "deep tunnel," a traditional infrastructure upgrade that significantly reduces overflows by holding excess water until it can be treated.[27]

Traditional infrastructure has made Chicago's waters cleaner. But overflows still happen, and their effects are still apparent. Chicago must frequently close its many public beaches when heavy rainfall results in sewer discharges into the Chicago River and Lake Michigan. Beaches in Illinois, along with those in other Great Lakes states, rank among the most-closed in the country, and they frequently make beachgoers sick.[28]

The City of Chicago has turned to green infrastructure as a way of better managing stormwater. As of 2008, city policy requires that large development or redevelopment projects must detain at least the first half of an inch of rain on-site, or reduce the site's imperviousness by 15 percent. Chicago's city council also adopted a green permitting system that expedites the permitting process for qualified buildings. A downspout program was initiated to prevent basement flooding, and the city has repaved nearly 100 of its alleys with permeable and green surfaces. Additionally, about 400,000 trees, on both public and private land, have been planted as part of the city's campaign for green streets.[29]

The Opportunity for a Sustainable Water Future

The decline in America's water infrastructure, and its associated economic, health and environmental costs, must be reversed. To achieve this reversal will require significant new investments that ensure the highest return possible and provide a multitude of additional benefits that help build stronger, healthier communities. This kind of strategic approach requires not only making traditional infrastructure upgrades but also pursuing new approaches, in particular green infrastructure techniques. Green and gray infrastructure should be viewed as complementary to each other, with this complementarity strengthening both approaches in a way that provides maximum benefit to our communities.

For example, New York City's Green Infrastructure Plan attempts to optimize its gray infrastructure investments by controlling stormwater runoff from 10 percent of its impervious surfaces. Its plan not only calls for new facilities and repairs to its existing infrastructure but also sets goals for

The Co-Benefits of Green Infrastructure

Experts have demonstrated the significant co-benefits, or supplemental community improvements, of green infrastructure techniques.[35] In addition to reducing pollution, green infrastructure (GI) provides the following benefits:

Environmental: GI can preserve and restores natural landscape features such as forests, floodplains and wetlands. Benefits include reduced stormwater runoff and pollutants, enhanced groundwater recharge, increased carbon sequestration, and improved air quality.

Health: GI can reduce CSO and SSO events, major contributors to water pollution. GI also naturally cools urban environments, mitigating the "urban heat island" effect and reducing the number of heat-related fatalities. In addition, increased recreational space in urban areas as a byproduct of GI can promote more physically active and therefore healthier lifestyles. (cont'd)

Economic Development: GI can increase land values and increases recreational space. In Philadelphia, green infrastructure improvements on vacant land increased property values as much as 30 percent. Wetland restoration efforts can lead to an approximately $500 per acre increase in economic value.[36]

Energy Savings: GI can save energy and money by cooling urban environments. For example, a 10 percent increase in tree vegetation can provide a temperature reduction of up to 0.7 °F.[37] In addition, green roofs can reduce energy demands in buildings by as much as 0.4 kWh of electricity per square foot and 123 MMBtu per building.[38] These energy reductions lower costs, air pollution, and greenhouse gas emissions.

Environmental Justice: GI produces the benefits noted above in dense urban areas—many of which suffer from among the worst environmental pollution and disinvestment in the U.S. In addition, recent studies demonstrate that green spaces reduce crime and violence while improving sense of community.[39]

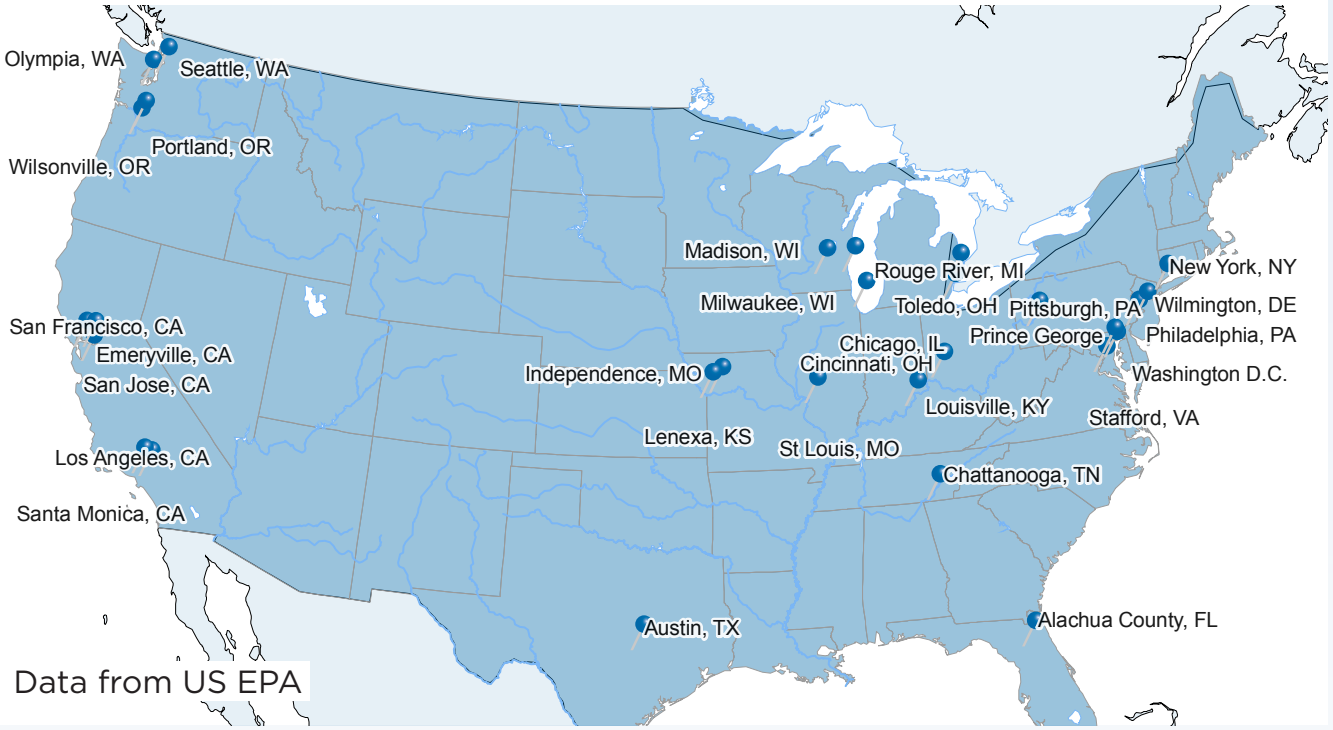
Climate Change Resilience: GI improves the ability of communities to respond to flooding and other impacts of climate change. It also recharges groundwater—an important tactic in areas that will face increased drought conditions as a result of climate change.[40]

implementing a comprehensive set of green infrastructure measures. Implemented over 20 years, the plan would invest $1.5 billion in green infrastructure.[30]

In addition to New York, there are an increasing number of cities[31] making significant investments to upgrade their water infrastructure. Philadelphia, nationally recognized for its "Green City, Clean Waters" plan, is investing $1.6 billion in green infrastructure over the next twenty years.[32] Washington, D.C. plans to create 20 million square feet of green roofs as part of a $1.9 billion investment, which should also serve as a substantial job creation engine.[33] Using data local to D.C., one study estimated that 19 jobs are created for every $1 million of investment in green roofs.[34]

