

LIQUID ASSETS

How Stormwater Infrastructure Builds Resilience, Health, Jobs, & Equity





laane»
A NEW ECONOMY FOR ALL

March 2018

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The author is responsible for the contents of this report and any errors or omissions it may contain.

List of Abbreviations

BMP	Best Management Practice
CCP	Construction Careers Policy
E/WMPs	Combination of WMPs and EWMPs
ERt	Economic Roundtable
EWMP	Enhanced Watershed Management Program
GI	Green Infrastructure
LADWP	Los Angeles (City) Department of Water and Power
LID	Low Impact Development
O&M	Operations and Maintenance
PLA	Project Labor Agreement
SCWP	Safe, Clean Water Program
UPCT	Utility Pre-Craft Trainee
WMP	Watershed Management Program

Executive Summary

Southern California's water supply is precarious, and our current practices are unsustainable. Of the roughly 500 billion gallons used annually in the L.A. Basin, only one-third comes from local groundwater; the majority of our water is transported from hundreds of miles away, at a significant financial and environmental cost. Projected increases in demand, dwindling supplies, and the effects of climate change are expected to create a water shortfall by 2050, even assuming significant additional water conservation.

Solving this crisis requires an investment in stormwater capture. We currently capture about 65 billion gallons of stormwater annually, but we discharge an additional 163 billion gallons each year. Investing in stormwater infrastructure could triple the amount captured, setting us on a path to sustainability.

Stormwater capture is also critical because runoff from storms is the greatest threat to the health of our surface water and the largest source of ocean pollution, as rain falling on impervious surfaces picks up bacteria, toxics, and pollutants before entering storm drains. The region's water quality is out of compliance with federal environmental standards and has led to lawsuits; projected compliance costs run into the tens of billions of dollars.

Many policy problems have municipal solutions, but water flows do not respect political boundaries. California's idiosyncratic restrictions on municipal funding mean few cities can comprehensively address stormwater, whose responsibility is shared among city, county, regional, and federal agencies. With over 200 entities overseeing different aspects of water resources throughout the county, we require a regional approach to stormwater investments.

The L.A. County Board of Supervisors is taking steps toward a regional solution with the Safe, Clean Water Program (SCWP). County staff is currently developing a parcel tax proposal for the November 2018 ballot; revenue would be shared with individual cities. The SCWP capitalizes on emerging nature-based solutions—so-called green infrastructure (GI)—to improve stormwater capture: rather than moving stormwater offsite and into a storm drain, GI uses natural features of the landscape to filter and infiltrate water onsite, also yielding aesthetic improvements. Green Streets, green alleys, rain gardens, bioswales, park retrofits, and other GI approaches have been used successfully across Southern California. The SCWP would dramatically increase the amount of green space across the county, improving air quality, reducing the heat island effect, and increasing property values. With both capital and maintenance costs of GI typically lower than those of traditional ("gray") infrastructure, and with extensive community benefits beyond water capture and water quality, a dollar invested in GI would yield 20 times the benefits of a dollar invested in gray infrastructure.

The County Supervisors have set goals for the program not only around water resilience, water supply, water quality, and community benefits, but around underserved communities, employment, and job training. Investing in GI through the SCWP would provide an economic stimulus for the region, creating good-quality jobs accessible to workers without advanced degrees.

This report develops a model to project job creation and other economic impacts under such a program. A new analysis of recent stormwater projects in L.A. County allows for a focus specifically on the construction and maintenance industries. Assuming a parcel tax raises $300 million annually for green stormwater projects, over 30 years the program would create 6,530 direct construction jobs and 1,347 direct operations and maintenance (O&M) jobs. Including the associated indirect and induced effects brings total jobs created over this period to 9,436. A $9 billion investment over 30 years would thus yield over $14 billion in regional economic benefits, even without accounting for jobs in high-wage fields like engineering and landscape design.

Construction jobs and O&M jobs have the greatest potential to incorporate career pathways into program design, benefitting residents, improving regional equity, and building ladders to the middle class. The apprenticeship model and on-the-job training in the construction and public sectors allow workers to earn as they learn. To maximize job access and career pathways, the county's SCWP should supplement industry apprenticeships with tailored training, project labor agreements, targeted hire goals for local or disadvantaged workers, and a pre-apprenticeship program.

Our unsustainable water supply and the high cost of our current uncompliant water quality require action. Investing in stormwater yields a significant economic return to the region, creating jobs, improving access to those jobs, adding green space and beautifying neighborhoods, and increasing equity. But the true upside could be significantly greater: with GI in its relative youth, L.A. County would house the largest concentration of industry activity in the nation—with implications for additional manufacturing activity and knowledge development. We can lead the way to a more sustainable water future by building a national industry in our backyard.



	Construction	O&M	Total
Jobs			
Direct Jobs	6,530	1,347	7,877
Indirect & Induced Jobs (annual avg.)	787	772	1,559
Total Jobs	7,317	2,119	9,436
Sales			
Direct Spending	$3,689,388,248	$3,510,611,755	$7,200,000,003
Indirect & Induced Spending	$3,662,359,789	$3,472,202,152	$7,134,561,941
Total Economic Activity	$7,351,748,037	$6,982,813,907	$14,334,561,944

Figure ES-1: Economic Outcomes of Investing in Green Stormwater Infrastructure

Introduction

The history of Southern California is in many ways the history of water. In past eras, leaders believed Southern California's local water supply to be insufficient and constructed massive projects to move large amounts of water from far afield. Today we know such decisions were short-sighted and unsustainable; they helped put in place a crisis whose magnitude we are starting to grapple with now.

California's five-year drought—the worst in 1,200 years—ended in April 2017, but the status of our water supply remains precarious: a single wetter-than-average year does not address ongoing structural flaws in our water system.[1] Indeed, while the recent rains are gratifying, they don't provide us with much usable water, as the overwhelming majority of stormwater rushes down gutters and storm drains and out into the ocean, uncaptured. We do not know when the next drought will start, but we know it will. We would be foolish not to consider possible paths forward to a more sustainable and resilient water future.

For most Southern Californians, our interrelated water systems—overseen by hundreds of distinct public entities—work quite well at the two things they were designed for: providing safe, clean drinking water; and offering protection from destructive floods when it rains. Yet we have relied on imported water which is increasingly expensive and less available, and contributes to climate change. Some water imports rely on century-old infrastructure and have sparked ecological, legal, and political challenges. Meanwhile, polluted runoff contaminates our groundwater, rivers, streams, and beaches; achieving compliance with federal and state water quality standards could cost tens of billions of dollars.

The status quo also has profound indirect costs in the form of missed opportunities. Addressing our outmoded water infrastructure and working toward sustainability would stimulate the economy, add good jobs, and create career pathways for some of our most vulnerable and disadvantaged residents. Using nature-based stormwater solutions, we can also add green space for residents, increase recreational opportunities, reduce greenhouse gas emissions, mitigate heat island effects, and add to property values throughout the region.

It is against this backdrop that the L.A. County Board of Supervisors has moved to develop the Safe, Clean Water Program (SCWP) to fund investments in stormwater infrastructure. County staff is currently developing details for a parcel tax to be placed on the ballot. If passed, such a tax would raise funds to address critical water challenges.

This report seeks to examine the county's stormwater infrastructure proposal in context. In the first section, we review the critical role stormwater plays in water systems broadly and in L.A. specifically.[a] We note the ways the status quo contributes to water instability and polluted waterways, identifying costs to residents, ratepayers, and the environment. Next, we examine emerging nature-based solutions, how some cities have begun to implement them, and the county's proposed approach. We then explore how investments in stormwater infrastructure can strengthen the regional economy: using a new data analysis we quantify the job creation potential, with particular attention to how unionized construction jobs and apprenticeships create career pathways and improve regional equity. Finally, we examine the critical role of ongoing operations and maintenance (O&M) to ensure project success, and to maximize economic benefits and job ladders.

[a] Throughout this report, "the county" refers to L.A. County. When referring instead to the city, we use "L.A. City." The more general "L.A." refers to the region. See also footnote (b) below.

Stormwater in L.A. County

Water—like air—is a necessity of life that many of us take for granted. We simply expect that when we turn on the tap, we will have ample clean, safe water, at a cost low enough to be ignored. Farmers, industrial operations, homeowners with verdant lawns, apartment-dwellers—all are tied together by a reliance on water. Talking about water generally indicates something has gone wrong: from California's drought to burst water mains across the Southland; from Flint, Michigan's lead crisis to toxic algae blooms killing pets and wildlife; from previously-pristine beaches now contaminated and closed to rivers overflowing their banks and polluted waterways catching fire; water makes news when its systems have failed.

California was the first state to recognize water as a human right.[2] It is a fundamental responsibility of government to provide residents a functional and efficient water system. Yet there is no single water system, and no single governmental entity, that encompasses all things water. Distinct systems move and treat drinking water; treat sewage; control floods; capture runoff; and ensure a clean and healthy natural environment. Numerous interrelated governmental entities—municipal, county, regional, state, and federal—are responsible for different functions.

