Climate Resilient & Equitable Water Systems Capital Scan JUNE 2017

THE KRESGE FOUNDATION | CREWS Climate Resilient & Equitable Water Systems | MISSIONPOINT PARTNERS | CEA California Environmental Associates

Acknowledgments

Our sincere thanks and appreciation to all who helped in the production of this Capital Scan, including the team of MissionPoint Partners (mppgrp.com) and California Environmental Associates (ceaconsulting.com); the numerous investment professionals, philanthropic colleagues, community based leaders, practitioners and other experts that were interviewed throughout this process.

For additional information, please contact Kresge team members:

Kim Dempsey
Deputy Director
Social Investment Practice
kidempsey@kresge.org

Jalonne L. White-Newsome, Ph.D
Senior Program Officer
Environment Program
jlwhite-newsome@kresge.org

Table of Contents

I. Background & Purpose

Climate change is affecting water supply, water management and the health of communities in U.S. cities. Changes in the timing, frequency and intensity of precipitation are placing stress on the built and natural systems that provide fresh water, manage stormwater, and treat wastewater. Droughts are shrinking the water supply; heavy rainfall overburdens stormwater systems, causing flooding in homes and neighborhoods. Low-income people and communities of color are often the most vulnerable to climate change, living in low-lying areas and lacking the resources to adapt and cope with challenges associated with these patterns.

The cumulative impact of climate change on water resources not only leads to a reduction in water quality and the destruction of homes and property, but it can also be a threat to public health, force relocation of communities and cause economic harm.

The vision of Kresge's Environment Program is to help communities build resilience in the face of climate change. We believe that cities are central to action on climate change and equity must be a fundamental part of our work in climate adaptation, climate mitigation and building social cohesion.

Early in 2016, Kresge's Environment Program began developing a new strategy to address water systems that would reflect the needs and priorities of low-income communities. Our goal is to advance a water-equity agenda that supports solutions to address climate-related impacts on water systems, enhance climate resilience planning at the local level to support integrated water management practices, and provide safe, healthy, affordable water for all people. We believe that this nexus of climate change, water and equity has not been adequately documented or addressed in the philanthropic sector, the water sector literature, or in the financial investment realm. Consequently, this water systems capital scan, in addition to a recently published national briefing paper, "An Equitable Water Future" by the U.S. Water Alliance, will begin to set the stage for a larger discussion of concepts that have been advanced by community based organizations and environmental and social justice organizations for many years.

Kresge's new strategy - Climate Resilient and Equitable Water Systems (CREWS) - works to:

- Support and nurture a new cadre of water leaders to amplify marginalized voices and strengthen climate-vulnerable regions and water systems;
- Define and promote a framework for addressing climate resilience and equity in the water sector; and
- Advance non-traditional approaches to finance, operations and community participation that produce multiple community benefits.

A key aim of this water systems capital scan is to develop integrated strategies with clear pathways for using a full suite of capital tools including high impact grants, program related investments (PRIs) and mission related investments (MRIs), to accelerate the implementation of innovative solutions and unlock the flow of capital in this sector. Kresge selected two consultant partners to conduct this research: MissionPoint Partners, an impact investment manager and advisor focused on solving large scale environmental problems through the deployment of high impact capital and California Environmental Associates, a consulting firm that works with environmental foundations and nonprofits as well as sustainabilty-oriented businesses to conduct in-depth research and analysis, program design and evaluation, and strategic planning.

Because this is a relatively new and emerging body of work in the water sector for Kresge and some of our philanthropic partners, please refer to Appendix E for definitions of terms used throughout this brief.

We are pleased to share the results of this work.