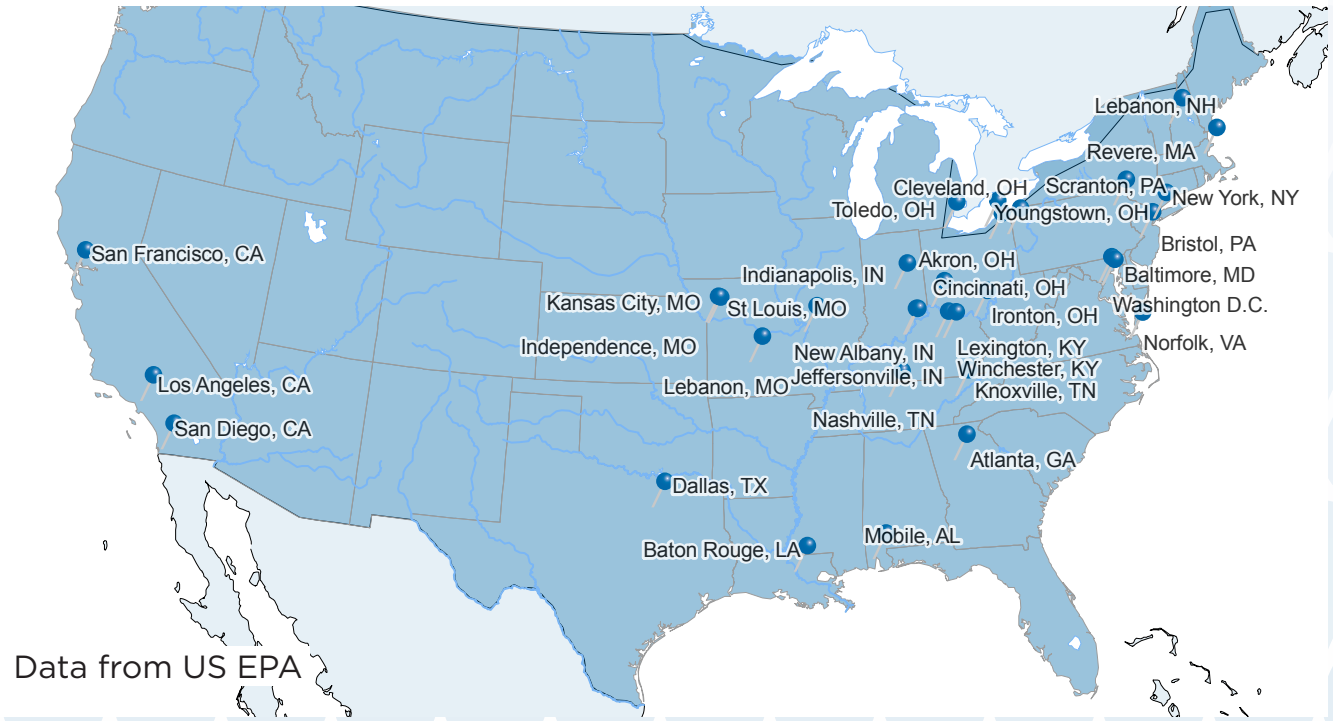
While there are many compelling reasons to adopt a green infrastructure approach, a primary catalyst for these upgrades is the need to meet clean water goals set by the Clean Water Act (CWA).

Selected Cities Investing in Green Infrastructure



Data from US EPA

Selected Cities with Clean Water Act Violations



Data from US EPA

Cities with aging infrastructure that pollutes waterways are vulnerable to lawsuits or enforcement actions to remedy CWA violations. If a city is found in violation, it often has to pay penalties and frequently must enter a consent decree with the EPA that stipulates how the city will fix its sewers. Increasingly, these consent decrees include green infrastructure components designed to meet water quality standards while also creating a more resilient water system for the future.

Although an increasing number of cities are implementing green infrastructure strategies, these opportunities have not been realized as extensively as their multiple benefits warrant. More broadly, very few cities have seized the opportunity to implement a more comprehensive, fully sustainable approach that balances the promotion of environmental, economic, and equity improvements. As cities recognize the immense value of green infrastructure in promoting clean water and economic development, they are faced with an opportunity to ensure that all investments in our water infrastructure create accessible, family-supporting jobs, are financed by stable and fair means, and maximize environmental gain.

A rain garden.

Case Study: Milwaukee, Wisconsin

Milwaukee has been pursuing green infrastructure strategies since 2001 when the Milwaukee Metropolitan Sewerage District (MMSD) initiated the integration of green infrastructure into the region's overall water management plans.[42] Key programs launched by MMSD include a downspout disconnection program, a habitat preservation program, a green roof initiative, and a consumer education campaign.

The **downspout disconnection program** assisted residents in redirecting their downspout flows into rain barrels, which in turn overflow into rain gardens and permeable surfaces. The program initially predicted that stormwater flows could be reduced by about 30 percent if participation rates were high. As of 2010, the city had sold over 14,000 barrels, capturing 770,000 gallons of water every time it rains.[43]

The **Greenseams program** is a partnership with MMSD and the Conservation Fund. Greenseams protects and restores land to help reduce flooding and polluted runoff. Since its start in 2001, the program has purchased 2,100 acres of land for conservation, with the capacity to hold an estimated 1.3 billion gallons of water.[44]

In 2010, as part of a **Regional Green Roof Initiative**, the MMSD authorized $3.8 million in contracts for over 4 acres of green roofs to soak up rainwater in the region.[45] In addition, as part of its **Every Drop Counts** campaign, the MMSD assists property owners with their rain gardens by selling discounted plants and providing educational materials. Milwaukee is also looking to construct one of the first "green corridors" in the State of Wisconsin.

Milwaukee's efforts have also addressed challenges faced by low-income communities. The MMSD promotes rain barrels that are manufactured by a local youth employment program. Two nonprofits—American Rivers and Milwaukee Riverkeeper—joined together to improve stormwater management in Johnson's Park, a diverse, lower-income neighborhood. Community residents were engaged to learn about how their neighborhood could better protect the environment, and resident volunteers disconnected downspouts, built rain gardens, and installed rain barrels as part of the initiative.[46]

Case Study: Portland, OR

In 1977, Portland instituted a stormwater management fee, a separate charge on water bills that finances infrastructure upgrades. In 2006, Portland instituted a fee discount program called **Clean River Rewards**. The program grants discounts of up to 35 percent of the stormwater management fee to ratepayers who implement green infrastructure practices on their property.[47] In addition to fee discounts, Portland operates a number of innovative programs promoting green infrastructure investments to manage urban drainage and restore watershed health.

Portland's **Green Streets Policy** helps ensure that new development projects follow best practices for stormwater management and livability. City stormwater management regulations, dating back to 1999, require all new development and redevelopment (even projects that impact as little as 500 square feet of surface) to manage stormwater runoff onsite. The regulations prioritize management strategies to require on-site infiltration wherever possible.[48]

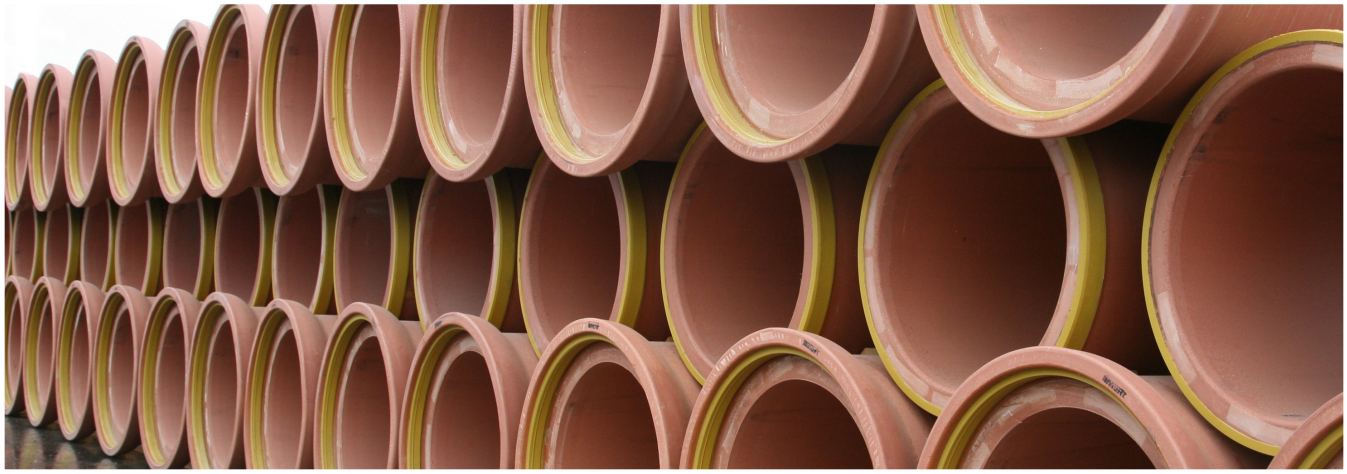
The **Grey to Green (G2G)** Initiative, launched in 2008, sets aggressive goals for initiatives to improve the health of Portland watersheds. It authorizes ratepayer funding for tree planting, culvert removal, invasive plant control, purchase of sensitive natural areas, new green street infrastructure, and incentives for the installation of ecoroofs (i.e., green roofs). The Ecoroof Incentive Program is particularly noteworthy, targeting a goal of 43 additional acres of ecoroofs by 2013. The program includes an incentive of up to $5 per square foot of ecoroof installed on any eligible roof in the City. The goals of the program are also to expand the ecoroof green job sector in Portland and to maximize the participation of minorities, women, and emerging small businesses.[49]

Between 1993 and 2011, the City's **Downspout Disconnection Program** engaged citizens and community groups in a grassroots effort to reduce combined sewer overflows into the Willamette River and Columbia Slough. Using door-to-door canvassing and financial incentives, the program disconnected more than 56,000 downspouts, removing more than 1.3 billion gallons of stormwater from combined sewers annually.[50]

The Economic Impact of Water Infrastructure Investments

Building a sustainable water future will create jobs in communities that need them badly. This section estimates the economic impact of a major investment in water infrastructure. Investment needs were derived from the EPA's 2008 Clean Water Needs Survey (CWNS).[51] The EPA identified $298.1 billion of capital investment needs for wastewater pollution control over the next twenty years. Our analysis focuses on $188.4 billion out of that $298.1 billion. Specifically, this $188.4 billion encompasses capital needs for pipe repair, new pipes, CSO correction, and stormwater management programs. All of these investments are essential to preserving water quality and managing wet weather events across the country.