Southern California's Water Needs

The Los Angeles Basin uses approximately 500 billion gallons of water annually.[b,c,3] As seen in Figure 1, only about one-third is from local groundwater sources; in L.A. City local groundwater only provides about ten percent.[4] Most of our water is imported via long aqueducts from Northern California, the Colorado River, and the Owens Valley. By 2050, a projected annual increase in demand of up to 60 billion gallons—combined with dwindling water supplies—means we will not be able to meet our basic water needs, even allowing for imported water and additional conservation.[5]

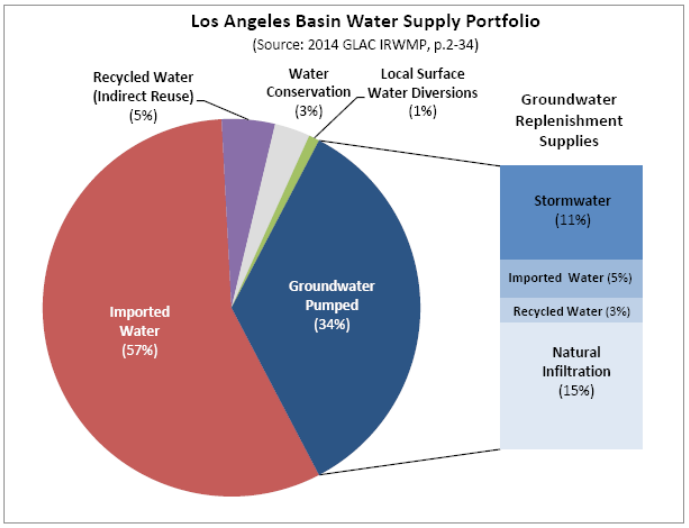


Figure 1: L.A. Basin Water Supply[6]

While local groundwater is an integral part of our water supply, the *L.A. Basin Study,* a partnership of county and federal government, acknowledged the future unreliability of imported water, stressed the importance of local water sustainability, and identified a variety of stormwater capture projects to maximize groundwater recharge.[7]

Stormwater: An Underused Asset

Stormwater capture is key to meeting water sustainability goals. As Figure 1 shows, stormwater—the runoff from precipitation that may or may not be absorbed back into the ground—already composes a significant portion of our water supply. This is, in part, a natural process: stormwater may soak back through the ground and into our local groundwater resources from which municipal water is later drawn. But approximately half of L.A. County is covered with impervious surfaces—roads, parking lots, buildings, sidewalks—preventing such natural infiltration.[8] The problem is especially pronounced in L.A. City, where over 61 percent of land is impervious, and each year the city loses an additional two-and-a-half acres of pervious surface to development, more than any other major U.S. city.[9] Prevented from seeping back into the ground, stormwater becomes a liability, threatening human

[b] The L.A. Basin approximately covers L.A. County, though it excludes the Santa Clarita Valley and Antelope Valley.

[c] Volumes of water may be expressed in either acre-feet or in gallons; for simplicity, this report uses gallons. When necessary, numbers have been converted at 1 acre-foot to 325,851 gallons.

and environmental health. The extent of Hurricane Harvey's destruction in Houston is partially attributable to the combination of impervious surfaces and an insufficient stormwater system.[10]

After a series of deadly floods killed hundreds of Angelenos in the 1930s, the Southern California stormwater system was designed to prioritize flood risk mitigation. Too much impervious cover distributed across a region has dangerous implications for flooding, but by paving the L.A. River, engineers converted it into a giant flood control channel that excels at moving stormwater swiftly along concrete directly to the ocean. The success of this project has dramatically reduced the threat of floods, but at a cost of billions of gallons of water each year that we fail to capture, instead dumping into the Pacific.[11]

Stormwater systems can convert rainfall runoff into a water resource by capturing it for immediate reuse (such as using cisterns or rain tanks for irrigation or toilet flushing), by capturing and storing it in dams and reservoirs for later use, or by sending it through a sewer system to a treatment plant where it is cleaned up for purple pipe irrigation or industrial uses. Most commonly, however, stormwater systems guide runoff into spreading grounds which infiltrate and help to replenish groundwater resources. This can be done artificially through direct injection or naturally by slowing the flow of water and allowing it to pass through permeable soils; such gravity-driven natural infiltration requires zero energy, and may occur in a small rain garden, a large spreading grounds facility, or anything in between.

In its role protecting the nation's most populous county, the L.A. County Flood Control District (LACFCD) manages regional stormwater infrastructure across 2,700 square miles. Its extensive system includes 14 dams and reservoirs, 483 miles of open channel, 27 spreading grounds, 3,330 miles of underground storm drains, 47 pump plants, 172 debris basins, 27 sediment placement sites, 3 seawater intrusion barriers and an estimated 82,000 catch basins.[12] With this massive infrastructure, the County Flood Control District captures and infiltrates about 65 billion gallons of stormwater per year, approximately one-ninth of our total water use.[d, 13] Yet each year we also discharge approximately 163 billion gallons of water into the ocean—one-third of our total water use.[14] Increasing the amount of stormwater captured would significantly improve the sustainability of our local water supply and reduce our reliance on water imports.

In recent years, as California suffered a punishing drought, government experts attempted to quantify the amount of wasted stormwater potentially subject to capture. *The L.A. Basin Study* concluded an additional 80 billion to 130 billion gallons could be captured annually across the region, doubling or tripling what we currently capture, and meeting 15 to 25 percent of total demand.[15] The L.A. City Department of Water and Power (LADWP) found within L.A. City limits we could capture up to four times the current amount, and a 2014 study from the Natural Resources Defense Council (NRDC) and the Pacific Institute saw even greater capture potential.[16]

Prioritizing Sustainability and Resilience

As seen in Figure 2, there is simply not enough water—local or imported—to support projected demand.[17] Assuming demand follows the predicted "high" trajectory, by 2050 the region will need 560 billion gallons, creating an 84 billion gallon annual shortfall relative to supply. With a mid-level reduction in demand ("median"), the shortfall would be 46 billion gallons. And even if we are wildly successful at conservation, putting ourselves on a

[d] Nearly half (44%) of our local water supply comes from natural infiltration, 32% from induced stormwater infiltration, 9% from treated wastewater, and 15% of our groundwater is actually imported for replenishment purposes.

path to cut per capita water use in half by the end of the century ("low"), demand will still outstrip supply in 2050. A study conducted by Tetra Tech for NRDC found L.A. County's water sustainability at "high risk" by 2050 given climate change projections.[18]

The severity of climate change will exacerbate these challenges. Snowpacks and runoff are expected to decrease significantly, as is the flow of the Colorado River; an increase in invasive species will reduce supply; sea level rise will cause intrusions into groundwater resources; higher peak flows from more intense storms will make natural infiltration more difficult; increased wildfires will require additional resources. Recently published research from the Lawrence Livermore National Laboratory concluded that climate change will not only reduce rainfall in California by 10 to 15 percent, but will result in greater year-to-year variance, increasing both wetter than usual years and drier than usual years.[19]

One scientist stressed the study's implications for water policy, noting "as we learn more about the subtleties in the dynamics of climate change, we are learning that certain climate change impacts, like California drought, may be far worse than we had previously thought."[21]

Unsustainability is only one reason to reduce our reliance on water imports. Moving water great distances is expensive and inefficient, and its very availability is clouded by uncertainty and risk. Most imported water is conveyed via the Los Angeles Aqueduct (419 miles north to Inyo and Mono Counties), the State Water Project's California Aqueduct (660 miles northwest to Contra Costa County), and the Colorado River Aqueduct (240 miles east to the Arizona border). Some stretches of infrastructure are more than 100 years old; a single earthquake could sever any one of these arteries. Ongoing legal and political challenges related to

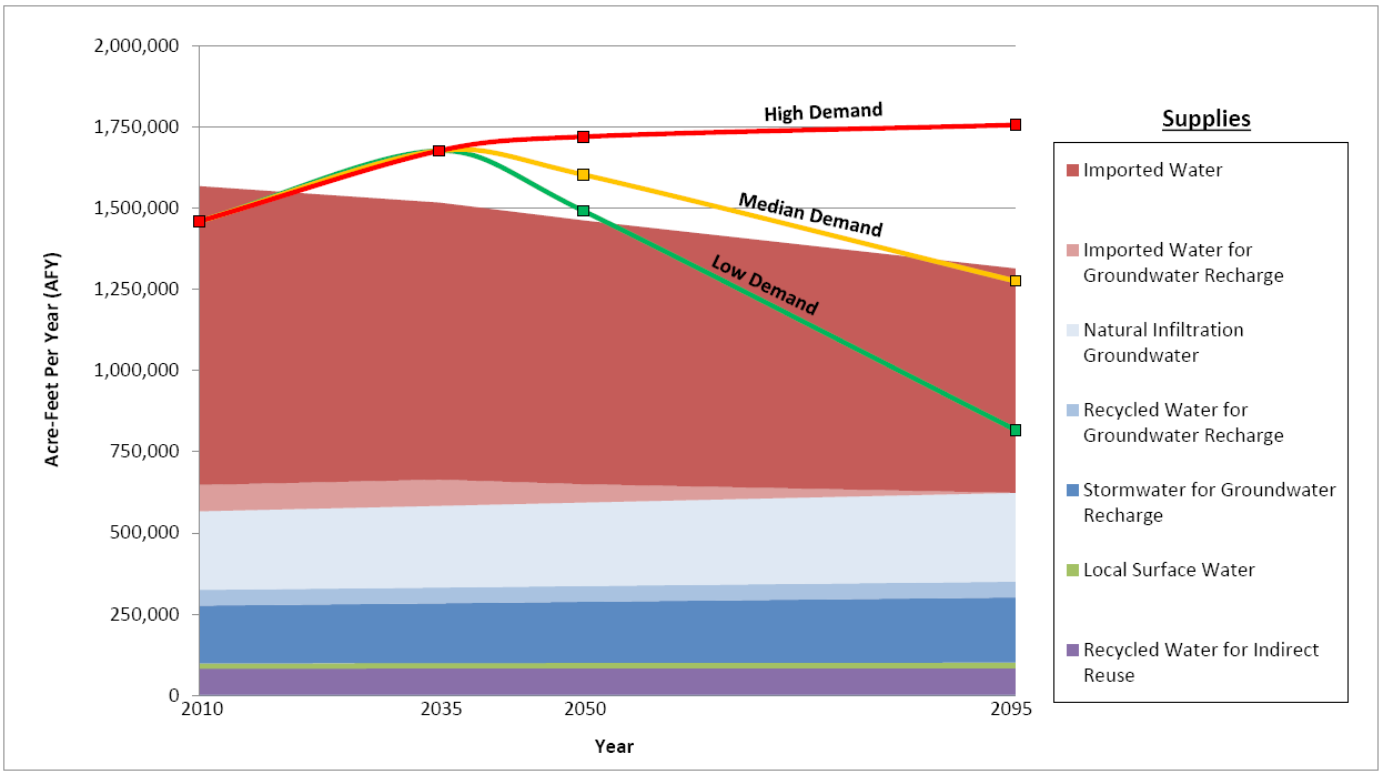


Figure 2: Projected Supply/Demand Imbalance[20]

water rights and environmental impacts contribute to uncertainty and drive up costs for water imports.