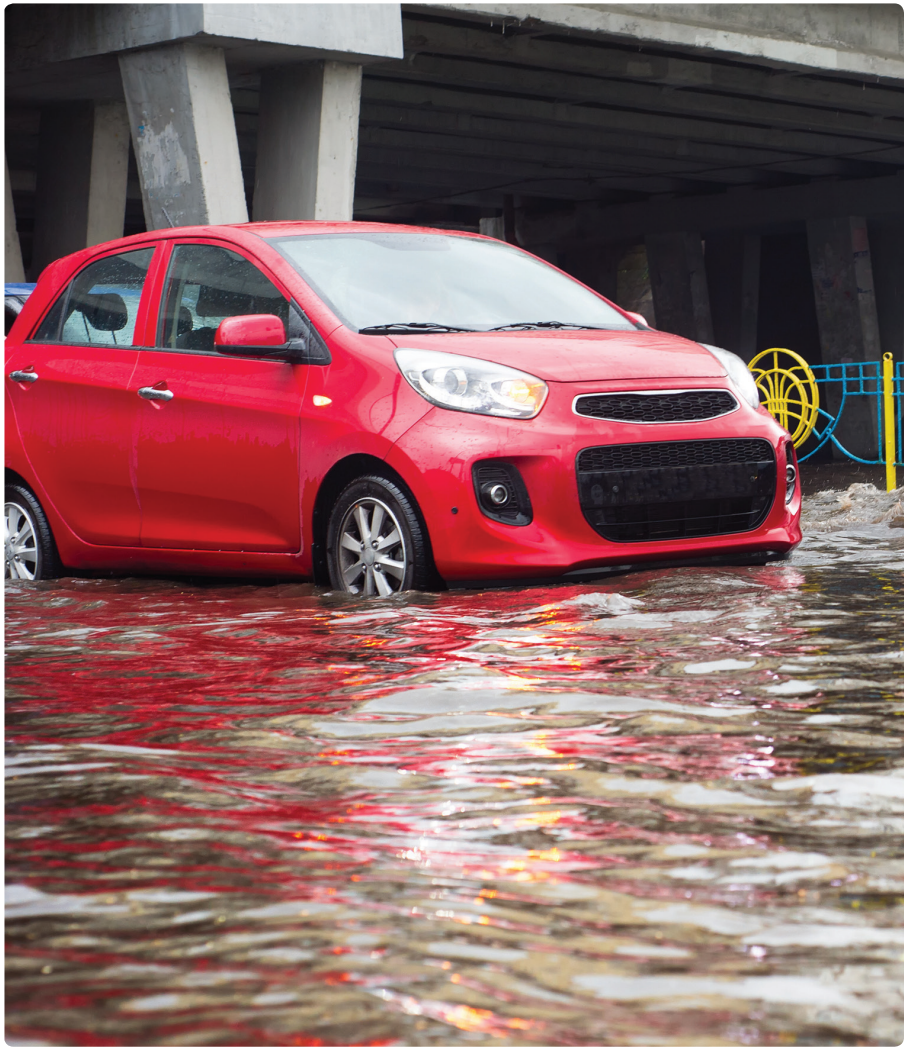
A NOTE ON TERMINOLOGY

Climate adaptation: Climate adaptation is the process of preparing communities and infrastructure to withstand the impacts of a changing climate. It can include building and upgrading physical infrastructure, such as seawalls; or changing systems and behavior; such as limiting development in floodplains. The term refers to the planning process as well as the implementation of adaptation strategies.

Climate mitigation: Mitigation seeks to reduce the impacts of climate change by lowering greenhouse gas emissions (GHG). Mitigation measures can include investments in renewable energy, energy efficiency upgrades, hydropower, or changes in behavior, such as encouraging the use of public transit instead of cars.

Water equity: Equity refers to just and fair inclusion—a condition in which everyone has an opportunity to participate and prosper. Water equity occurs when all communities have access to safe, clean, affordable drinking water and wastewater services; are resilient in the face of floods, drought, and other climate risks; have a role in decision-making processes related to water management in their communities; and share in the economic, social, and environmental benefits of water systems.

Definitions sourced from the US Water Alliance Report. ***uswateralliance.org/initiatives/water-equity***



II. Problem Overview

Urban communities depend on municipal water systems for affordable, safe and reliable drinking water, wastewater, and stormwater services. However, inadequate investment in aging infrastructure has left low-income communities particularly vulnerable to climate threats to these systems. Further exacerbating this challenge is the fact that these communities are often located in areas most vulnerable to climate shocks and families have limited capacity to manage water rate increases or temporary loss of income or dislocation that can be caused by disruptions or failures in water management. The following is an overview of the opportunities and challenges related to investing in water infrastructure.

Lessons for Investing in Water

Opportunities	Challenges
U.S. water market is very large ($160B+) and growing, water prices are rising nationwide	• Largest segments are hard to invest in (e.g. pipes and valves) and funded by municipal bonds • Roughly 70% of demand is agriculture, 20% industrial, and 10% residential • Highly fragmented; over 50,000 water utilities versus 3,300 electric utilities
Water market is in crisis and in need of innovation across multiple sectors	• Highly regulated, dominated by regulated utilities selling undervalued water • Culture of utilities does not incentivize innovation
Water intersects with other major sectors (energy, agriculture, health)	• Customers and cities often do not integrate planning to value non-financial benefits • Customer purchase decisions are generally compliance driven, limiting value add services
Large and growing number of water startups across multiple sectors, including university research and development (R&D), accelerator, and cleantech incubators*	• Too long of a design and deployment cycle (similar to cleantech) • Too capital intensive for many infrastructure-driven businesses • Many top researchers are in Israel or the European Union serving markets outside of U.S. • *"Of the dozens of water startups that I have seen over the past 5 years, virtually none have quickly grown revenues above $3-5 million."* – Water expert
A lack of early stage water investors allows for generally low valuations and favorable terms	• There is a limited set of investors for future capital needs • There is a limited set of dedicated co-investors to bring deal flow
Many large water firms are active in buying smaller enterprises, providing financial returns (exits) for early stage investors	• Standard multiples do not capture value outside of revenue/profit multiples • Businesses typically look for bolt-on value (integrate revenue and customers into current platform), not disruption that threatens core business (e.g. utilities)

** Cleantech refers to clean technology, which includes any technologies (including processes, products or services) that reduces the negative environmental impacts through significant energy effiency improvements, the sustainable use of resources, or environmental protection activities.*

Reference: "U.S. Water Industry Revenues Rise to $160 Billion", Waterworld.com, Dec 2016.

CLIMATE THREATS

Cities face three significant climate threats related to water systems.

First, ***storms*** can directly cause harm to people and infrastructure, while accompanying heavy rains can cause flood damage and water contamination. Flash flooding occurs in all 50 states and the frequency and intensity of severe storms has increased across all parts of the country over the past half century. Climate change has tripled the odds of once-a-century floods as compared to historical levels for most coastal cities.

Second, ***droughts*** can limit the availability of clean drinking water; forcing the use of more polluted groundwater sources and increasing costs for emergency supplies and treatment. Climate change is projected to increase water stress and drought risk in all U.S. regions by 2050, by nearly triple in some areas.

Finally, ***sea level rise*** contributes to storm surges that exacerbate flooding in coastal areas, where 40 percent of the U.S. population lives. An additional climate impact is extreme heat, which is responsible for between 670 and 1,300 deaths in the U.S. annually. The risk is compounded in urban neighborhoods which can be as much as 5-8 degrees Fahrenheit higher than surrounding areas because of the large number of buildings and paved surfaces – most of which are dark colored and absorb heat. The abundance of dark surfaces drive this ***urban heat-island*** effect, elevating daytime temperatures and making it harder for cities to cool off at night. Many of the best ways to mitigate excess heat in urban areas are green infrastructure (GI) solutions that also address excess stormwater, such as permeable pavements, shade trees and green space. Other solutions come from the built environment and do not have direct effects on water, such as cool (reflective) roofs and pavements.