This figure of $188.4 billion is a conservative estimate for needed investment in the above categories. It does not include operation and maintenance costs, which amount to 60 percent of all water investments.[52] It also excludes additional state needs that do not meet these narrow definitions, excludes a full accounting of future population growth or climate change, and excludes costs beyond 20 years. A number of other estimates suggest a significantly higher need. For example, while the EPA estimated total investment needs for clean water and drinking water at $632.9 billion over 20 years, the Mayors Water Council projects estimated local government spending needs for water infrastructure between 2009 and 2028 to be between $3 trillion and $4.8 trillion.[53]



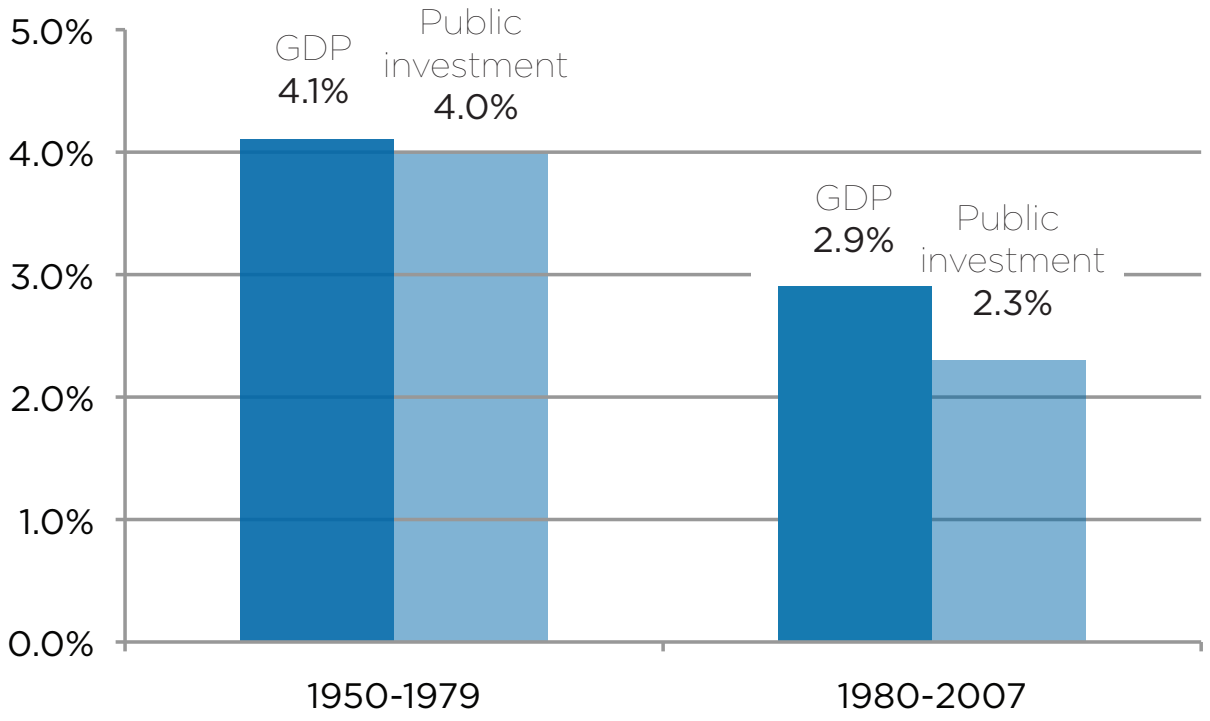
Why Public Investment in Water Infrastructure?

Public investment boosts economic growth

The economic case for increased water infrastructure investments is overwhelming. Water infrastructure—along with other public goods such as roads, levees, an educated workforce, and R&D—are vital to the nation's long-term economic growth and global competitiveness. At the most basic level, public investments are characterized by benefits that accrue in the future and for an extended period of time. For example, the benefits of a bridge endure throughout the bridge's useful life, just as the benefits of education persist throughout a person's life. These future benefits are realized by enhancing the nation's stock of physical capital, human capital, or knowledge capital.

Real GDP and public investment growth avgs. 1950-2007

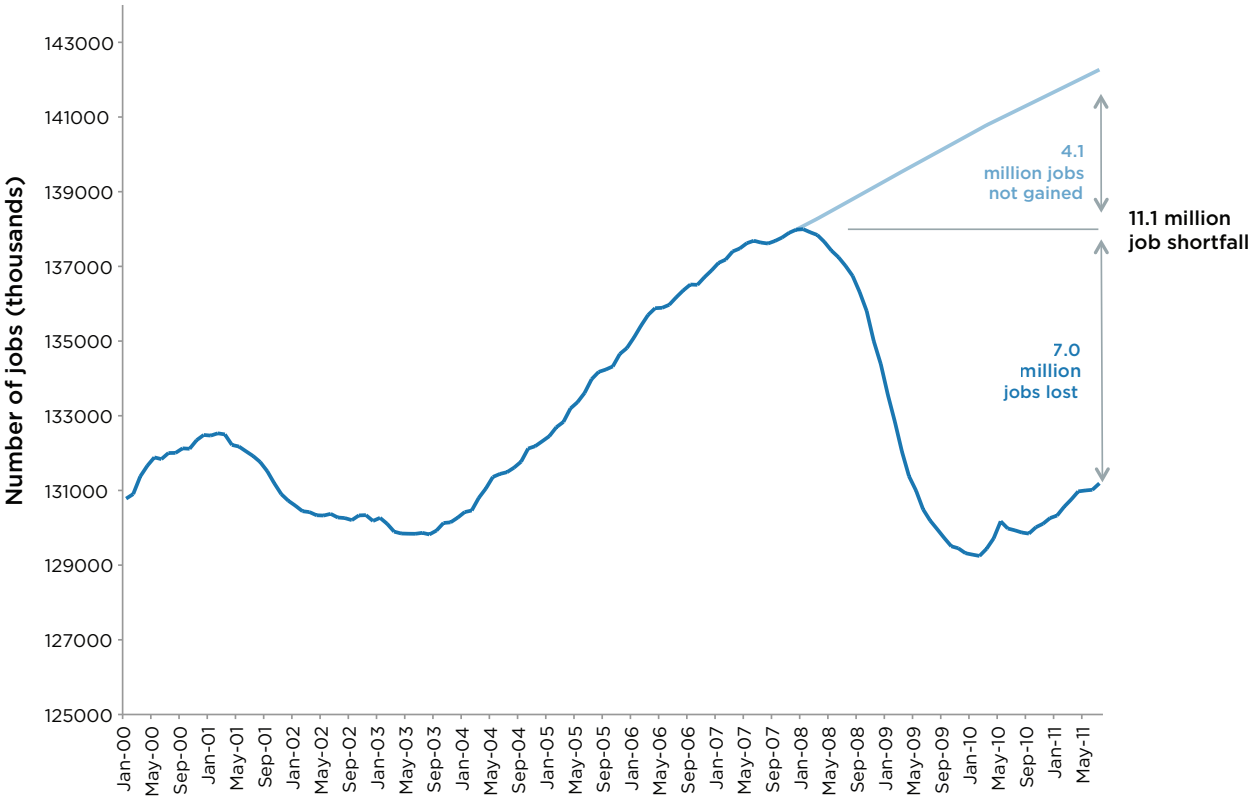
Source: Pollin, Heintz, and Peltier



Public investment boosts economic development. As shown here, periods of high growth in public investment correspond with high growth in GDP.