Importing water also uses a tremendous amount of energy, with the carbon footprint of water conveyance exceeding that of water treatment or distribution.[22] Approximately 20 percent of California's electricity is used in the state's water systems, and supplying water to Southern California requires approximately 50 times as much energy as supplying water to Northern California.[23] By reducing water imports, L.A. County could save enough energy to power 20,000–65,000 households annually.[24] Extensive energy use increases emissions, and water systems account for ten percent of the state's greenhouse gas emissions.[25] Reducing our reliance on imported water would thus contribute to air quality improvements, and could interrupt the vicious cycle whereby water imports yield increased carbon emissions, which hastens climate change, which then requires additional water imports.

The High Price of Dirty Water

A successful stormwater system not only addresses flood risk mitigation and water supply, but protects water quality, ensuring a clean and healthy environment. As rain falls onto impervious surfaces, it picks up trash, chemicals, motor oil, bacteria, metals, and other toxics and pollutants before entering a storm drain. Absent rain, pollutants still enter the stormwater system from dry-weather runoff associated with car washing, street and sidewalk cleaning, irrigation runoff, fountains, and commercial and industrial activities. Designed to move water as quickly as possible to avoid floods, Southern California's storm drains act as a pollution intensifier, moving harmful and often microscopic detritus into creeks, rivers, and beaches. These flows "are believed to be the greatest threats to rivers and streams within the region" as well as the greatest source of ocean pollution.[26]

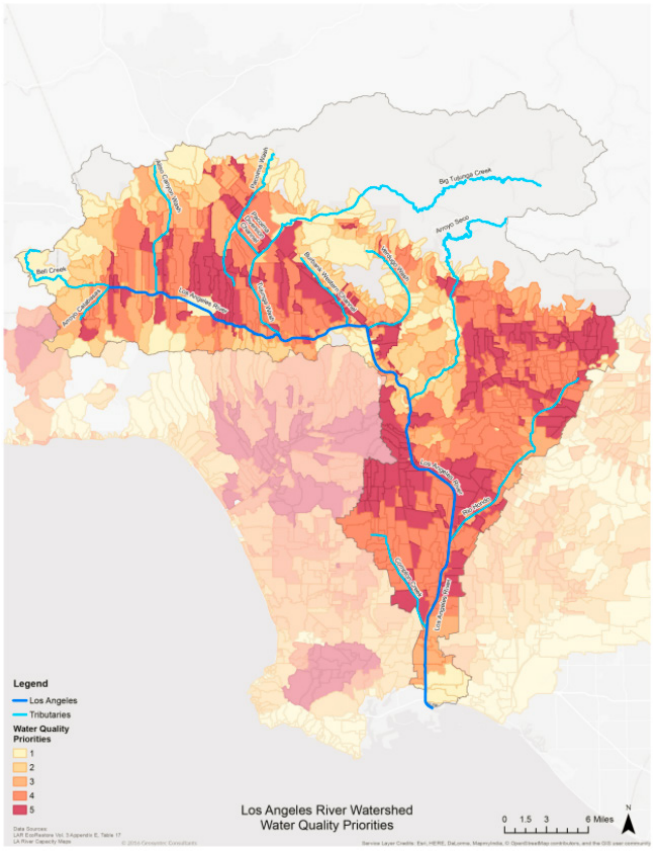


Figure 3: Surface Water Quality, L.A. River Watershed [27]

Southern California's waterways have seen a dramatic reduction in pollutants since the passage of the Clean Water Act, but much of our surface water is still classified as "impaired," including two-thirds of the 319 waterbody segments assessed by the L.A. Regional Water Quality Control Board in 2016.[28] More than three-quarters of California's waterbody impairment results from stormwater and similar nonpoint source pollution.[29] According to the U.S. Environmental Protection Agency (EPA), Los Angeles' watershed health was among the worst in the state.[30] Figure 3 shows the poor quality of surface water in one of the county's watersheds.

The uncommonly wet winter of 2016–2017 demonstrates the harm to Southern California's beaches from bacterial pollution in stormwater. According to Heal the Boys 2017 *Beach Report*

Card, during the dry summer months, 93 percent of L.A. beaches earned an A grade, yet during the wet winter, with stormwater flowing in abundance, a mere 23 percent of beaches scored an A. Most beaches earned a failing grade last year, a significant uptick from the same period in previous, drier years.[31]

Human and ecological health suffer from contaminated stormwater flows. Elevated bacteria levels expose swimmers and surfers to flus, infections, and rashes; public health agencies recommend swimmers avoid the water for at least three days following rain. Other pollutants can destroy aquatic habitats, and heavy metals and organic compounds can accumulate in sea creatures and enter the food chain. People can suffer serious and unexpected illness: a recent study in the *American Journal of Epidemiology* showed the risk of runoff to surfers, and in September 2017, over 100 kayakers on the L.A. River encountered harmful E. coli bacteria levels exceeding 100 times the federal limit.[32]

The region's ongoing failure to comply with environmental standards has a direct cost to taxpayers. State and federal fines and penalties to cities for non-compliance can reach tens of thousands of dollars per day. In 2008, the Natural Resources Defense Council sued L.A. County, alleging over 500 violations of the Clean Water Act related to polluted stormwater discharge. After eight years of litigation, including a hearing in front of the U.S. Supreme Court, the county settled for four million dollars.[33] In 2012, the city of Malibu settled a similar suit for $6.6 million. The cost to bring L.A. County's waterways into compliance with environmental standards has been estimated to be as much as $284 billion.[34]



Finding a Home for an "Orphaned Utility"

An interrelated multiplicity of over 200 governmental bodies is responsible for managing varied aspects of water resources in Southern California. The federal and state levels each have three different agencies involved in water quality, water supply, and flood control, and there are a set of regional institutions like the Water Quality Control Board and the Metropolitan Water District that overlap multiple levels of government. In addition, 78 different water districts across L.A. County play a role in water distribution, though residents and businesses ultimately get water from one of 228 distinct community water systems—sometimes these are municipalities (as with LADWP), sometimes special districts, and sometimes private companies.[35]

Even in this "fragmented system," most responsibilities are coordinated across the county's 88 cities.[36] Stormwater, however, has been described as an "orphaned utility," with functions distributed across several city and county entities.[37] Rain that hits the ground and becomes surface flow in L.A. City, for instance, is the responsibility of the L.A. City Department of Public Works and is managed through the Bureaus of Sanitation, Street Services, and Engineering. Some parts of the storm drain system within the city are maintained and operated by either the County Flood Control District or the U.S. Army Corps of Engineers. Since most of the groundwater basins of L.A. County are adjudicated, a court appointed watermaster sets limits on how much water can be safely extracted by any agency and monitors the wells for water quality. Per the City Charter, LADWP is the only city entity that can sell water. Shared responsibility leads to diffusion of responsibility, creating funding and coordination challenges. While special districts and water agencies have built-in funding, stormwater projects (if they happen) are typically funded from a city's general fund, potentially leading to political fights as investments in stormwater are balanced against law enforcement, parks, libraries, and more. Unlike investor-owned utilities, water agencies face additional funding challenges owing to California's two-thirds voting threshold for raising taxes.

The disconnect between physical and political boundaries poses an additional challenge; rain and water flows hew to the former and ignore the latter. The L.A. Basin (the physical entity) largely overlaps with L.A. County (the political entity), with 92 percent of the county's population living inside the basin.[38] The L.A. Basin, in turn, comprises five major distinct watersheds (see Figure 4), or physical geographies separating water flows.[e] The crazy-quilt complexity is most apparent when overlaying water agencies (often mapping onto municipalities) on the physical landscape. Figure 5 shows dozens of distinct agencies operating within a single subregion of the basin. With the natural landscape dictating the flow of water and a fragmented political landscape determining infrastructure investments, efforts at a comprehensive solution to stormwater management have historically been stymied.