Overview of Water-Related Climate Threats

Storms	Of climate threats to the water system, storms and floods have the most severe harm across the broadest number of low-income urban communities. Impacts can be mitigated with existing planning methods and centralized or distributed technologies that absorb or store rainwater during peak rain events to prevent the worst outcomes.	 *Hurricane Sandy aftermath (ABC News)*
Droughts	Drought will be a growing threat in many U.S. regions. Droughts primarily cause broad economic hardships as emergency water supplies are acquired and water-intensive industries suffer. Health and social cohesion impacts are likely limited to smaller pockets of rural communities. Impacts can be mitigated by long-term urban planning, supply diversification and novel water sourcing approaches.	 *Drought in CA (prepperways.com)*
Sea-Level Rise	Sea-level rise threats will cause significant health, economic and social cohesion impacts. A subset of the 40% of U.S. population living in coastal counties will be impacted. Vulnerable coastal real estate is generally inhabited by higher-income families, while residential areas adjacent to urban industrial waterfronts are an exception with lower-income populations. Impacts can be mitigated indirectly by many solutions to storm-driven flooding. However, major sea-level threats require large capital projects to raise buildings, construct sea walls, or complete other large scale infrastructure projects to mitigate the impact of coastal storm surge.	 *Projected flooding (thehigherlearning.com)*

Reference: "What percentage of the American population lives near the coast?" NOAA. 1. "Floods: The Awesome Power," National Weather Service, 2005

COMMUNITY IMPACTS

There are several types of impacts related to inadequate water infrastructure that disproportionately affect low-income communities. First, ***health*** risks include physical harm from intense storms, water-borne disease from flooding, contaminated drinking water and long-term mental health concerns. A second dimension is ***economic***. Climate extremes can directly influence low-income communities by damaging buildings and harming local businesses. Extremes may also escalate costs for water utilities, resulting in unaffordable water rates that lead to other cascading effects including loss of home due to property liens. The final impact is related to ***social cohesion***, when flooding disrupts or displaces community residents, fracturing relationships and neighborhoods and even resulting in the removal of children from homes deemed uninhabitable due to lack of water. Sustainable water solutions can serve not only to mitigate these harms, but also deliver co-benefits to a community, such as local job creation, cleaner air, and higher property values.

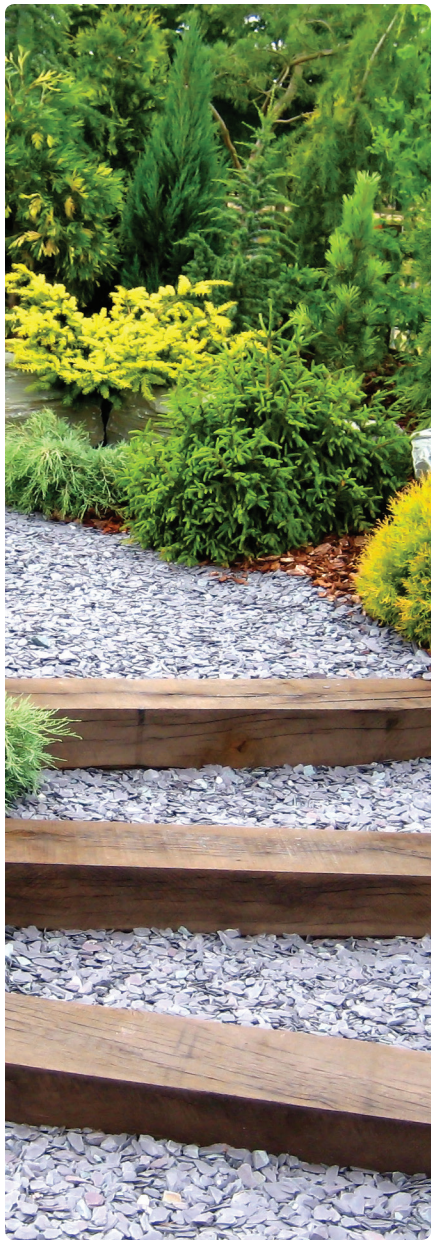
Overview of Water-Related Community Impacts

	Health	Economic	Social Cohesion
Core Impacts	**Contaminated waterways** – Low-income communities are more at risk of contamination and water-borne disease, especially during floods, due to proximity to industrial waterfronts, wastewater plants, and Superfund sites. **Polluted drinking water** – Aging infrastructure faced by poorer neighborhoods and shrinking cities acts as a climate risk multiplier, increasing vulnerability. **Severe harm** – Low-income communities face higher risk of death and injury during storms due to lack of robust preparation and response systems. **Long-term effects** – Flood damage (e.g., mold) can cause respiratory disease, while displacement and property loss can lead to mental health issues. **Chronic risk** – Informal housing, homeless encampments, trailer parks and unincorporated towns face the highest risk of chronic water supply insecurity (which can threaten sanitation and drinking water quality) and flood damage.	**Storm/flood damages** – Severe weather disproportionately harms low-income neighborhoods because homes are often physically less sturdy, emergency response is weaker and families have fewer resources (e.g., insurance, savings) to assist with recovery. **Water rates** – Rates are often disproportionately high for lower-income families, and climate shocks drive up rates through a higher cost of treatment, infrastructure operation and maintenance and emergency supplies during drought. **Employment** – Certain industries (e.g., fishing) are harmed by limited or contaminated water supply, impacting incomes, employment, or even food security.	**Dislocation** – Communities can be temporarily or permanently displaced after large climate events, and there can be a lack of political will and financial resources to rebuild. **Climate planning** – Low-income communities are often not included in planning efforts, resulting in planning that does not prioritize their specific needs or risks. **Removal of children from homes** – Low-income communities experience water shutoffs due to unpaid bills and unaffordable water rates. Parents can lose their children to foster care when homes without water are declared unfit for habitation.
Solution Co-Benefits	Proactive urban planning and green infrastructure can reduce heat island impacts from climate change, improve local air and water quality, and provide opportunities for recreation.	Green infrastructure can be a strong local job creator, while the adoption of water efficiency measures can directly reduce household water bills.	Distributed supply and treatment can provide local control and community ownership over these important water system functions.