Recession has left in its wake a job shortfall of over 11 million

Payroll employment and the number of jobs needed to keep up with the growth in working-age population



Source: EPI analysis of Bureau of Labor Statistics data.

These capital stocks are the building blocks of a prosperous economy. A recent review of the literature on this topic finds that a sustained 1% increase in the public capital growth rate translates into a 0.6 percentage-point increase in the private sector GDP growth rate.[54] This is reinforced by historical evidence: as the graph on page 11 shows, periods of high public investment tend to be characterized by high economic growth, and those of low public investment tend to be plagued by low economic growth.[55]

The right moment for public water infrastructure investment

The question is not whether or not we repair and modernize our water infrastructure; we will be forced to make these investments eventually. The question is, when (and how) will we do it? Fortunately, the best time in a generation to tackle these needs is right now, for three key reasons.

(1) Water infrastructure investments would create jobs now, when they are most needed. The nation is in the worst jobs crisis since the Great Depression. There are still 14 million unemployed Americans, about half of whom have been unemployed longer than six months.[56] Another 11 million Americans are either involuntarily part-time or are willing and able to take a job but have given up looking.[57] The economy needs to create slightly more than 11 million jobs just to get back to the pre-recession unemployment rate (see graph, page 20); to do so by the middle of 2014 would mean adding roughly 400,000 jobs every month for 36 months straight. By contrast, the average monthly job gain in 2011 has been less than a third of that target.[58]

(2) The cost of financing this investment is at historic lows. Unsettled and risky global markets have resulted in a flight to safety among investors, with the safest assets being U.S. Treasury bonds. This unprecedented spike in demand for government debt has driven interest rates—that is, the cost of borrowing—to some of the lowest levels seen in decades. In fact, the current cost of borrowing is over three times smaller than the average interest rate over the forty years before the recession.[59]

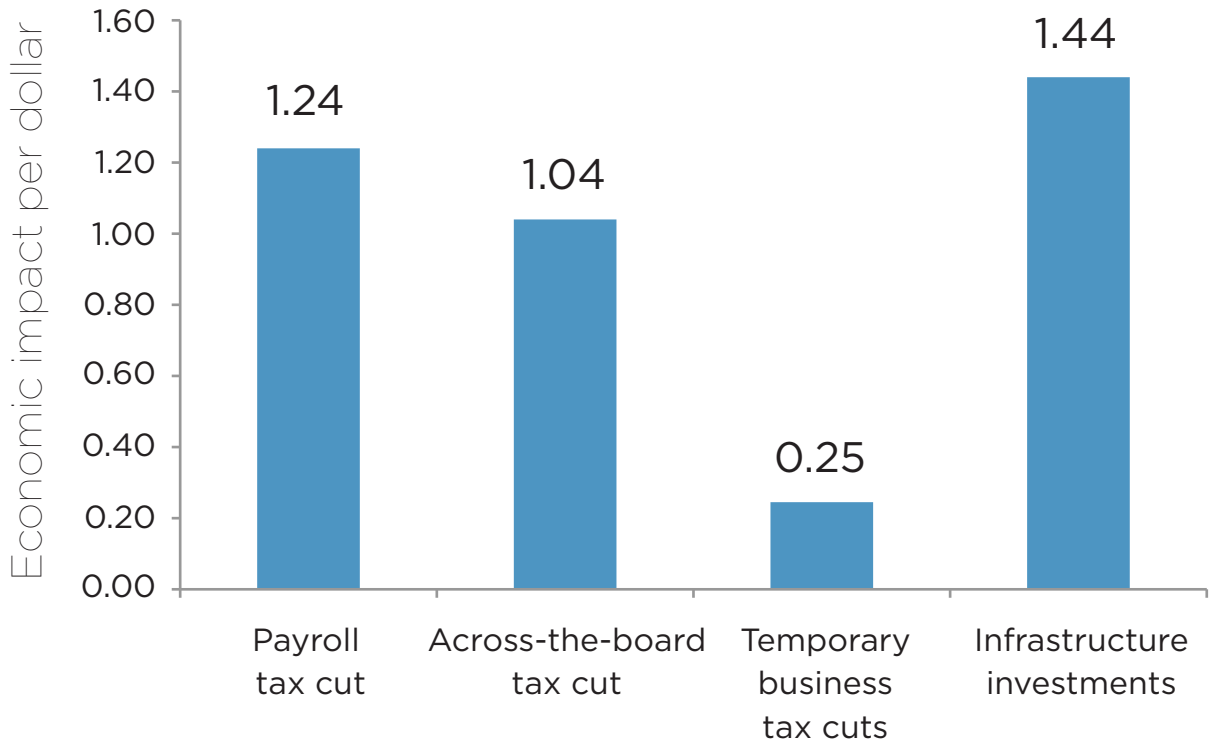
(3) The current economic climate can reduce the costs of infrastructure projects. During economic downturns, infrastructure projects are less costly as many contractors are competing for work amidst slack labor and capital markets. Many states actually had difficulty getting Recovery Act infrastructure funds out the door because contract bids kept coming in below the states' original estimates.[60]

For these reasons, there is an opportunity for job creation and cost savings if we act now. If we wait to make needed investments in water infrastructure until the economy has already recovered, the net job impact will be lower, because labor costs will be higher and there might be some "crowding out" of private investment (i.e., public spending might use up resources that would otherwise be used by the private sector). The cost of financing the projects will also be higher, because private capital will no longer be as dependent upon government bonds and thus will charge higher interest rates. Finally, the costs of the projects themselves will be higher because with more available work there will be less competition among contractors.

When policymakers make decisions about public investments, they must always weigh competing priorities and different levels of return on investment for different uses of public funds. By this measure, investments in water and other infrastructure are one of the most efficient methods of job creation in the current economy, particularly when compared to other policy prescriptions that often claim the political center stage.

According to Mark Zandi, Chief Economist of Moody's Analytics, infrastructure investments create over 16 percent more jobs dollar-for-dollar than a payroll tax holiday, nearly 40 percent more jobs than an across-the-board tax cut, and over five times as many jobs as temporary business tax cuts[61] (see below). Infrastructure's high job-creation potential occurs for two reasons. First, infrastructure investments are targeted toward the areas in the economy with high excess capacity, such as the construction industry and its associated supplier industries. Second, tax cuts—especially those for high-income individuals—are more likely to be saved, whereas worker-directed income (resulting from infrastructure investment) is more likely to be put back into the economy.

Bang for the buck



Overall Job Impact

Our analysis examines the job impact of the full $188.4 billion investment if it were spread equally over the next five years.[62] **We find that this investment would generate $265.6 billion in economic activity (i.e., growth in GDP) and create close to 1.9 million jobs.** These figures are in job-years, which is equivalent to one job for one year. For an explanation of our methodology, see Appendix A.

Investments to meet the nation's water infrastructure needs would create jobs throughout the economy. Specifically, these investments create:

- **Direct jobs** in industries such as the construction and utility sectors that implement the actual work on projects.
- **Indirect jobs** in sectors such as manufacturing that supply the direct industries with equipment and machinery.
- **Induced jobs** when income earned by newly hired workers and firms is re-spent throughout the economy.

Job impact from $188.4 billion of water infrastructure investment over five years

	Direct and indirect jobs	Induced jobs	Total job impact
Jobs	**1,293,015**	**568,927**	**1,861,942**
Full time equivalent jobs*	**1,831,772**	**805,980**	**2,637,751**

* A full time equivalent job is equivalent to a 40-hours-a-week job. It is more correctly described as a measurement of work translated into jobs, rather than a measurement of jobs themselves. A measurement of FTEs is thus more comprehensive because it includes both the new jobs created and the increased hours worked by existing employees, while a straightforward job creation measurement ignores the latter effect.

State-by-state Results

We also calculate how many jobs would be created in the 50 states and District of Columbia. Our analysis combines two common job projection methods to determine a credible range for each state: (1) job impacts proportional to the investment needs of each state, as reported in the EPA CWNS; and (2) job impacts as a share of national employment. Results are shown below. It should be noted that the larger the range, the more the state's reported water infrastructure needs are disproportionate to their share of national employment. (See Appendix A for full methodology.)