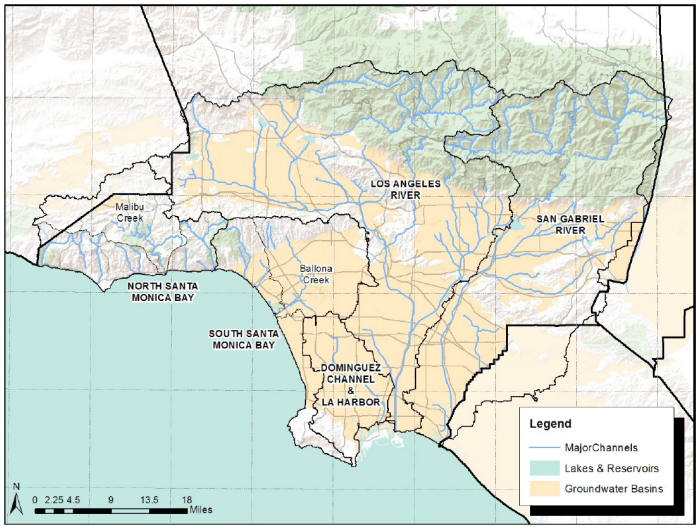


Figure 4: Watersheds in the Los Angeles Basin[39]

[e] No matter where in a given watershed a drop of water falls, it will flow to the same place.

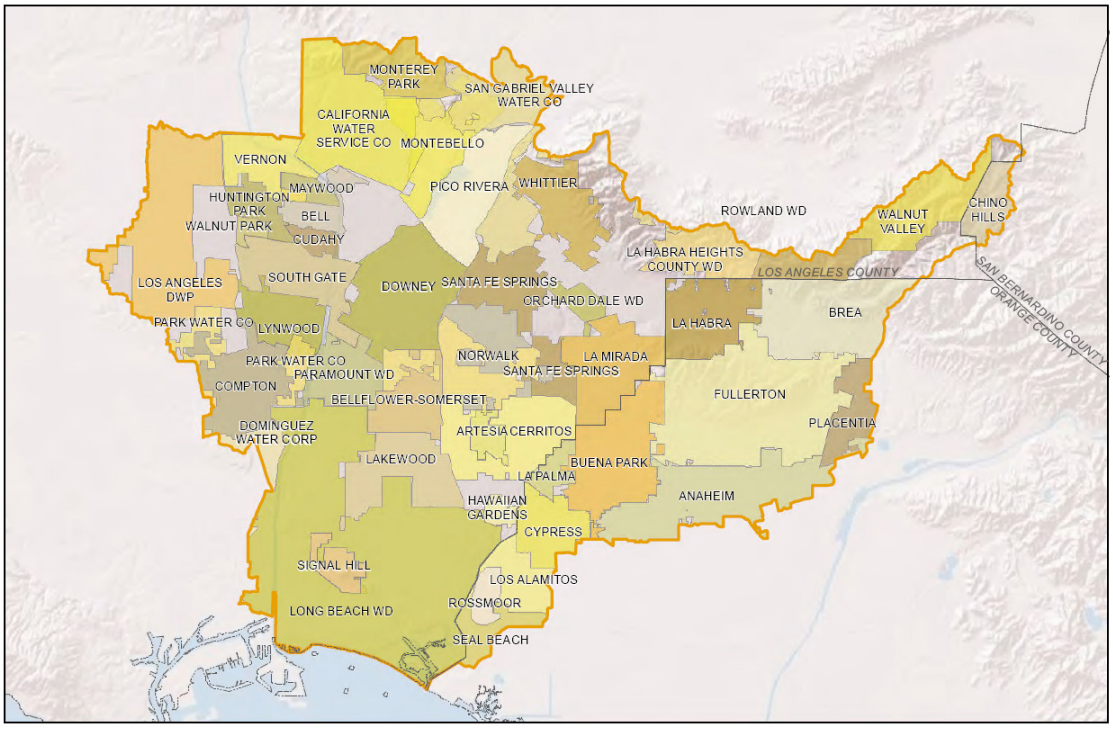


Figure 5: Water Agencies in the Lower L.A. and San Gabriel River Watersheds[40]

Policy responses to stormwater are largely governed by the federal Clean Water Act as administered by the EPA, with authority generally delegated to the states to issue permits for municipal separate storm sewer systems (MS4s) and to ensure any pollutant discharge does not exceed its Total Maximum Daily Load (TMDL). To comply with 2012 permitting requirements, cities and other agencies began to develop and implement Watershed Management Programs (WMPs). Programs that include stormwater infiltration are considered Enhanced Watershed Management Programs (EWMPs).[f] E/WMP projects are designed to improve stormwater quality, comply with environmental regulations, address flood control, enhance water supplies, promote conservation, and improve natural beauty and recreational opportunities. While some cities in the region are acting alone, most have joined together into Watershed Management Groups (WMGs), with some cities (and the county) involved in multiple WMGs. Figure 6 shows L.A. County's 19 WMGs.

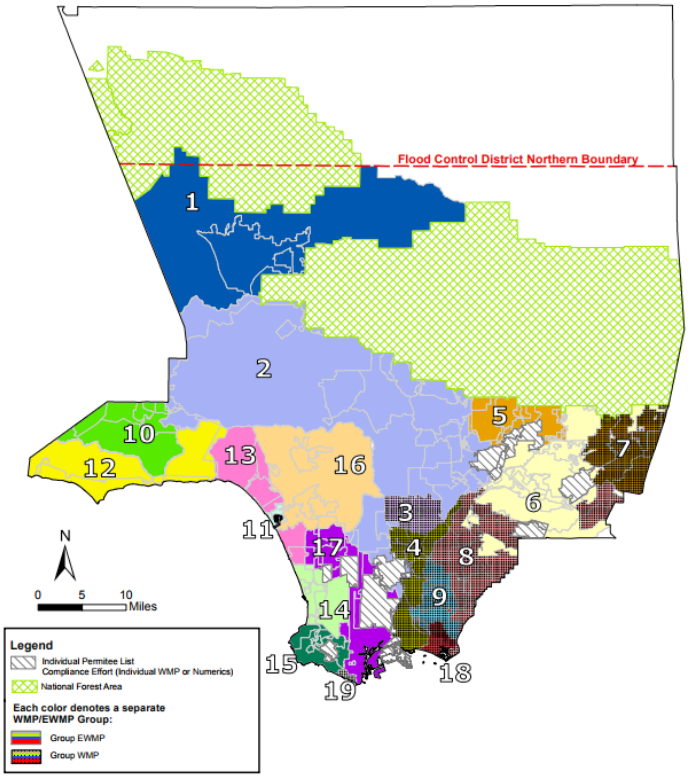


Figure 6: Watershed Management Groups in L.A. County[41]

[f] Throughout this report we will encompass both WMPs and EWMPs with the term E/WMPs.

Putting Stormwater Plans into Action

There is no cookie-cutter approach to addressing stormwater: projects are designed for specific geographies and account for the uniqueness of each landscape as well as particular pollutants. While individual E/WMP projects tend to be local, the full set of E/WMPs together amount to a regional plan to address our ongoing crises of water supply and water quality. Implementing the E/WMPs would cost $20 billion over the next two decades, yet few municipalities have identified needed funding.[42]

Managing Stormwater Through Nature-Based Solutions

Stormwater management has traditionally relied on gray infrastructure—so-called because of its heavy use of concrete, and typically including dams, reservoirs, storm drain systems, and treatment facilities—to move stormwater offsite and into a storm drain. The 2012 MS4 permitting process began to change the paradigm, moving from a gray toward a green approach by requiring cities to adopt Low Impact Development (LID) and Green Streets ordinances. In keeping stormwater onsite, green infrastructure (GI) uses natural features of the landscape to absorb water, filter pollutants, and replenish groundwater resources.[g] Green-gray hybrid approaches such as cisterns and spreading grounds enhance the value of an existing ecosystem with engineered solutions to increase water capture potential.

GI approaches are typically decentralized, broadly distributed strategies that take advantage of (or mimic) natural hydrological systems, and are tailored to a specific location to reduce impervious ground cover, maximize infiltration, and capture water when infiltration is impossible. While traditional gray infrastructure often requires land, buildings, and the construction of additional impervious surfaces, GI maximizes the smaller spaces available in dense urban areas, blending into and enhancing the landscape. Specific GI techniques—also called Best Management Practices (BMPs)—are varied. Common examples follow (and see also page 18 for specific examples).

- **Cisterns** and **rain tanks** collect and store stormwater for later use, generally for irrigation. In a typical year in Southern California, rainfall harvested from a 1,200 square foot roof can save 10,000 gallons of water.[43]



[g] Despite arguably nuanced differences, we use the terms "green infrastructure," "green stormwater infrastructure," and "low-impact development" interchangeably.

- **Permeable surfaces** filter pollutants and allow water to be reabsorbed into the ground through streets, parking lots, sidewalks, driveways, and other surfaces. The EPA has cited studies showing "removal efficiencies of between 82 and 95 percent for sediment, 65 percent for total phosphorus, and between 80 and 85 percent of total nitrogen" as well as "high removal rates for zinc, lead, and chemical oxygen demand."[44]



- **Vegetated bioswales** are depressions or channels in the ground, typically near roads and parking lots, that direct water and allow it to infiltrate. A Seattle project using drainage swales reduced the total volume of stormwater leaving the street by 99 percent.[45]



- Installing vegetation through climate-appropriate **tree planting, landscaping,** or **green roofs** can capture water, reduce runoff, and save energy. A single medium-sized tree can intercept over 2,000 gallons of rainfall per year.[46] If vegetation were planted to create so-called "green roofs" across half of Southern California, 36 billion gallons of stormwater runoff would be reduced and we would use 1.6 million fewer megawatt-hours of energy, saving $211 million and up to 465,000 metric tons of CO2 equivalent annually.[47]



- **Green Streets** can incorporate bump-outs, curb cuts, tree wells, and bioswales, and can remove impervious surfaces, to create vegetated areas for infiltration in otherwise impervious environments, and to add to neighborhood livability. In Portland, Oregon, curb bump-outs were found to capture 85 percent of the runoff from a "25-year storm."[48]



- **Rain gardens** appear like traditional landscaping, but in addition to providing an aesthetic appeal, they maximize infiltration by collecting water flows from nearby impervious surfaces. They have been found to retain 90 percent of stormwater.[49]



- **Green alleys** replace pavement with vegetation, increasing both infiltration and a neighborhood's green space. Chicago's Green Alley program reduced stormwater runoff by 80 percent.[50] There are 12,000 alley segments (over 900 linear miles) in L.A. City alone in dense areas with the least existing green space.[51]



- **Park retrofits, land reclamation,** and **wetland restoration** are larger, regional GI approaches that maximize pervious surfaces and allow for the infiltration of larger amounts of water.