Reference: Lane, Kathryn; et al. "Health Effects of Coastal Storms and Flooding in Urban Areas: A Review and Vulnerability Assessment," Journal of Environmental and Public Health, Volume 2013.

KEY TAKEAWAYS

- Flooding from storms or sea level rise have a variety of impacts across all three categories and can be severe in nature
- Drought's urban impact is mainly economic: extra spending pushes up rates while employment from water-related businesses suffers
- Green infrastructure generates more co-benefits than any other solution



III. Investable Solutions and Barriers to Scale

The process undertaken for this capital scan included a pipeline assessment across six sectors and more than 100 companies or projects that are actively seeking capital or have raised capital within the past three years. More than two dozen interviews were conducted to assess key barriers inhibiting the deployment of these solutions at scale. Here are the highlights from that research.

GREEN INFRASTRUCTURE

DESCRIPTION: Includes natural and on-site water treatment systems such as bioswales, permeable pavement, parks, rooftop gardens, natural wetlands, oyster beds, etc., and can have a range of direct water-system benefits and additional health and community co-benefits.

PIPELINE: A mix of solutions including project development, engineered products, financing and adaptive systems to deploy distributed and natural systems for water treatment and storage.

KEY BARRIERS: High operation and maintenance costs, data gaps on cost effectiveness at scale, lack of customer know-how and limited track record of large-scale deployments.

PLANNING AND PREPAREDNESS

DESCRIPTION: Includes general climate-related services and refers to planning specifically for water system and water management viability and resilience in the face of a range of climate impacts.

PIPELINE: A small collection of water system design software, flood risk assessment and flood prediction solutions.

KEY BARRIERS: Human capacity, data and policy to integrate climate risk into budgets, software and processes.

DISTRIBUTED TREATMENT & SUPPLY

DESCRIPTION: Decentralized treatment at the municipal, neighborhood, commercial building or residential level can provide system integrity and redundancy in the face of rapid change and shocks; distributed supply options include rainwater harvesting, greywater reuse, and desalination.

PIPELINE: Primarily industrial and home water treatment systems, with limited municipal or supply opportunities.

KEY BARRIERS: Unproven technology, financing gap to de-risk adoption and a utility culture that does not embrace a decentralized model.

WATER MONITORING

DESCRIPTION: Real-time and static monitoring of distributed water systems (excluding centralized treatment), including end user water usage, water quality, pump and pipe flow and rain flow.

PIPELINE: Generally early-stage software and distributed sensor solutions focused on home water usage, real-time water quality, and flow and leakage detection within municipal pipeline networks.

KEY BARRIERS: Poor integration into existing information technology (IT) systems, weak cost-benefit justification and limited municipal capacity to get value out of large amounts of data.

WATER EFFICIENCY

DESCRIPTION: Reducing leaks in municipal systems and demand limitation through low-water use landscapes, smart appliances and use-limitation incentives.

PIPELINE: A large pool of smart landscape irrigation, utility software and building sub-metering solutions.

KEY BARRIERS: Low price of water, distributed usage and municipal policy that creates disincentives for efficiency by lowering utility revenues and increasing consumer rates.

ENERGY EFFICIENCY

DESCRIPTION: Improving energy efficiency of water-related infrastructure to mitigate climate change and reduce local impacts of energy production, such as emissions.

PIPELINE: A small mix of technology companies including tankless water heaters, in-pipe electricity generation, waste heat recovery and efficient wastewater treatment.

KEY BARRIERS: Technology reliability and service, third party financing and municipal culture to prioritize cost reduction capital projects.

Barriers to Scaling Solutions

Barriers/Solutions	Green Infrastructure	Planning & Preparedness	Distributed Supply & Treatment	Water Monitoring	Water Efficiency	Energy Efficiency
Technology	💧		💧			💧
Financing	💧	💧	💧	💧	💧	💧
Policy		💧			💧	
Data	💧	💧				
Human Capacity	💧	💧				
Risk Averse Culture	💧		💧	💧		💧
Progress to Date	Technology is generally mature and can be integrated into stormwater projects	Planning is a core part of municipal water culture using standard software technology	Data shows benefits and return on investment from early decentralized systems in cities and industry	Water monitoring has begun to spread from core centralized assets to distributed systems	Large efficiency gains have come from rate-funded programs and mature products	Utilities have slowly proved positive return on investment from more efficient treatment, digesters, and heat recovery

Note: The rain drops in the matrix indicate barriers

For each of the sectors investigated, an investment heat map was created to assess the number of potential investment opportunities. As of November 2016, more than 100 potential water investments were identified. Some deals cut across sectors, including technology funds, project finance funds and market intelligence. Opportunities by asset class (equity, debt and guarantees) were spread roughly evenly across the investment sectors.

Investment Heat Map

	Storms	Drought	Sea Level Rise
Green Infrastructure (GI)	An excellent solution for stormwater management in urban contexts	Some opportunity for rainwater reuse for irrigation/toilets, limited investment potential	Financing solutions for coastal infrastructure to combat sea level rise
Planning & Preparedness	Climate planning is critical overarching solution for mitigating flood impacts	Securing diversified water sources is key to managing variability in rainfall	Planning is needed to build smart infrastructure to mitigate coastal damage
Distributed Treatment	Provides system redundancy during recovery in storm-impacted cities	Can pair well with greywater reuse in some areas	Applicable in places experiencing chronic saltwater intrusion or storm surge
Distributed Supply	Can provide system redundancy during recovery in storm-impacted cities	Desalination, rainwater harvesting, and greywater reuse are resilient supply sources, moderate investment opportunities	Alleviates supply loss from saltwater intrusion in aquifers
Water Monitoring	Not applicable	Usage and pipe monitoring directly results in water efficiency	Limited water quality monitoring opportunities help with storm surge
Water Efficiency	Not applicable	Large investment potential to scale up efficiency programs	Not applicable
Energy Efficiency	Negligible impact on severity of floods and storms	Some solutions achieve combined energy and water efficiency	Negligible impact on severity of sea level rise