State-by-state job impacts

Alabama	26,839	to	29,185	Montana	2,692	to	6,172
Alaska	**	to	4,634	Nebraska	13,476	to	21,735
Arizona	26,089	to	34,311	Nevada	9,934	to	16,082
Arkansas	3,289	to	16,632	New Hampshire	7,197	to	8,959
California	120,402	to	199,526	New Jersey	55,404	to	263,518
Colorado	4,039	to	31,914	New Mexico	308	to	11,565
Connecticut	22,984	to	24,700	New York	122,759	to	128,104
Delaware	1,486	to	5,905	North Carolina	37,971	to	55,538
D. C.	10,186	to	19,065	North Dakota	**	to	5,343
Florida	90,857	to	102,977	Ohio	72,184	to	127,822
Georgia	209	to	54,969	Oklahoma	9,718	to	21,889
Hawaii	8,431	to	12,268	Oregon	18,126	to	22,960
Idaho	3,615	to	8,677	Pennsylvania	80,518	to	167,831
Illinois	80,515	to	131,714	Rhode Island	**	to	6,597
Indiana	40,060	to	63,658	South Carolina	1,670	to	25,856
Iowa	16,026	to	21,124	South Dakota	589	to	5,769
Kansas	18,685	to	19,008	Tennessee	8,952	to	37,420
Kentucky	16,784	to	25,335	Texas	74,447	to	147,905
Louisiana	26,518	to	27,091	Utah	6,479	to	16,920
Maine	7,133	to	8,540	Vermont	975	to	4,268
Maryland	36,054	to	56,429	Virginia	35,544	to	52,022
Massachussets	45,759	to	53,610	Washington	27,882	to	39,904
Michigan	28,491	to	55,279	West Virginia	10,710	to	26,253
Minnesota	32,147	to	37,877	Wisconsin	39,274	to	39,792
Mississippi	10,805	to	15,644	Wyoming	1,083	to	4,042
Missouri	38,134	to	46,116				

** Needs not submitted to EPA CWNS 2008.

Confronting Deficits and Debt

As these calculations establish, investments in water infrastructure can create a significant number of jobs. We do not suggest that all water infrastructure improvements be financed through public deficit spending. We believe that the solution will require an innovative combination of public spending, fair rate structures, and responsible private sector involvement. However, we must acknowledge the reality of tight budgets at the federal, state, and local levels. Indeed, the most common argument against any proposal to make a significant investment in water infrastructure—or any infrastructure—is that it would add to the deficit and thus the debt burden on future generations.

But there is more than one kind of debt burden. It is future generations who will suffer from an inadequate investment in our water infrastructure today. As mentioned above, sewer overflows and leaks already cause 3.5 million people to fall sick every year from swimming in contaminated waters. This problem goes beyond the human toll: getting sick often means absence from work, costing the economy billions of dollars. And the 14 percent of all drinking water that our faulty system wastes through leaky pipes inflates the cost of drinking water, which is then translated into either higher water bills or higher taxes. There are also added costs from more advanced water treatment systems to treat the polluted water.

As our water infrastructure falls further into disrepair and our needs grow, these problems will be exacerbated. More people will get sick, and water prices or taxes will increase, lowering the living standards of future generations. Failure to address our crumbling water infrastructure is, in other words, another form of debt that we are merely shifting on to the next generation. Closing that debt now is both fiscally responsible and economically strategic.

Philadelphia, PA

Philadelphia is investing $1.6 billion in its water infrastructure over the next 20 years. A recent study found that if 50 percent of stormwater was managed by green infrastructure development, it could create 15,266 green collar jobs.[63] A study by the Sustainable Business Network of Greater Philadelphia found over 32,000 current jobs related to stormwater management in the Philadelphia metropolitan region. These jobs are mainly classified as Water Systems, Water, Sewer and Pipeline Construction, Architectural and Engineering Services, and Environmental Consulting Services.[64] Firms include green design, green infrastructure, green systems, and greenscape companies. There are nearly 2,500 firms in the green stormwater infrastructure supply chain, representing more than $7.4 billion in sales.[65]

Northeast Ohio

A study by Cleveland State University found that 31,000 jobs could be created between 2012-2016 from a $3 billion investment in traditional infrastructure investments. The study projected that jobs would be created in Construction of Other New Nonresidential Structures; Architectural, Engineering, and related services; and Maintenance and Repair Construction of Nonresidential Structures. [66]

Rain garden, Atlanta

Workforce Opportunities in a Sustainable Water Future

Investing in resilient water infrastructure represents a true opportunity to drive economic growth and improve the health of our communities. With this in mind, it is important to examine the composition of the resulting workforce, as well as the quality and accessibility of the jobs that are created. Understanding these opportunities will help us develop a sustainable water future and, in particular, improve workforce development efforts toward that end.

Our analysis of workforce opportunities builds on the 2010 study *Capturing the Storm: Profits, Jobs, and Training in Philadelphia's Stormwater Industry*.[67] (For methodology, see Appendix B.)[68] We draw several conclusions from the results of this analysis.

We find that most of the occupations associated with water infrastructure projects do not require high levels of formal education. Thirteen of the 15 occupations listed (see pages 30-31) typically require only a high school degree plus some post-secondary education or training. The vast majority of jobs in these occupations (with the exception of environmental engineering and construction management) are accessible to workers who do not have a four-year college degree.

This provides an important opportunity to counteract income inequality, which has skyrocketed over the last few decades—largely due to increases in the "college premium" since 1979. The college premium is the pay advantage enjoyed by workers who have completed a four-year college degree (controlling for other relevant labor market characteristics such as gender, race, ethnicity, experience, and region of residence). In 1979, the college premium was roughly 50 percent (i.e., college graduates earned wages that were 50 percent higher on average than those of non-graduates), and by 2007 it had risen to roughly 80 percent.[69] Pushing against this trend by opening up job opportunities with family-supporting wages for "middle-skilled" workers without college degrees is thus a vitally important step toward a more just and equitable society.

Most of the jobs supported by these investments are also more unionized than jobs in the overall economy, with unionization rates as high as 38 percent, well above the national average of 10.7 per-

Occupations involved in stormwater infrastructure

O*Net occupation (Department of Labor)	Median Wage (2009)	Education Requirements
Cement Masons and Concrete Finishers	17.04	These occupations usually require a high school diploma.
Construction Managers	39.58	Most of these occupations require a four-year bachelor's degree, but some do not.
Environmental Engineers	37.04	Most of these occupations require a four-year bachelor's degree, but some do not.
First-Line Supervisors/Managers of Construction Trades and Extraction Workers	28.04	Most of these occupations require training in vocational schools, related on-the-job experience, or an associate's degree.
Helpers for Pipelayers, Plumbers, Pipefitters, and Steamfitters	12.91	These occupations usually require a high school diploma.
Paving, Surfacing, and Tamping Equipment Operators	16.36	These occupations usually require a high school diploma.
Pipelayers	16.12	These occupations usually require a high school diploma.
Plumbers, Pipefitters, and Steamfitters	22.27	Most of these occupations require training in vocational schools, related on-the-job experience, or an associate's degree.
Septic Tank Servicers and Sewer Pipe Cleaners	16.03	Some of these occupations may require a high school diploma or GED certificate.
Water and Liquid Waste Treatment Plant and System Operators	19.16	Most of these occupations require training in vocational schools, related on-the-job experience, or an associate's degree.
Maintenance and Repair Workers, General	16.65	Most of these occupations require training in vocational schools, related on-the-job experience, or an associate's degree.
Welders, Cutters, Solderers, and Brazers	16.71	These occupations usually require a high school diploma.*

projects (O*Net analysis)