GI is an attractive strategy for Southern California because of its intensely local nature, with individual interventions matched to individual locales to maximize water capture and environmental improvements. GI has a number of additional benefits:

- GI tends to be **less expensive and more cost-effective** than its traditional gray cousin, though the site-specific nature of GI projects and differing methods of quantifying benefits make direct comparisons challenging. EPA studies looked at a range of GI techniques and found, depending on the BMP, capital costs to be 15 percent to 80 percent lower than with gray infrastructure, and maintenance costs about 25 percent lower.[52] One outlier was pervious pavement, which has slightly higher capital costs but can last twice as long as standard pavement.[53] Overall, the same dollar invested in GI, relative to gray infrastructure, would yield 20 times the benefits.[54] Because GI projects tend to be smaller and have a less capital-intensive bidding process for contractors, Philadelphia found the GI approach helped **level the playing field for smaller, local firms** to win valuable public works contracts.[55]

- Virtually by definition, GI **increases the amount of green space.** Currently, more than half the county population does not have easy access to a park, and the county has less than a third of the park space per capita recommended by the National Recreation and Parks Association.[h] More parks, pocket parks, trees, and green alleys would particularly benefit people of color: in L.A. City, predominantly white neighborhoods have 31.8 acres of park space for every 1,000 people, while African American neighborhoods have only 1.7 acres and Latino neighborhoods 0.6 acres.[57] Increasing park and open space also **reduces the heat island effect,** increases recreational opportunities, and provides potential habitat for wildlife.
- Reducing harmful pollutants in our rivers, streams, and beaches is a primary goal of GI, **but human health and safety are further enhanced** through secondary effects, such as improved air quality from using less energy and increasing vegetation. Access to green space is strongly associated with positive health outcomes and with increased physical activity leading to improvements in blood pressure, cardiovascular health, and mood.[58] Introducing green space into blighted areas has led to a statistically significant **reduction in crime** which researchers suggest stems from fostering stronger social ties and community ownership, as well as eliminating vacant lots which may host illegal activity.[59]
- The broadly distributed nature of GI contributes to **greater regional equity.** Disadvantaged and neglected areas would disproportionately benefit from additional green space, neighborhood beautification, improved health and safety, and increased property values. Indeed, the very features that challenge an area like South L.A.—a lack of green space and a close proximity between residential and industrial uses—make it a "high priority area" for GI investment.[60] And as private investment tends to follow public investment, GI projects may leverage outsized economic development in underserved areas. (In later sections, we will look more closely at the potential of GI-related employment to contribute to greater economic equity.)
- GI can lead to a **broad increase in property values** as well as an increase in residents' **quality of life through neighborhood beautification**. A number of studies have shown an increase in property values near parks, green space, open space, and wetlands.[61] Following Philadelphia's investment in GI, nearby property values increased by 11.5 percent (for those already near green space) to 12.7 percent (for those near newly added green space).[62] Increased property values translate to increased tax revenue, and GI investments **stimulate consumer spending**: "research has found that people are willing to spend more, visit more frequently, or travel farther to shop in areas with attractive landscaping, tree cover, or green streets."[63] Developer attitudes toward environmental considerations shifted following Philadelphia's GI program: project *costs* became project *enhancements*, leading to an increase in determinations of project feasibility.[64]

Early Adopters Demonstrate Feasibility

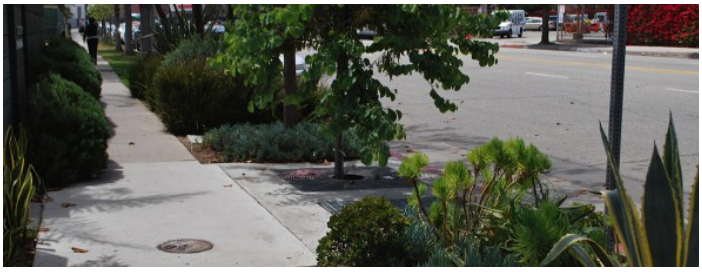
Some Southern California cities have already identified funding and taken action. In 2004, voters in **L.A. City** passed Proposition O by more than three to one, authorizing up to $500 million in bonds to fund stormwater improvements.[i] Projects ran the gamut from landscaping and Green Streets to major overhauls of parks and stormwater infrastructure.[65] Some of the city's successes over the past decade follow.

[h] L.A. County has 3.3 acres of park per 1,000 people; 10 acres are recommended.[56]

[i] Later we will explore how the lack of funding for ongoing O&M under Proposition O proved problematic.



The **South L.A. Wetlands Park** sits on nine acres on Avalon Boulevard, an area without sufficient open or green space. The project replaced a blighted former bus yard with a verdant park, collecting up to 680,000 gallons of polluted storm drain runoff daily and filtering it through a specially designed and constructed wetlands. After two years of construction, the park opened in 2012 as a new community resource—one that captures and infiltrates nearly 31 million gallons of water annually.[66]



The **Grand Boulevard Tree Wells** project installed new filtration systems in seven tree wells in a dense residential and commercial section of Venice. A curb cut directs runoff into the tree wells, which filters the water through three feet of soil, removing bacteria, sediments, metals, nutrients, and organics, and capturing nearly one million gallons of water annually.



A formerly paved alley in North Hollywood was converted into a pocket park in the **Elmer Paseo** project. Using vegetated swales, permeable pedestrian surfaces, rain gardens, and native landscaping, this 5,400 square foot parcel now captures over 3.2 million gallons annually.



The rehabilitation of **Echo Park Lake** was spurred by a 2006 determination of water impairment. Important as a cultural and recreational facility, wildlife habitat, and part of the city's storm drain system, the lake was drained and dredged to remove 20 years of trash and contaminants, and relined to prevent seepage. New wetlands, bioswales, pervious pavement, and a new irrigation system were installed. Finally, the iconic lotuses were replanted, restoring one of the city's historic gems. The project now captures over 100 million gallons annually.

Once complete, the full set of Proposition O projects is expected to capture 652 million gallons of stormwater annually.[j,67] When approximately half of projects had been completed, about 2 million square meters (approximately 500 acres) of habitat were restored, 77 acres of land purchased to convert to green space, and over 135 acres of green space enhanced.[68] Today, however, the Proposition O funds are nearly depleted, posing a challenge for the ongoing operations and maintenance work these projects require. Though E/WMPs focus on water quality, the city has used them to identify billions of dollars of additional projects which, once funded, will help meet L.A. City's goal of 50 percent local water by 2035.[69]

In November 2016 **Culver City** passed Measure CW—the Clean Water, Clean Beach Parcel Tax—with 73 percent of the vote, creating a dedicated ongoing revenue source.[70] At $99 per single family residential parcel, with slightly different rates for multi-family and commercial parcels, and excluding tax-exempt properties, the tax is expected to generate two million dollars annually to keep polluted runoff out of Ballona Creek. Stormwater will be diverted to a treatment plant and infiltrated into the ground, and the city will design and implement a Green Streets Master Plan. Ongoing funding will support monitoring, education and outreach, ongoing maintenance, and the development of new projects.

By its own description, "[t]he **City of Santa Clarita** is in somewhat of a unique situation with regard to stormwater management."[71] Incorporated in 1987, it is one of the youngest cities in the county and has benefitted from stormwater management lessons learned elsewhere. It is also the county's only city in the Santa Clara River watershed, with the Santa Clara River providing about half the area's water, as well as a habitat for extensive flora and fauna. Santa Clarita's Stormwater Pollution Prevention Fee, passed by its council in 1992, appears on property tax bills as a function of a parcel's size and its percent covered by impervious surfaces; the current fee for the median single-family home is $24.51 annually. Revenue can only be used in relation to stormwater projects. The current anticipated need is $13.8 million in capital expenditures by 2022, in addition to ongoing O&M.[72] The city contracts with an outside consulting firm for technical monitoring.

Often at the forefront of environmental stewardship, the **City of Santa Monica** generates over four million dollars annually through two different stormwater fees. In 1995, the city adopted the Stormwater Management User Fee at a fixed $36 for the typical parcel. When the city prepared its WMP a decade later, revenues were dwarfed by project needs anticipated to be $200 million over 20 years.[73] In response, more than two-thirds of Santa Monica voters passed the Clean Beaches & Ocean Parcel Tax in November 2006. Today, the $101 annual fee on the median property funds a broad set of stormwater projects and is overseen by a five-member citizens oversight committee. The 1,691 projects successfully completed since 2000 include park retrofits, storm drain improvements, and the installation of Green Streets and green alleys, leading to the capture and treatment of 1.7 billion gallons of runoff.[74]

County Action: More Than a Drop in the Bucket

Efforts from individual cities have been valiant, necessary, educational—and insufficient: few cities have taken action and those that have struggle with ongoing funding needs. We need a regional approach not only to reflect the reality of the physical landscape, but to create economies of scale to reduce the financial burden on individual cities.