Number of Investment Opportunities: High Medium Low Not Applicable/Negligable

COMBINED ASSESSMENT OF THREATS AND OPPORTUNITIES

The purpose of the scan was not only to evaluate a pipeline of potential investment opportunities across six sectors, but also recommend a set of integrated strategies for how grants and investments can best achieve benefits for low-income urban communities while incorporating resiliency to climate change. The chart shown on the right is an extension of the Investment Heat Map on the previous page, providing context across four specific categories: Threat to Low-Income Communities, Scale of Impact, Solution Co-benefits and the potential Investment Pipeline.

The scan determined that storms and associated flooding represent a broad climate threat with a wide range of investment opportunities. Drought is a major and addressable threat, although most current investment opportunities may not reach the most vulnerable. Sea-level rise is a substantial threat to coastal communities, but with limited available investment opportunities.

	Threat to Low-Income Communities	Scale of Impact	Solution Co-Benefits	Investment Pipeline
Storms	Flooding and storm damage can cause large and lasting impacts to low-income communities through damage to property and polluted drinking and flood waters. Floods are traumatic events for families and can cause death and widespread dislocation.	All 50 US states are at risk to storm-driven flooding, particularly in urban areas.	*Green infrastructure and distributed treatment solutions to flooding have large co-benefits (e.g., air quality, recreation, local control).	There is a large pool of investable opportunities in green infrastructure and planning & preparedness, as well as distributed treatment, and water monitoring.
Drought	Droughts reduce water security, lead to long-term increases in water rates, and can impact drinking water quality (e.g. saltwater intrusion). For informal communities already facing chronic water insecurity, droughts have larger direct economic and health impacts.	Peri-urban, rural, and agricultural communities are more affected than urban communities.	Utility water efficiency can improve system-wide resiliency, residential efficiency directly reduces water use and cost and water reuse reduces long-term vulnerability to supply shocks.	Many investment opportunities are focused around water efficiency technology and monitoring to drive more efficient behavior; the majority of solutions improve efficiency across the central utility water system but may not help the most vulnerable populations.
Sea-Level Rise	Storm surges can completely displace coastal communities and pollute water resources. Wealthier communities have begun to invest in preparedness, but low-income waterfront communities are particularly vulnerable to contamination as a result of storm surges.	Only impacts coastal cities. On average, beachfront property is wealthier.	Coastal green infrastructure – such as oyster beds, wetlands, and sand dunes – can have recreational and ecosystems co-benefits, but have few economic benefits.	There is a limited pool of privately investable deals, as most solutions are publicly funded projects for sea walls, coastal marshes and dunes, or projects to raise the height of street and building levels.

Strength of Combined Threat & Opportunity: Strong Medium Weak

**Note: The heat-island effect is a major climate threat and leading cause of death from extreme weather. It is not included in this analysis because it is not directly part of the water system. However, green infrastructure solutions that build more resilient water systems reduce this threat. See Appendix for more detail.*

References: "Floods: The Awesome Power," National Weather Service, 2005

IV. Integrated Strategies

In addition to a strategic focus at the intersection of climate, equity and water, four criteria were utilized to identify priority investments: impact, co-benefits, scale and deal flow. Given our limited resources, Kresge is particularly interested in identifying high-leverage opportunities for grantmaking and investments by addressing capital and capacity barriers. Such barriers include policies, practices and assumptions that impede the flow of capital, as well as perceptions of risk. We believe barriers like these may be overcome through transactions that demonstrate the value of a new intervention or financing mechanism; unlock capital from other investors, donors and foundations; bring new intermediaries or skills to the sector; or deepen our understanding of the market, policy and structural issues that stand in the way of progress. The scan has helped identify opportunities to test new models, catalyze markets, leverage capital and demonstrate where perceived risk exceeds actual risk.

The highest-ranking strategy for the specific project scope is to ***scale up green infrastructure and climate planning within low-income communities to address storm-driven flooding***. This approach could support (i) *flexible financing* and contracts to attract private capital, reduce total project costs, create economies of scale in procurement and transfer operations and maintenance (O&M) and performance risk from the municipality to service providers; (ii) *integrated planning* to incentivize low-income benefits by engaging other municipal departments in water project design and supporting capacity building; and (iii) *software and data collection* to measure equity-related impacts, improve storm response, and reduce costs through adaptive control.

A second near-term strategy that could be impactful in communities would be to ***achieve deep water efficiency and rate reduction in affordable housing to protect against drought***. This approach could support (i) differentiated rate policies, (ii) new technology adoption within affordable housing, (iii) leak reduction at the utility level, and (iv) a network of distributed water reuse systems in at-risk neighborhoods.

The next two pages provide a deep-dive into four integrated strategies.

The following pages provide examples of integrated strategies and offer specific roles for foundations. In terms of the barriers category, we define ***culture*** as "the prioritization of gray infrastructure among city planners and utilities" and ***capacity*** as the "limited capacity on the part of city planners, utilities, and civil society to design, implement, and maintain green infrastructure."