Job Training	O*Net Code
Employees in these occupations need anywhere from a few months to one year of working with experienced employees. A recognized apprenticeship program may be associated with these occupations	47-2051.00
Employees in these occupations usually need several years of work-related experience, on-the-job training, and/or vocational training.	11-9021.00
Employees in these occupations usually need several years of work-related experience, on-the-job training, and/or vocational training.	17-2081.00
Employees in these occupations usually need one or two years of training involving both on-the-job experience and informal training with experienced workers. A recognized apprenticeship program may be associated with these occupations.	47-1011.00
Employees in these occupations need anywhere from a few months to one year of working with experienced employees. A recognized apprenticeship program may be associated with these occupations.	47-3015.00
Employees in these occupations need anywhere from a few months to one year of working with experienced employees. A recognized apprenticeship program may be associated with these occupations.	47-2071.00
Employees in these occupations need anywhere from a few months to one year of working with experienced employees. A recognized apprenticeship program may be associated with these occupations.	47-2151.00
Employees in these occupations usually need one or two years of training involving both on-the-job experience and informal training with experienced workers. A recognized apprenticeship program may be associated with these occupations.	47-2152.01 & 47-2152.02 (plumbers)
Employees in these occupations need anywhere from a few days to a few months of training. Necessary training can generally be provided by an experienced worker.	47-4071.00
Employees in these occupations usually need one or two years of training involving both on-the-job experience and informal training with experienced workers. A recognized apprenticeship program may be associated with these occupations.	51-8031.00
Employees in these occupations usually need one or two years of training involving both on-the-job experience and informal training with experienced workers. A recognized apprenticeship program may be associated with these occupations.	49-9042.00
Employees in these occupations need anywhere from a few months to one year of working with experienced employees. A recognized apprenticeship program may be associated with these occupations.*	51-4121.00

(cont'd next page)

Machinists	18.1	Most occupations in this zone require training in vocational schools, related on-the-job experience, or an associate's degree.
Landscaping and Groundskeeping Workers	11.29	Some of these occupations may require a high school diploma or GED certificate.
Construction Laborers	14.01	Some of these occupations may require a high school diploma or GED certificate.

* Information for Welders, Cutters, and Welder Fitters

cent (see table on page 34). Unionization bolsters the average wages of these occupations, which for most part meet or exceed a living wage standard. It also impacts the ability of workers to move up a career ladder, as many of these occupations are supported by Registered Apprenticeship programs and, in particular, joint labor-management programs. These programs are privately financed and have a long track record of providing high-quality training to both apprentices and incumbent journeyperson workers.

An exception to the above is the Landscaping and Groundskeeping Worker occupation, which is notable, in that of the occupations listed in the table above it is most closely associated with green infrastructure techniques. Wage rates for this occupation are low, and the industry is rife with low road contractors, frequent violations of employment law, and few if any benefits for workers. On the positive side, this industry, with its low bar to entry, is accessible to workers with low levels of education and training. But such access will be of little benefit without well-structured pathways to careers, with associated education and training programs, skill certifications, and bargaining power for workers in the marketplace. There are encouraging examples of green infrastructure training programs, such as the Green Infrastructure Worker Training Program in Syracuse, New York, but as we make these investments in green infrastructure we must pay close attention to the career pathways and the quality of the jobs we are creating.

We also find that people of color tend to be underrepresented in many of the construction sector occupations, especially in medium- to high-paying jobs such as managers and engineers (although they fare well in some decently paid occupations, such as construction laborers and cement masons). Women are also vastly underrepresented, making up between zero and 7 percent of most

Employees in these occupations usually need one or two years of training involving both on-the-job experience and informal training with experienced workers. A recognized apprenticeship program may be associated with these occupations.	51-4041.00
Employees in these occupations need anywhere from a few days to a few months of training. Necessary training can generally be provided by an experienced worker.	37-3011.00
Employees in these occupations need anywhere from a few days to a few months of training. Usually, an experienced worker could show you how to do the job.	47-2061.00

Source: BLS O*Net

of these occupations—only in the environmental engineer occupation do women even exceed 10 percent (see table, next page). These findings emphasize that while water investments can provide greater economic opportunity for communities most in need, they should be accompanied by smart education and training policies, in particular those that support quality non-traditional employment and other pre-apprenticeship training programs that foster career pathways for women and people of color. Investment should also include targeted hiring strategies to ensure that workers from all communities can get the jobs for which they're trained.

That said, it should be noted that these are only the jobs associated directly associated with water infrastructure projects themselves. Additional jobs will be created by re-spending in the broader economy, where people of color and women have much greater representation.

Bioswale on Maryland street capable of receiving stormwater runoff.

Occupations involved in stormwater infrastructure proje

Census occupation (Current Population Survey)	CPS Code
Construction managers	0220
Environmental engineers	1420
First-line supervisors/managers of construction trades and extraction workers	6200
Cement masons, concrete finishers, and terrazzo workers	6250
Paving, surfacing, and tamping equipment operators	6300
Pipelayers, plumbers, pipefitters, and steamfitters	6440
Helpers, construction trades	6600
Septic tank servicers and sewer pipe cleaners	6750
Water and liquid waste treatment plant and system operators	8620
Maintenance and Repair Workers, General	7340
Welding, soldering, and brazing workers	8140
Machinists	8030
Grounds maintenance workers	4250
Construction laborers	6260

Overall economy

Source: U.S. Census' Current Population Survey (CPS), pooled 2008-2010

ects, CPS analysis

	Education	Ethnicity		Union	Gender	
	No college degree	White	Non-white	Member	Male	Female
	73.6%	84.6%	15.4%	3.6%	92.9%	7.1%
	19.1%	74.9%	25.1%	14.6%	75.9%	24.1%
	89.0%	77.4%	22.6%	13.1%	96.8%	3.2%
	98.3%	41.0%	59.0%	8.3%	99.4%	0.6%
	96.7%	69.3%	30.7%	24.3%	93.2%	6.8%
	95.1%	69.7%	30.3%	21.4%	98.6%	1.4%
	97.6%	46.9%	53.1%	4.5%	93.1%	6.9%
	97.2%	75.8%	24.2%	36.0%	100.0%	0.0%
	87.1%	72.9%	27.1%	37.9%	94.4%	5.6%
	93.4%	70.4%	29.6%	13.6%	97.1%	2.9%
	97.2%	66.6%	33.4%	15.4%	95.5%	4.5%
	95.0%	73.6%	26.4%	14.8%	94.8%	5.2%
	93.9%	51.6%	48.4%	3.8%	94.1%	5.9%
	93.9%	47.5%	52.5%	8.3%	96.9%	3.1%
	69.1%	**68.2%**	**31.8%**	**10.7%**	**53.1%**	**46.9%**

Profile: SUNY ESF Green Infrastructure Worker Training (Syracuse, NY)

The Green Infrastructure Worker Training program, developed by the State University of New York and serving the Syracuse region, provides 10 weeks of instruction in green infrastructure job training. Low-income residents, particularly members of a refugee community in Syracuse, are targeted for the program. Participants devote six weeks to learning about gardening, landscape design and green infrastructure, with a 2- to 4-week internship with a local employer following.

Participants who complete this program receive a 10-hour certification from the Occupational Safety and Health Administration (OSHA) as well as certificates of completion from SUNY-ESF and the Northside Urban Partnership.[70] In addition, participants receive preparation to pursue additional certifications in Green Infrastructure, including the following programs:[71]

- Permeable Concrete Installer certification – www.nrmca.org
- Certified Arborist – www.isa-arbor.com/home.aspx
- Master Gardener – www.gardening.cornell.edu/education/mgprogram
- Rochester Civic Garden – various certifications – www.oldsite.rcgc.org
- New York State Certified Nursery and Landscape Professional – www.nysnla.org
- Rainwater Harvesting Certification – www.arcsa.org

The program, coordinated in partnership with Northside Urban Partnership, the U.S. Department of Agriculture Forest Service, CNY Works, and Centerstate Corporation for Economic Opportunity, dovetails with additional investment being made in green infrastructure projects by the City of Syracuse and Onondaga County.

As part of Onondaga County's "Save the Rain" program, fifty new green infrastructure projects are being constructed in the region.[72] In addition, Syracuse has been chosen by the EPA as one of ten cities across the country to participate in the EPA's new Green Infrastructure strategic initiative.[73] Under this initiative, the EPA will help support the expanded use of green infrastructure in the city and highlight its success as a model for other cities across the country.[74]

Moving Forward: Advancing a High-Road Approach for Sustainable Water Infrastructure

Making smart and strategic investments in water infrastructure can provide cities and communities with the kind of economic, environmental, and social benefits that are desperately needed. But the full array of benefits will only be realized if such investments are made within a high road framework.

The "high road" approach is a scalable economic development strategy to build a society characterized by environmental sustainability, shared prosperity, and democratic governance.[75] High road standards ensure that programs create high-quality jobs, produce high-quality work, ensure broad access to economic opportunities for diverse businesses and workers, and support quality training programs that connect workers to career pathways. High road standards result in substantial, measurable, and long-term economic, environmental, and social benefits.