In April 2016, County Supervisors directed staff to develop a Drought Resiliency Plan, later broadened into a Water Resiliency Plan. On May 30, 2017, following staff's Rapid Assessment report and after extensive public testimony, the Board unanimously passed the Regional Water Resilience Planning, Outreach, and Engagement, and Stormwater Capture Expenditure Plan (subsequently dubbed the Safe, Clean Water Program, SCWP, or the County Program).[k]

[j] Note that while Proposition O provided critical funding, additional funding came from other sources.

[k] In 2013, the county had begun planning a similar initiative, but scrapped it before it went to the ballot.

Currently, the County Program is a framework: details are being jointly developed by county staff along with a Stakeholder Advisory Committee comprising business interests, environmentalists, unions, academics, and government officials.[75] The Board of Supervisors is expected to hear program details at a public hearing later in 2018, and to consider placing the SCWP on the November 2018 ballot.[76]

As outlined by the Board, the goals of the County Program are to enhance our regional water resilience, increase our water supply, improve water quality, and provide "targeted tangible community benefits," while establishing coordinated governance and ongoing stakeholder engagement.[77] In working toward these goals, the SCWP is guided by four core principles: prioritization of multi-benefit projects; preference for green infrastructure; prioritization for projects that leverage additional resources; and attention to underserved communities. Finally, the Supervisors required the program to provide job training and employment opportunities.[l, 78]

Funding is expected to come from a countywide parcel tax to be placed on the November 2018 ballot that would require a two-thirds vote.[79] A detailed list of projects is currently being developed, including both centralized and distributed projects; green, gray, and hybrid projects; and capital projects as well as provisions for O&M. Revenue would be allocated to three distinct programs: 50 percent to regional projects, 40 percent to individual municipalities to implement their own programs, and 10 percent to the County Flood Control District.[80] The SCWP may include an incentive component for individual property owners, and some funds will go toward program administration.

Cautious optimism is warranted. Residents across Southern California have demonstrated a recent appetite to tax ourselves to fund public goods. This is true not only with regard to water (Santa Monica, Culver City, and L.A. City), but also housing, transportation, and education, bonds for which have all won supermajorities at the polls in recent years. Recent polling shows 70 percent of L.A. County residents would support a $54 annual property tax to fund water resilience, with a three-to-one ratio of those saying "definitely yes" to those

[l] We explore the employment and job training potential in later sections of this report.



saying "definitely no."[81] Early adopting cities also support the County Program as supplementary to their efforts.[82]

As the county, in partnership with stakeholders, fleshes out the finer points of the SCWP, the focus should remain on projects providing multiple tangible benefits, particularly to underserved communities. While large and centralized projects (like reservoirs or spreading grounds) may meet water supply and water quality goals, smaller and more distributed projects (like Green Streets and rain gardens) offer the best opportunity to provide additional benefits—increasing parks and green space, greening schools, and enhancing and improving public access to natural habitats. The Economic Roundtable prioritized a distributed approach in part because it would "support better stewardship of this precious resource by residential and commercial water consumers."[83]

A green, distributed, multi-benefit approach is more practical in highly developed Southern California, and more cost effective when the full range of benefits is tallied. The executive officer of the regional Water Quality Control Board noted "the growing recognition that smaller, watershed-based projects . . . provide more robust water resiliency, and provide better water quality at lower costs than the large water projects."[84] The award-winning 2004 Sun Valley Watershed Plan pioneered just such a multi-benefit approach; it was the most cost-effective of the alternatives considered, and has been called a "model infrastructure project."[85] In a subsequent analysis, the EPA praised the approach that looked beyond "just lowest capital cost" and instead provided "more long-term value to the community."[86]

Community input and engagement are crucial to program development and implementation, and have been credited by Metro and the EPA for their success on various projects.[87] The County Department of Public Health urges leaders to "broaden the list of stakeholders and partners" beyond the usual suspects when beginning such projects.[88] Engagement increases a community's investment in and ownership of a project, capitalizing on existing expertise: community members may be best positioned to site Green Streets and other smaller distributed BMPs, allowing county staff to develop the larger, regional hybrid projects. Improvements should benefit current residents, and engagement should help inform program design to incorporate safeguards against displacement.[89]

The County Program, with its focus on multi-benefits and its prioritization of projects with outside funding, affords municipalities the opportunity to incorporate water goals within a broader vision of a livable city, alongside health, mobility, transportation, and other goals. Preexisting needs may be adjusted: planned sidewalk repairs can use permeable materials; planned traffic-calming can incorporate elements of Green Streets. The County Program is developed explicitly with an eye toward such multi-benefits and the additional funding opportunities they may leverage.

Revenue from the potential parcel tax has not been established. Experts put regional needs in the tens of billions of dollars, and proper GI functioning depends on ongoing funding for O&M in addition to capital costs. Assuming the SCWP raises revenue roughly in line with past efforts—the 2013 measure would have raised $290 million annually—it would be prudent to view the potential funding from the current county measure not as a panacea, but as a solid financial foundation upon which to build, and a potent way to leverage additional funding. Local, state, and federal funds are available under a variety of programs to supplement the County Program:

- The Governor and state legislature recently approved a four billion dollar **parks and water bond for the 2018 ballot;** voter approval could make a significant portion of those funds available for GI projects. The proposed bond fits well with the SCWP, as it "is heavily tilted toward urban parks and Southern California, along with water improvements in low-income communities."[90]
- L.A. County voters passed **Measure A—**the Parks and Open Space Parcel Tax—in November 2016 with 75 percent of the vote, providing funds to develop, protect, and preserve parks, open space, and waterways. Funds are prioritized for areas in high-need of parks, and with an eye to career development and job training.



- In November 2016, L.A. County voters passed **Measure M** by more than two-thirds. The Traffic Improvement Plan created a funding stream for transportation projects, including repairs and retrofits to roads and sidewalks, potentially including permeable pavements, tree wells, curb cuts, and other Green Streets features; local job creation is an explicit goal.
- Various state and federal **loan programs** provide inexpensive financing to cities for a range of stormwater infrastructure projects. Two promising programs—already active and with funding remaining—are the California Clean Water State Revolving Fund and the federal Water Infrastructure Finance and Innovation Act Program.[91]
- State and federal **grant programs** lend themselves to GI projects. California's $7.5 billion water bond (2014's Proposition 1) created the Stormwater Grant Program, Watershed Restoration Grant Program, Water Storage Investment Program, Groundwater Sustainability Program, Flood Management program, and other relevant funds.[92] As of September 2017, over one billion dollars remained available.[93] Relevant federal funds are available through the Bureau of Reclamation's WaterSMART Program, and some EPA funds are administered by the state.[94]
- Cities can follow the success of L.A. City's Proposition O by **issuing bonds.** Financing remains inexpensive by historical standards, and while bonds are generally restricted to capital projects, they can provide an additional infusion of capital.
- Cities can follow the example of Santa Clarita, Santa Monica, and Culver City, and seek voter approval for a municipal **stormwater fee,** which could be crafted in various nuanced ways to align incentives.

Stormwater's Economic Return on Investment

A headline in the early-2017 *Los Angeles Times* read "L.A. is the bad jobs capital of the U.S."[95] This has long been true, but perhaps never more so than today: Southern California may not suffer from a lack of jobs so much as a lack of *good* jobs, defined by a recent Georgetown University report as "jobs paying more than $35,000 a year for U.S. workers without four-year college degrees."[96]

The County Program holds tremendous promise to boost the regional economy. According to Moody's Mark Zandi, investing in infrastructure is among the more efficient job-creation strategies, creating "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."[97] The sorts of positions created—construction jobs, engineering and design jobs, and public sector O&M jobs—tend to be middle-class, family-sustaining jobs. Many are trade and technical jobs that do not require advanced schooling, placing them within reach of our most disadvantaged residents, providing a pathway to economic stability and increasing regional equity.

Beyond job creation, a further opportunity exists to foster the development of an industry and get a leg up on other regions. LID and GI techniques are still in their relative youth. With the passage of the County Program, Southern California will become the single largest national consumer of specialized equipment—from cisterns and rain tanks to various permeable materials—making it a logical home for anticipated manufacturing activities.

Stormwater Infrastructure and Job Creation

A 2011 Economic Roundtable (ERt) report modeled the economic impacts and job creation potential in a range of water efficiency, capture, and conservation projects.[98] Though the ERt analysis extended beyond stormwater, they isolated and examined two dozen recent local stormwater infrastructure projects, concluding that each million dollars of investment stimulated $1.99 million in regional economic activity.[m] They also found that on average each million dollars directly stimulated 6.6 (project-related) jobs, and in total stimulated 13.1 jobs, including indirect and induced effects.[n]

These results are consistent with other expert estimates. In 2014, engineering and construction firm AECOM found that each million dollars spent in the water sector (broader than, but including, stormwater-related work) supported 16 jobs across the economy.[99] The report noted three similar studies with job creation estimates ranging from 10 to 25 jobs per million dollars spent. A more recent report from the Value of Water Campaign similarly modeled broader water infrastructure work, finding 15.5 jobs per million dollars spent.[100]

To model job creation under the SCWP, we follow and build upon the ERt analysis. It is likely to be the most relevant, as it is based on projects entirely in L.A. County and it segregates stormwater projects. With the ERt number at the low end of the range, it is also the most conservative approach. The county has not released figures on projected annual revenue or spending, but a UCLA vice chancellor for environment and sustainability estimated "we need a good $300 million to $500 million a year" in order to "really transform the Los Angeles region," and the proposed 2013 initiative would have raised $290 million annually.[101] We therefore assume annual revenue of $300 million.[o]

[m] Regional economic activity is composed of direct jobs and spending (those jobs created directly by and for the SCWP), indirect (or "upstream") effects (e.g., purchasing materials and services from suppliers, and the creation of associated supplier jobs), and induced (or "downstream") effects (the purchases made by direct workers and the jobs stimulated by that consumer spending).