INTEGRATED STRATEGY #1:

Deploy large-scale green infrastructure in shrinking cities with combined sewer overflow (CSO) quality mandates and flood risk

OPPORTUNITIES:

- Environmental Impact Bond (EIB) or Community Based Public Private Partnership (CBP3) structuring to leverage private financing and lower risk for cities with poor credit (71% of municipalities have credit rating below AAA) to deploy green infrastructure
- Grant support for capacity building, data collection and municipal leadership training focused on large-scale green infrastructure (GI) programs, co-benefits, performance risk and data
- Foundation guarantees to reduce cost of capital, tapping EIB or the municipal bond market, in exchange for integrated planning to achieve clear co-benefit milestones, resiliency and environmental performance data
- Scale project developers to generate deal flow and integrate financing, engineering, policy incentives, community engagement and private-land sourcing. Guarantees would help stimulate project deal flow
- Use adaptive control (defined in Appendix E) to lower project cost, freeing capital for high co-benefit projects
- Use lower stormwater fees for small businesses to increase competitiveness and job creation
- Use grant support for green infrastructure Operations & Maintenance (O&M) certification with community colleges as tools and green job creation to replace aging workforce

BARRIERS: Finance, data, capacity

POTENTIAL ACTION STEP: RFP to bring $100M of green infrastructure projects to 5 new cities using leadership grants, developer PRI, software MRI, and large loan guarantee to ensure strong co-benefits link

INTEGRATED STRATEGY #2:

Better planning tools and data to reduce storm damage and increase co-benefits

OPPORTUNITIES:

- Software tools that easily allow for GI and climate resiliency planning variables to be integrated into both municipal and neighborhood planning processes
- Grants to support integration of feedback and needs of community in planning processes
- Flood warning and preparedness services, including better risk assessment to lower insurance cost, sensors for rapid warning and response for victims, and cost-effective projects to mitigate risk
- Integrate quantifiable co-benefits into planning software and feed into RFPs for professional services contracts
- Integrate citizen science tools to overcome gaps in data collection on co-benefits from various technologies
- New private financing from insurance and building owners for flood prevention with commercial benefits

BARRIERS: Data, capacity, policy

POTENTIAL ACTION STEP: Deploy robust set of climate and flood planning tools across five high-risk cities that lack capacity and resources

INTEGRATED STRATEGY #3:

Use financial innovation to help scale GI and resiliency planning

OPPORTUNITIES:

- Environmental Impact Bond (EIB) leverages private financing sources to lower risk for cities with poor credit and move green infrastructure performance risk to private sector
- Community Based Public Private Partnership (CBP3) framework brings private sector speed, risk taking, capital, and Operations and Maintenance (O&M) management to achieve scale
- Foundations can use grants and RFPs to push banks to issue green bonds that integrate climate resiliency (70% of utilities rely on municipal bonds for financing today)
- Leverage state revolving funds, Community Development Financial Institutions (CDFIs) or foundation program related investments (PRIs) (lowest-cost sources of infrastructure financings) to spur innovation adoption or guarantee financing GI projects with co-benefits
- New project financing vehicles to facilitate faster adoption of flood mitigation projects
- Grant support to set up green banks for water or new stormwater utilities that are the best reliable funding stream to pay back upfront financing or pay for O&M ($1M in ongoing stormwater fees can be leveraged to raise an additional $13.5 million in outside capital)

BARRIERS: Finance, culture, capacity

POTENTIAL ACTION STEP: Grant for municipal leadership network on financing innovation, backed by MRI and guarantee to support the multi-city scale up of one or more innovations

INTEGRATED STRATEGY #4:

Private capital/data to speed adoption of innovative technologies

OPPORTUNITIES:

- Water information technology (IT) sector (e.g. sensors, data, analytics) has a wave of new innovations, fits well with existing venture model of funding, and can be adopted quickly by customers
- Grant support for utility advisory board to overcome cultural barriers, particularly around the adoption of decentralized systems
- Foster a buying club of water utilities to test, validate and procure new technologies together to spread transaction costs over a broader set of rate payers, reduce the number of pilots, access private capital and speed the adoption cycle by giving more certainty of demand for new water innovators
- Adding performance insurance could further de-risk new innovation adoption for utilities
- Support innovative contracting that shifts risk from risk-averse public sector to engineering firms

BARRIERS: Technology, risk-averse culture

ROLE OF FOUNDATIONS: Catalyze at least $50M of additional innovation capital that targets priority climate resilience technologies with mechanisms for speeding adoption cycle

V. Conclusion

The purpose of this capital scan was to identify opportunities for philanthropy to use grants, program related investments and mission related investments to catalyze improvements in water infrastructure that advance climate resiliency and minimize negative impacts on urban, low-income neighborhoods and communities of color. The figure on this page is the guiding framework for the scan. It is our hope that the learnings from herein will provide an impetus to encourage the philanthropic sector to explore investments aligned with their mission and strategy; further motivate collaborative funding opportunities across the water sector; and, ultimately, overcome capital barriers that inhibit investments in the water sector. Our vision is a robust water system that promotes greater resiliency in communities that are vulnerable to climate threats, health risks and economic and social injustices.

Capital Scan Guiding Framework

CLIMATE THREATS

- **Storms**
- **Sea-Level Rise**
- **Drought**

CLIMATE RISKS

- **Flooding and Water Pollution** (Runoff, Saltwater Intrusion)
- **Lack of Water Availability**

WATER SYSTEM IMPACT

- Damaged buildings and infrastructure, contaminated wastewater and drinking water systems
- Rate pressure from higher cost of water procurement and treatment, lower revenues from water effiency mesaures

INVESTABLE SOLUTIONS

- **Green Infrastructure** Natural, distributed and adaptive stormwater systems
- **Distributed Treatment** Community, building, or residential scale systems
- **Distributed Supply** Desalination, wastewater reuse, rainwater harvesting
- **Water Efficiency** Lower demand from end users, less waste by utilities

- **Planning & Preparedness** - Adaptive design software, crisis response, climate tools and services
- **Water Monitoring** - Sensors, data, and analytics on leaks, floods, water usage and quality
- **Energy Efficiency** - Lower direct costs and green house gas (GHG) emissions for water utilities and end users