As cities and municipalities make investments in water infrastructure, we propose that they apply the following criteria:

(1) Create accessible and high road jobs

There is no question that water infrastructure investments will result in new jobs, as demonstrated in this report. But in order to truly maximize this opportunity, we must guarantee equitable access and shared prosperity for all communities.

Jobs created by these investments should meet a set of high road standards that provide family-supporting wages and benefits, promote strategies to increase participation by women and minority workers, utilize Community Workforce Agreements on larger construction projects (see page 42), connect to Registered Apprenticeship and other quality job training programs, and establish career pathways.

Having these standards in place goes hand in hand with the recruitment of responsible and qualified contractors who can guarantee the level of quality work we need on infrastructure projects—especially important for contractors installing emerging green infrastructure technologies in a new industry that will require the confidence of consumers, private investors, and policymakers in order to reach scale.

(2) Maximize environmental gain

In concert with traditional technologies, new green technologies can help us build a 21st-century infrastructure that guarantees clean water, reduces air pollution, minimizes energy costs, and increases green space in our communities. Green infrastructure techniques will help address our water crisis while simultaneously building resiliency in the face of climate change. Infrastructure plans should include green components where possible and utilize policy drivers to require green infrastructure when feasible. Implemented in combination with quality control measures, this approach not only will help ensure that investments produce optimal environmental gain and take advantage of the many co-benefits green infrastructure offers our communities.

An overflow point in Arlington, Virginia.

Profile: LIUNA Moves Water

For over 100 years, members of the Laborers' International Union of North America (LIUNA) have worked on jobs that move water. They have built locks, dams, levees and tunnels; they have laid water supply and wastewater removal pipes; and they have installed stormwater control systems.

Over the past decade, Laborers have seen changes in the way they accomplish traditional work in water infrastructure, water management, and pollution prevention. For example, they may now install plastic pipe for moving fresh and waste water, use trenchless technologies to repair and replace existing pipe with a minimum of surface disruption, and work on construction projects that separate storm sewers and sanitary sewers, stopping overflow of sewage into waterways after heavy rains. Laborers' skills are also in demand for new types of work. These include green roof installation, which helps with stormwater control; installation of surfaces such as brick pavers, pervious concrete and pervious asphalt for storm water control; and installation of water collection systems and new types of irrigation systems that help to conserve water, especially in arid climates.

LIUNA Training helps Laborers get the training they need to work on water infrastructure and pollution prevention jobs, and also operates programs that help new, disadvantaged and under- or unemployed workers obtain employment on water infrastructure jobs. LIUNA Training provides its curriculum, training programs, and instructor training to more than 70 affiliated training sites in the U.S. and Canada. Members can receive training at established training sites, from mobile units, at contractor yards, or any other place that meets the needs of the members and LIUNA's signatory contractors.

Using its independently accredited curriculum development process, LIUNA Training develops training programs that are based upon industry skill standards and incorporate a competency-based training approach. Participants demonstrate that they have acquired the necessary knowledge and skills (cont'd)

through written and performance assessments. Instructors who teach the courses also participate in accredited training programs, ensuring that they have the professional and technical skills required to provide top-quality adult education in the Laborers' craft.

Training that has been available for many years includes pipelaying techniques for ductile iron and concrete pipe, pressurized and gravity flow installations, concrete installation, and safety training that addresses a variety of hazards. Newer courses include an introduction to green construction, heat fusion techniques for plastic pipe, trenchless technology for pipe repair and installation, and green roof installation. Courses under development include pervious concrete installation, irrigation system installation, and installing retention/detention ponds and other methods of stormwater control.

(3) Use financing that is stable, fair, and scalable

These investments will require the use of existing financing strategies, such as municipal bonds and state revolving loan funds, and may also require rate increases and other fee-based approaches. We must take this opportunity to identify creative, progressive financing mechanisms that do not disproportionately impact communities and businesses that have the least ability to pay. In addition, we must replicate these practices to ensure that we are financing all of these projects through stable and fair means. Finally, such financing should promote the growth of emerging private-sector green infrastructure industries.

Together, these three criteria form the basis for a high road model of investment that maximizes the impact of every dollar spent. These criteria also build support for policy and investment by appealing to the interests of a broad range of constituents who may not currently be engaged on the critical issues facing our water systems. Engaging new and diverse constituencies will help build a broader coalition of supporters who can help advocate for making these needed investments and can lend their unique expertise to local infrastructure projects and policies.

The crisis we face in our water infrastructure and the opportunities we gain by addressing this crisis are clear. By making these needed investments—and ensuring they follow a high road approach—we can create quality jobs and healthier, more sustainable communities for the future.

What are High Road Standards?

High road standards,[76] as noted above, ensure that programs create high-quality jobs, produce high-quality work, ensure broad access to economic opportunities for a diversity of businesses and workers, support quality training programs that connect workers to sustainable career paths, and result in substantial, measurable, and long-term environmental, economic, and social benefits. High road employers meet as many as possible of these characteristics:

- Pay a livable wage;
- Hire workers from disadvantaged communities;
- Provide quality, affordable health insurance;
- Provide an employer-funded retirement plan;
- Provide paid sick leave; and
- Comply with tax and labor laws.[77]

There are a number of high road green jobs programs in the United States. Clean Energy Works Oregon (CEWO) is a non-profit program committed to high-quality job creation, equitable hiring, inclusive business opportunities, standardized training, and energy conservation. It aims to finance energy upgrades for 6,000 homes over three years. Its original pilot program, Clean Energy Works Portland, employed over 350 workers, with 50 percent of all work done by people of color. Additionally, 22.9 percent of pilot dollars went to women-owned and minority-owned businesses. Average wages were over $24 per hour, and 64 percent of participating contractors provided health insurance to their workers.[78]

Profile: Community Workforce Agreements: San Francisco Public Utilities Commission Water System Improvement Program (WISPLA)

Community Workforce Agreements (CWAs) are a best-practice tool in the construction industry. CWAs are used by labor unions, community organizations, construction project owners (often public entities), and contractors. They are negotiated agreements that guarantee certain job quality and hiring standards on publicly funded or subsidized construction projects.[79] They can also define uniform hours of work and project schedules, safety provisions, the training of workers on-site, and dispute resolution processes.[80]

The primary goals of a CWA are to ensure job quality and access to construction career opportunities for members of targeted communities. Local governments have also seen the value of CWAs in preventing project delays and ensuring workplace safety and a quality workforce—all of which help safeguard public investment in construction projects.

CWAs can be used as a tool in water infrastructure projects. One example is an agreement that the San Francisco Public Utilities Commission (SFPUC) entered into with building trades unions covering construction work on a $4.39 billion water system improvement program.[81] The agreement includes a commitment to increase the hiring of low-income local residents. To support the agreement, the SFPUC has created detailed apprenticeship and local hiring plans. Contractors submit quarterly data on compliance with the program, and those data are used to provide updates to contractors and community and labor leaders.[82]

A green roof.

Green Infrastructure Financing

Green infrastructure can be financed by special fees or from general revenues. Many cities pay for projects out of general funds, with federal grants or bonds. Fees levied on new developments can create special funds for green infrastructure. Cities often charge "in-lieu" fees for developments as a substitute for self-financed green infrastructure in order to comply with stormwater management codes. Lenexa, Kansas (a suburb of Kansas City) uses an in-lieu fee on new development to finance green infrastructure projects.

Stormwater fees are a popular method of financing green infrastructure. As opposed to taxes, which must be approved by voters or city councils, fees are charges for specific city services. Fees are usually calculated based on impervious square footage or metered water use. Many landowners, such as nonprofit institutions, do not have to pay property taxes but are nevertheless required to pay fees. Many cities have set up stormwater utilities to manage and collect fees. Cities often build incentives into fees by offering discounts or credits for installing certain types of green infrastructure. Portland, Oregon and Philadelphia have both used this method of financing green infrastructure.