[n] When modeling employment projections, it is more accurate to speak in terms of job-years than of jobs. One job-year is one year's worth of full-time employment. As we explore below, many of the direct jobs are inherently temporary construction jobs. For the sake of simplicity, we use "jobs" rather than the clunky "job-years."

Much of the spending—and nearly all early spending—will be dedicated to building stormwater infrastructure, creating a large demand for construction jobs. Construction is one of the few industries where workers with little formal education can gain the skills to command family-supporting wages: fewer than ten percent of construction workers have college degrees, yet a journeyman operating engineer can earn over $46 per hour.[p, 102] The industry's high-quality on-the-job training and apprenticeship programs are valued at $40,000 to $150,000, making construction the rare industry poised to provide a pathway out of poverty.[103] Using new data and an original analysis, we project the number of construction jobs to be created by a County Program.

We begin by examining a set of recent stormwater infrastructure projects carried out in L.A. City under Proposition O and related funding. Using certified payroll records provided by the L.A. Bureau of Contract Administration, we tally all actual construction hours for four projects.[q] Geosyntec—a consulting and engineering firm with extensive experience in stormwater management and GI design and implementation—analyzed six additional projects.[r] Using budget data from published, awarded contractor bids, Geosyntec developed a model to calculate the approximate amount of construction labor on each project.[104]

Using government data, construction hours for each project are converted to construction jobs, which are then compared to the overall budget for each project.[s] This yields a ratio: number of jobs created per million dollars of budget. The county has not finalized a list of projects, but the ten projects selected in this analysis represent a mix of potential project types including distributed Green Streets (i.e., parkway retrofits to include rain gardens, bioswales, bioretention, treewells, underground infiltration chambers, etc.), centralized projects with passive treatment (i.e., large-scale public park retrofits including wetlands and restoration), centralized projects with active treatment (i.e., large-scale public park retrofits with pumps and additional infrastructure for onsite use of stormwater as irrigation), and centralized spreading grounds projects.[105]

As shown in Figure 7, a simple average of the respective job creation ratios indicates that on average each million dollars invested in stormwater infrastructure projects will create 1.77 construction jobs.[t] Though a quantification of non-construction job creation is beyond the scope of this report, it is worth noting this same spending will also create employment opportunities in other typically high-wage industries, such as engineering and landscape architecture.[106]

The revenue under the SCWP would fund construction, O&M, and program administration—though the amounts dedicated to each will change over time. A *one-time* construction project requires *ongoing* O&M, the cost of which is typically expressed as a percentage of the associated capital spending. A commitment to a capital project is therefore also a commitment to project

[o] Job projections would scale in accordance with spending: if the parcel tax raises and spends $375 million (25% higher than the assumption here), job projections would similarly be 25% higher.

[p] A journey-level worker has successfully completed apprentice-level (and any pre-apprentice-level) work.

[q] Riverdale Avenue Green Street, Broadway Neighborhood Stormwater Greenway, Echo Park Lake Rehabilitation, and Temescal Canyon Park.

[r] Elmer Paseo Green Alley, Grand Boulevard Tree Wells, Imperial Highway Stormwater, Penmar Water Quality Improvement, Santa Anita Spreading Grounds Rehab, and South L.A. Wetlands Park.

[s] We use overall project budget as the baseline to ensure an accurate extrapolation to proposed county spending. We assume these ten projects provide a sufficient sample such that differences balance out in the aggregate. For further information, see the online Technical Appendix.

[t] There does not appear to be any consistent relation in this sample between job creation and any other significant variable (e.g., green, gray or hybrid; more expensive or less expensive; more centralized or more distributed). For the sake of simplicity we therefore use a single figure for the balance of the modeling of construction employment.

Project	Total Budget	Construction Hours	Construction Jobs	Construction Jobs / $1M Budget
Broadway Neighborhood Greenway	$4,600,000	7,028	3.74	0.81
Echo Park Rehabilitation	$37,225,890	97,023	51.64	1.39
Elmer Paseo Green Alley	$675,806	3,516	1.87	2.77
Grand Boulevard Tree Wells	$713,039	1,800	0.96	1.34
Imperial Highway Stormwater Project	$1,301,724	4,032	2.15	1.65
Penmar Water Quality Improvement	$20,750,000	84,124	44.77	2.16
Riverdale Green Street	$771,005	2,777	1.48	1.92
Santa Anita Spreading Grounds Rehab	$3,500,000	18,375	9.78	2.79
South L.A. Wetlands Park	$17,700,000	41,670	22.18	1.25
Temescal Canyon BMP	$14,247,435	42,350	22.54	1.58
Average				**1.77**

Figure 7: Construction Jobs in L.A. Stormwater Projects

maintenance in the future, thus reducing future capital availability. For these reasons, we must analyze changes in spending over time to provide a more accurate projection incorporating both construction jobs and O&M jobs. We will explore O&M in more detail in the next section.

Figure 8 shows total spending over a 30-year period. This assumes the SCWP generates $300 million in annual revenue, assumes 20 percent of revenue is allocated for program administration, and uses the County Department of Public Works assumption of annual O&M costs at five percent of capital costs.[u]

(For a comprehensive methodological explanation, please see the Technical Appendix to this report posted online at www.laane.org.)

Because of the accretive nature of O&M spending, after 30 years the SCWP will have generated roughly the same amount for capital projects ($3.7 billion) as for O&M work ($3.5 billion). Using a multiplier of 1.77 per million dollars budgeted, over this time frame the SCWP would create 6,530 construction jobs. Based on the ERt modeling of indirect and induced employment, we see that this level of investment over this time frame would also create, on average, 295 upstream jobs and 492 downstream jobs annually. Once we factor in the multiplier effects—as project dollars are spent and re-spent through the economy—we project this $3.7 billion investment to yield $7.35 billion in overall regional economic activity.

[u] Revenue may vary dramatically based on the structure of the parcel tax. A fixed dollar amount (per parcel or per square foot) would yield more stable revenue than an amount per *developed* square foot, or per *impervious* square foot, where revenue would change over time. More fundamentally, inflationary effects would erode the buying power over time: $300 million in year 25 would likely buy significantly less than it would in year 5. Parcel taxes thus often include "escalators" raising the amount each year, generally in sync with the consumer price index. For the purpose of the numbers in Figure 8, we assume that over the 30-year period, growth in tax revenue (from an escalator and/or from development) will likely balance out the loss of value from inflation. As a result, we assume the revenue will have the same buying power each year, creating a steady stream of consistent jobs.

Funding Year	Unallocated Funds	Capital	O&M (new)	O&M (aggregate)
1	$240,000,000	$228,571,429	$11,428,571	$11,428,571
2	$228,571,429	$217,687,075	$10,884,354	$22,312,925
3	$217,687,075	$207,321,024	$10,366,051	$32,678,976
4	$207,321,024	$197,448,594	$9,872,430	$42,551,406
5	$197,448,594	$188,046,280	$9,402,314	$51,953,720
6	$188,046,280	$179,091,695	$8,954,585	$60,908,305
7	$179,091,695	$170,563,519	$8,528,176	$69,436,481
8	$170,563,519	$162,441,447	$8,122,072	$77,558,553
9	$162,441,447	$154,706,140	$7,735,307	$85,293,860
10	$154,706,140	$147,339,181	$7,366,959	$92,660,819
11	$147,339,181	$140,323,029	$7,016,151	$99,676,971
12	$140,323,029	$133,640,980	$6,682,049	$106,359,020
13	$133,640,980	$127,277,124	$6,363,856	$112,722,876
14	$127,277,124	$121,216,309	$6,060,815	$118,783,691
15	$121,216,309	$115,444,104	$5,772,205	$124,555,897
16	$115,444,103	$109,946,765	$5,497,338	$130,053,235
17	$109,946,765	$104,711,205	$5,235,560	$135,288,795
18	$104,711,205	$99,724,957	$4,986,248	$140,275,043
19	$99,724,957	$94,976,150	$4,748,807	$145,023,850
20	$94,976,150	$90,453,476	$4,522,674	$149,546,524
21	$90,453,476	$86,146,168	$4,307,308	$153,853,833
22	$86,146,167	$82,043,969	$4,102,198	$157,956,031
23	$82,043,969	$78,137,113	$3,906,856	$161,862,887
24	$78,137,113	$74,416,298	$3,720,815	$165,583,702
25	$74,416,298	$70,872,665	$3,543,633	$169,127,335
26	$70,872,665	$67,497,776	$3,374,889	$172,502,224
27	$67,497,776	$64,283,597	$3,214,180	$175,716,403
28	$64,283,597	$61,222,473	$3,061,124	$178,777,527
29	$61,222,473	$58,307,117	$2,915,356	$181,692,883
30	$58,307,117	$55,530,588	$2,776,529	$184,469,412
TOTAL		**$3,689,388,248**		**$3,510,611,755**

Figure 8: Distribution of Capital Spending and O&M Spending Over Time

Construction Jobs and Career Pathways

Governments and public agencies across Southern California have long built ladders to the middle class by investing in the construction jobs associated with public works and infrastructure projects. These ladders are most stable and effective when built using the framework of a **Construction Careers Policy (CCP)**, an approach adopted and championed by L.A. City Department of Public Works, L.A. City Community Redevelopment Agency (CRA), the Port of Los Angeles, the County Board of Supervisors (covering MLK Hospital), Metro, and the Exposition Line Authority. CCPs have covered tens of thousands of jobs on over $12 billion worth of regional infrastructure projects since 2008, creating career pathways for thousands of disadvantaged workers, and hundreds of millions of dollars in economic activity for some of the region's most distressed communities.[107]