LOW-INCOME COMMUNITY VULNERABILITIES

- Families lack savings or insurance as financial buffer to rebound after shocks
- Low-income neighborhoods are generally more vulnerable to climate threats and receive lower quality assistance following disasters
- Poorer cities generally have less resilience planning and access to finance

COMMUNITY IMPACT

	POTENTIAL HARMS	SOLUTION CO-BENEFITS
Health	Waterborne disease, respiratory illness, mental health, direct flood harm	Clean air, reduced heat island effect
Economics	Home/building damage, water rate increases, small business threats	Green jobs, lower water rates, property value
Social Cohesion	Families dislocated from homes and employment options	Participatory decisions, recreation

Appendix A: Detail on Co-benefits

Green Infrastructure

- Reduces the heat-island effect by providing a general cooling effect from plants and soil instead of heat-absorbing asphalt and concrete
- Improves air quality by increasing number of urban plants and trees
- Generally less energy intensive than gray infrastructure
- Provides opportunities for recreation (playgrounds, school yards)
- Supports local job creation and tax revenue because projects are more likely to be bid on by local and minority-owned businesses
- Couples with graywater reuse to aid in water supply and drought alleviation
- Improves property values (average 10% in Philadelphia) when projects have visual greening by enhancing aesthetics and reducing blight
- Can protect the immediate and downstream environments and habitats

Distributed Supply and Treatment

- Lowers the cost to meet regulatory requirements, reducing risk of rate increase
- Enhances local habitats and water quality
- Provides redundancy to systems and increases resilience in the face of multiple impacts, especially storms, floods, and sea-level rise, and in cases where centralized treatment or supply is not available
- Creates opportunity for increased graywater re-use and water efficiency to increase drought resiliency
- Provides opportunity for local control of treatment infrastructure and decision-making
- Can be a strong driver of job creation
- Improves energy efficiency by reducing pumping demand to and from centralized systems

Planning and Preparedness

- Provides an overarching strategic framework that optimizes the effectiveness of other solutions
- Provides opportunities to include low-income groups and informal communities in urban planning and decision-making
- Reduces the costs of climate adaptation and emergency response when mainstreamed into urban planning
- Aids in the prevention of disproportionate climate change impacts on low-income communities

Water Efficiency

- Reduces water usage, helping maintain affordability by reducing the total water bill even in the face of rate increases
- Has potential to improve property value by lowering utility bills
- Reduces energy usage tied to inefficiency in hot water heating

Water Monitoring

- Catches leaks or malfunctioning distribution systems early to prevent expensive repairs or negative health impacts such as contamination

Appendix B: Detailed Barriers to Scaling Solutions

Green Infrastructure

- It is often efficient to combine green infrastructure with distributed gray systems for large projects
- Service providers must help utilities overcome widely varying upfront and long-term O&M costs that are hard to plan for with fixed budgets and resource constraints
- Better data would help reduce the risk perception among utilities that GI has poor performance and uncertain job creation
- Access to finance is the biggest challenge for projects on private property and cities with poor credit ratings, but innovative finance solutions often stall because utilities lack capacity within their finance departments
- Integrated planning is needed for large projects, public-private partnerships, or to maximize co-benefits by leveraging funding from other city departments (e.g. Parks, Planning)

Distributed Supply and Treatment

- The largest markets today are small rural water systems and industrial applications
- Municipalities struggle to integrate decentralized solutions at scale because it is hard to finance and maintain projects on private property under current regulation
- There are limited examples of large-scale distributed networks deployed in cities
- A long-term risk is that wealthier customers go "off the grid", reducing utility revenues, while low-income communities are tied to failing centralized systems

Energy Efficiency

- GHG mitigation potential is relatively small, with limited direct benefit to low-income families, and thus climate mitigation may be treated as a co-benefit of energy solutions
- The largest potential is within central utility systems (efficient treatment, heat recovery, in-pipe generation) and would benefit from contracts that shift risk to service provider
- While central utility efficiency will have a marginal impact on low-income rates, a more direct and substantial impact can come from lowering energy bills using efficient water heaters

Planning and Preparedness

- There are generally good climate projection maps and data today, but a gap exists in user-friendly "climate services" that link scientific data to existing infrastructure and help decision-makers assess vulnerability and potential solutions
- Resilience planners need to embed into ongoing city infrastructure budgets so that instead of a one-off, top-down climate plan, there is ongoing funding to help communities participate in iterative planning for continuous improvement over time
- Inequitable planning leads to slow emergency responses to even small climate shocks
- Need for regional planning whereby cities integrate with surrounding rural counties to more cost effectively build resiliency to water shocks

Water Efficiency

- Home indoor water use declined 22% since 1999 from wide use of efficient appliances
- >90% of water of consumption in water-scarce regions goes to irrigated agriculture
- Large opportunities remain in utility pipe leak repair and smart urban irrigation
- Rate design and end user water usage is a larger cost driver for low-income residents than droughts or utility efficiency, for which costs are spread among all ratepayers
- The majority of utility costs are fixed, so water efficiency among wealthy customers reduces profitability and has a perverse impact of higher rates for low-income families

Water Monitoring

- Traditional monitoring for water supply, delivery and overall system contamination is generally already deployed and mature
- Most new innovative water IT and monitoring solutions are embedded to support other solutions, such as water efficiency, green infrastructure or distributed systems
- Widespread real-time water quality monitoring for end users is not cost effective, limiting the ability to address storm-related water quality threats, particularly resulting from failed infrastructure

Appendix C: References and Data Sources

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Appendix D: Interview List

Investors

- **Debra Coy**
  XPV
- **James Spidle**
  Breckenridge Capital Advisors
- **Jane Silfen**
  Encourage Capital
- **Matt Diserio**
  Water Asset Management
- **Michael Ellis**
  Inherent Group
- **Steve Kloos**
  True North VP