Another common method of financing green infrastructure is to borrow from the EPA's Clean Water State Revolving Fund (CWSRF). At present, only a small percentage of CWSRF loans finance green infrastructure development, though a growing number of states have used it for this purpose. CWSRF loans are generally paid back over 20 years, and interest rates can be as low as zero percent. Repayment funds can come from the project itself or from municipal service fees. Examples of green infrastructure projects that are eligible for CWRSF funds include green roofs, permeable pavement, and wetland restoration. Ohio's CWRSF program recently financed a green infrastructure project to protect the Big Darby Creek watershed as the land surrounding it is developed.[83] Other states, such as New York, have established green infrastructure grant programs with SRF funds.[84]

Municipal Policies to Support Green Infrastructure

Update stormwater management and building codes

Many municipalities have rules governing how buildings let stormwater flow into wastewater pipes. These rules can be updated to require greater on-site water retention with green infrastructure improvements.

Institute stormwater utility fees

In order to encourage green infrastructure, cities can include a separate storm-water utility fee on water bills and base this fee on the amount of impervious surface on a property.

Offer discounts and credits for utility fees for stormwater reduction

Stormwater fees can be adjusted to encourage downspout disconnections and other infrastructure modifications that reduce stormwater runoff.

Repave streets and alleys with permeable pavement

Cities can integrate permeable pavements into their regularly scheduled street and alley resurfacing.

Purchase and preserve land near waterways

Targeted land conservation and restoration can create buffers along waterways to filter and absorb rainwater.

Grants and loans for green infrastructure installations

Cities can use financial supports and incentives to encourage private landowners to install green roofs or rain gardens. Green roofs and rain gardens can also be installed on public buildings.

Streetscape retrofits

Municipalities can invest in alterations to streets and sidewalks that promote water absorption, such as stormwater bumpouts, swales, rain gardens, and tree planting.

Tree planting programs

Increasing tree planting is a simple and common way to increase water retention. Cities can support efforts to increase tree planting through municipal or community-based tree planting programs.

Appendix A: Jobs Projection Methodology

National Projection

To create our jobs projections, we used an estimate of the relationship between infrastructure spending and economic growth from Moody's Mark Zandi. This macroeconomic multiplier (1.44) is consistent with a range of independent estimates, including those supplied by the Congressional Budget Office. This multiplier includes an implied "re-spending" multiplier of 0.44, which is consistent with estimates of private sector re-spending surveyed.[85] This multiplier is applied to the amount of upfront spending to calculate the total amount of new economic activity generated by the upfront spending. We then used the historical relationship that prevails between GDP growth and employment growth to infer that each 1 percent increase in GDP corresponds to 1.2 million new jobs. This relationship between GDP growth and employment growth is also relatively constant across many macroeconomic forecasts.[86]

State Shares

The estimates of job impacts in each state were calculated by taking the national job estimate (1.9 million) and applying it to two scenarios. The first scenario—the needs-based scenario—assumes that (a) the investment is spread to meet the needs of each state as identified in EPA CWNS 2008, and (b) the job impact is proportional to the state-level investment. This would be true, for example, if every dollar of investment in each state directly translated into an increase in demand for goods and services produced exclusively in that state and nowhere else in the country, or if there were no net economic flows between states in the various affected industries.

This scenario would be an appropriate estimate on its own if the investment dollars were spread relatively evenly across the states, but that is not the case—for example, New Jersey has more than twice the water infrastructure needs of California despite being only a fraction of the size.

To adjust for this, the estimate also contains a second scenario: the national employment share scenario. This scenario assumes that the job impact is proportional not to each state's water infrastructure needs, but rather to the state's share of national employment. This assumption would provide a rough estimate of the state-by-state job impact if the actual location of the investment had no impact on where the jobs were created. Neither assumption is likely, but because the truth lies somewhere between these two extremes, the estimates for each scenario provide a plausible range of job impacts for each state. The table at right provides the same data as the table on page 25, but is organized according to the scenario that produces either the lower or upper end of the job impact range.

Workers install a new water pipe.

State-by-state scenarios

	Needs-based	Nat'l employment share		Needs-based	Nat'l employment share
Total	**1,861,942**	**1,861,942**	Missouri	46,116	38,134
Alabama	29,185	26,839	Montana	2,692	6,172
Alaska	N/A	4,634	Nebraska	21,735	13,476
Arizona	26,089	34,311	Nevada	9,934	16,082
Arkansas	3,289	16,632	New Hampshire	7,197	8,959
California	120,402	199,526	New Jersey	263,518	55,404
Colorado	4,039	31,914	New Mexico	308	11,565
Connecticut	24,700	22,984	New York	128,104	122,759
Delaware	1,486	5,905	North Carolina	37,971	55,538
D.C.	19,065	10,186	North Dakota	N/A	5,343
Florida	90,857	102,977	Ohio	127,822	72,184
Georgia	209	54,969	Oklahoma	9,718	21,889
Hawaii	12,268	8,431	Oregon	18,126	22,960
Idaho	3,615	8,677	Pennsylvania	167,831	80,518
Illinois	131,714	80,515	Rhode Island	N/A	6,597
Indiana	63,658	40,060	South Carolina	1,670	25,856
Iowa	16,026	21,124	South Dakota	589	5,769
Kansas	18,685	19,008	Tennessee	8,952	37,420
Kentucky	16,784	25,335	Texas	74,447	147,905
Louisiana	26,518	27,091	Utah	6,479	16,920
Maine	7,133	8,540	Vermont	975	4,268
Maryland	56,429	36,054	Virginia	35,544	52,022
Massachusetts	53,610	45,759	Washington	27,882	39,904
Michigan	28,491	55,279	West Virginia	26,253	10,710
Minnesota	32,147	37,877	Wisconsin	39,792	39,274
Mississippi	10,805	15,644	Wyoming	1,083	4,042

Appendix B
Methodology for Workforce Analysis

For a better understanding of the kinds of jobs demanded by these types of water infrastructure projects, we turned to a study called *Capturing the Storm*, compiled by GSP Consulting Corp and the Ecolibrium Group. Using Bureau of Labor Statistics (BLS) data, interviews, and O*Net, they identified ten occupations most relevant to stormwater infrastructure investments. To this analysis, we added five additional occupations: one to represent workers who are extremely common on traditional stormwater infrastructure projects (Construction Laborers); one to represent the workers in charge of operating and maintaining facilities (Maintenance and Repair Workers, General); two to represent the manufacturing workers that supply the equipment and machinery for the construction project (Machinists and Welders, Cutters, Solderers, and Brazers); and one to represent workers associated with the installation of green infrastructure (Landscaping and Groundskeeping Workers).

Using O*Net data, we then looked at the median wage, and education and job training requirements associated with each of these jobs. We also analyzed analogous occupations (note that the titles of these occupations are often not identical) in the U.S. Census's Current Population Survey to characterize the current workers in these jobs according to educational attainment, ethnicity, union membership, and gender.

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Study Partners

Green For All www.greenforall.org

Green For All is a national organization working to build an inclusive green economy strong enough to lift people out of poverty. Green For All works in collaboration with business, government, labor, and grassroots communities to help create quality jobs and broad opportunities in green industry.

Green for All believes that sustainable investments in our water system offer opportunities for green job creation, business growth, and career pathways.

American Rivers www.americanrivers.org

American Rivers is the leading conservation organization standing up for healthy rivers so communities can thrive. American Rivers protects and restores the nation's rivers and the clean water that sustains people, wildlife, and nature. Founded in 1973, American Rivers has more than 65,000 members and supporters, with offices in Washington, DC and nationwide.

Through our work in five key program areas - Rivers and Global Warming, River Restoration, River Protection, Clean Water and Water Supply - American Rivers is working to protect our remaining natural heritage, undo the damage of the past and create a healthy future for our rivers and future generations.

Pacific Institute www.pacinst.org

The Pacific Institute works to create a healthier planet and sustainable communities. We conduct interdisciplinary research and partner with stakeholders to produce solutions that advance environmental protection, economic development, and social equity—in California, nationally, and internationally.

Founded in 1987 and based in Oakland, California, the Institute has been recognized with the Environmental Protection Agency's Award for "Outstanding Achievement," the American Water Resource Association's "Csallany Award" for exemplary contributions to water resources, and, in 2011, the Institute was awarded the first U.S. Water Prize.

Economic Policy Institute www.epi.org

The Economic Policy Institute is a nonprofit, nonpartisan think tank that seeks to broaden the public debate about strategies to achieve a prosperous and fair economy. EPI stresses real world analysis and a concern for the living standards

of working people, and it makes its findings accessible to the general public, the media, and policymakers. EPI's books, studies, and popular education materials address important economic issues, analyze pressing problems facing the U.S. economy, and propose new policies.

www.greenforall.org/resources/waterworks