Academic

- **Amber Wutich**
  Arizona State University
- **Casey Brown**
  University of Massachussets Amherst
- **David Sedlak**
  UC Berkeley
- **Marc Edwards**
  Virginia Tech
- **Melissa Kenney**
  University of Maryland

Government

- **David Behar**
  San Francisco Public Utility Commission
- **Howard Neukrig**
  formerly Philadelphia Water
- **Michael Murphy**
  Massachusetts Clean Energy Center

Foundations

- **Cristina Rumbaitis del Rio**
  formerly Rockefeller Foundation
- **Helen Chin**
  Surdna Foundation
- **Margaret Bowman**
  formerly Walton Family Foundation
- **Wade Crowfoot**
  Water Foundation

NGOs

- **Allison Deines**
  WERF LIFT
- **Brooke Barton**
  Ceres
- **Colin Bailey**
  Environmental Justice Coalition for Water
- **Craig Holland**
  The Nature Conservancy/ NatureVest
- **Eddie Bautista**
  NYC Environmental Justice Alliance
- **Scott Bryan**
  Imagine H2O
- **Scott Mosley**
  The Water Council
- **Shaun O'Rourke**
  Trust for Public Land

Industry

- **Eric Letsinger**
  Quantified Ventures
- **Erica Brown**
  Association of Metropolitan Water Agencies (AMWA)

Appendix E: Definitions

Adaptive Control

A best management practice that combines sensor data, weather forecasts and algorithms to optimize stormwater infrastructure through active, cloud-based control. Advances in sensor technology and Internet connectivity offer an important opportunity for stormwater managers to design smarter, more cost-efficient facilities. Continuous monitoring and verification of performance on an individual facility scale is now possible.

Source: www.ncppp.org/wp-content/uploads/2015/12/Session-3-Marcus-Quigley.

Community-Based Public-Private Partnership (CBP3)

An EPA-supported structure in which a municipality partners with a private developer to finance, design, construct, operate and maintain green infrastructure, lowering costs and increasing community benefits. The largest CBP3 to date is the $100M partnership between Prince George's County, MD and Corvias, in which the contract includes incentives for small business job creation and participation of minority-owned businesses. A traditional P3 is a performance-based contract between the public sector and the private sector to arrange financing, delivery, and typically long-term operations and maintenance (O&M) of public infrastructure. Communities of all sizes across the country have been using the P3 approach to meet their transportation, solid waste, energy and drinking water/wastewater infrastructure needs. The CBP3 includes many features of the traditional P3 model, but has modifications to meet the unique requirements of stormwater management systems. These modifications include a focused effort to invest in Green Infrastructure (GI) approaches that provide for local economic growth and improved quality of life in urban and underserved communities.

(Source: https://www.epa.gov/waterfinancecenter/community-based-public-private-partnerships)

Environmental Impact Bonds (EIB)

A novel pay-for-performance financing vehicle recently piloted by DC Water, Goldman Sachs, and the Calvert Foundation.

Green Infrastructure (GI) or Green Stormwater Infrastructure (GSI)

A collection of natural lands, working landscapes, and appropriate constructed interventions that conserves ecosystem functions and provides benefits to human populations. Traditional green infrastructure has included parks, urban forests, street trees, large gardens, wetlands, greenways, and other forms of "nature in the city"—all features that existed long before the term "green infrastructure" became commonly used. Other approaches to reduce stormwater runoff by steering rain to areas where it can infiltrate into the ground include rain gardens, green roofs, pervious pavement, bioswales, planter boxes, rainwater harvesting, downspout disconnections, and more.

Source: www.jff.org/publications/exploring-green-infrastructure-workforce

Mission Related Investment (MRI)

An MRI generates a market rate of return while also achieving a set of social or environmental impact goals.

Operations & Maintenance (O&M)

An effective and rigorous maintenance program is crucial for the long-term sustainability and function of Green stormwater infrastructure (GSI) systems. Because GSI systems incorporate vegetation, they can change over time as plant communities grow and establish. In urban environments in particular, GSI may be subject to temperature extremes, pollution, heavy sediment and trash accumulation, and an aggressive weed community—all of which can create a challenging environment for plants. Furthermore, sediment and trash, if allowed to accumulate, can create unsightly conditions and take up space within the SMP. Proper maintenance can ensure that GSI systems remain healthy, attractive, and safe for many years to come. Specific maintenance tasks might include such as vegetation removal, sediment removal, and trash removal. Each protocol provides information on required training, materials, health and safety issues, and provides a detailed procedure for executing tasks.

Source: http://phillywatersheds.org/doc/GSIMaintenanceManual-1stEdwpreamble_HRes.pdf

Program Related Investment (PRI)

A type of mission or social investment that foundations make to achieve their philanthropic goals. PRIs are typically utilized to make below market rate capital available to organizations that are furthering the foundation's priorities. A key attribute of the PRI is its flexibility, which means it can be structured to effectively address different types of financing gaps.

State Revolving Funds

The CWSRF was established by the 1987 amendments to the Clean Water Act (CWA) as a financial assistance program for a wide range of water infrastructure projects, under 33 U.S. Code §1383. The program is a powerful partnership between EPA and the states that replaced EPA's Construction Grants program. States have the flexibility to fund a range of projects that address their highest priority water quality needs. The program was amended in 2014 by the Water Resources Reform and Development Act. Using a combination of federal and state funds, state CWSRF programs provide loans to eligible recipients to: construct municipal wastewater facilities, control nonpoint sources of pollution, build decentralized wastewater treatment systems, create green infrastructure projects, protect estuaries, and fund other water quality projects. Building on a federal investment of over $39 billion, the state CWSRFs have provided more than $111 billion to communities through 2015. States have provided more than 36,100 low-interest loans to protect public health, protect valuable aquatic resources, and meet environmental standards benefiting hundreds of millions of people.

Source: https://www.epa.gov/cwsrf/learn-about-clean-water-state-revolving-fund-cwsrf

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