CCPs succeed on the strength of two key elements. The first is a **Project Labor Agreement (PLA)**, an agreement made prior to the start of work setting terms and conditions for employment, generally negotiated between unions, contractors, and the government agencies providing funding. All sides are expected to compromise, with a typical PLA requiring contractors to provide wages and benefits at the prevailing union standard, and requiring a no-strike commitment from the unions representing workers.[v] In this way, PLAs reduce uncertainty for all parties, ensure a reliable flow of labor, protect the public investment, and are associated with improved safety.[108] A five-year PLA at the Port of Los Angeles recently finished after $848 million worth of projects, after which the port extended the PLA for an additional ten years.[109]

The union standard is critical in ensuring construction jobs are, in fact, good jobs. Unionized construction workers in Los Angeles not only earn 56 percent more than their non-union counterparts, but are significantly more likely to have affordable, employer-subsidized health care and retirement plans. Approximately 80 percent of union construction workers have job-based health-care coverage, compared to only 46 percent of their non-union counterparts.[110] Unionized construction jobs have also been shown to help close the racial wage gap and the gender wage gap.[111]

A **targeted hire program** is the other essential element of a CCP, ensuring good jobs go where they are most needed. Targeted hire policies may vary with community priorities, but each fundamentally identifies a specific target population and sets a



[v] While PLAs typically require wages and benefits *at the union standard,* they do not require workers to join a union, and thus bidding is open to union and non-union contractors alike.

goal to hire a percentage of the workforce from that population. Targeted populations are often determined based on income, on geography (living near the project, or living in a high-poverty area), and/or on disadvantaged status (generally including people with historic barriers to employment, such as single parents, military veterans, the formerly incarcerated, and those on public assistance). Figure 9 shows the universal success reported in an earlier LAANE analysis of the six Southern California CCPs: all agencies exceeded goals for targeted hiring (by an average of 14 percentage points) and for disadvantaged hiring (by an average of 8 percentage points).[113]

CCPs complement the ubiquity of **apprenticeships** within the construction industry. A proven strategy valued across the political spectrum, apprenticeships have been prioritized by the U.S. Department of Labor through different administrations.[114] Newer workers gain valuable training on the job in exchange for a lower wage, and more senior workers are protected because apprentice pay increases with experience, preventing a permanent second-tier workforce. Of 11 different types of training programs examined in a 2014 study, "registered apprenticeships had by far the largest positive effect on short- and long-term salaries, returning 18 times the cost of the program in lifetime earnings."[115] Apprenticeships are an investment in tomorrow's economy: with approximately 50 percent of construction workers across L.A. County eligible for retirement in the next two years, and with construction job growth

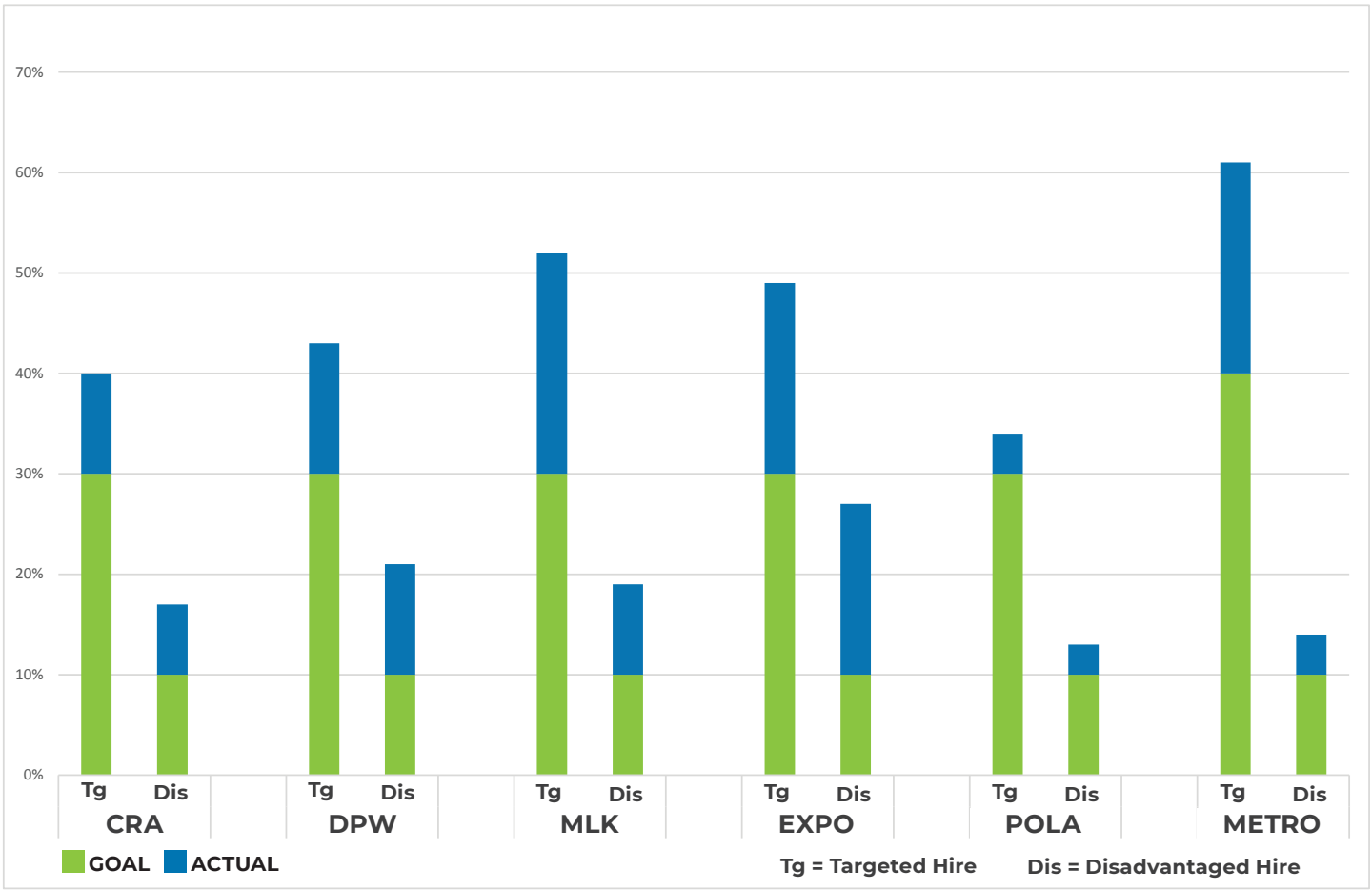


Figure 9: Targeted and Disadvantaged Hiring under Southern California CCPs[112]

Project	Local Hire		Apprentices				Disadvantaged Hire	
			Overall		Local Share			
	Goal	Actual	Goal	Actual	Goal	Actual	Goal	Actual
Echo Park Rehab	30%	55%	20%	24%	50%	79%	10%	14%
Penmar Water Quality Improvement	30%	52%	20%	33%	50%	77%	10%	35%
Temescal Canyon BMP	30%	34%	20%	21%	50%	79%	10%	28%

Figure 10: Targeted Hiring In Stormwater Projects[120]

expected to outpace all other industries over the next decade, apprenticeships can alleviate the construction "job crunch" that threatens to "blossom into an acute skilled worker shortage that touches everyone."[116] Under California law, at least 20 percent of hours on public construction projects must be completed by apprentices, though CCPs could set higher targets, or could set goals for local apprentices.[117] On two CCP-covered projects for which data are available, apprentices accounted for 51 percent (CRA) and 73 percent (L.A. City DPW) of hours.[118]

Career ladders are strengthened through the use of apprenticeship-readiness programs. The regional Building and Construction Trades Council sponsors the Multi-Craft Core Curriculum, partnering with local community groups and schools to prepare young people for success in an apprenticeship program through a standardized, comprehensive training curriculum. The L.A. and Orange County Building Trades partner with a range of community organizations such as YouthBuild and Conservation Corps, increasing access to and diversity in the trades.[119] In the next section, we look more closely at the potential for these nonprofits to create pathways to O&M jobs.

Recent projects under Proposition O demonstrate success at incorporating similar provisions around career pathways and targeted hiring into stormwater projects, as seen in Figure 10.



Operations and Maintenance: Paying Dividends into the Future

Constructing stormwater infrastructure is necessary for the success of the SCWP, but it is not sufficient. After conducting one of the first national surveys on the subject, the EPA recently concluded that "proper maintenance is essential to maximizing the environmental, social, and economic benefits of green infrastructure, as well as ensuring that projects perform as they were designed to."[121] If BMPs are not properly maintained, vegetation can die or overgrow; permeable surfaces can clog; filters, inlets, basins, and soils can fill with trash, sediment, and other deposits. The threat is not only a failure to maximize water capture benefits, but overflows and excess runoff can lead to standing water and increased pollutants entering storm drains—endangering human and environmental health.

Planning for O&M activities must therefore begin with project design. The growing adoption of GI approaches is encouraging, but its relative youth poses challenges to planners and policymakers: there are no universally accepted standards for GI O&M practices. O&M must be viewed holistically, in the context of a project's lifecycle, yet few projects have been adequately studied over a 30-year span, and fewer still of the scope being developed in the SCWP. The range of different BMPs and the way they are tailored to their specific environment pose additional challenges to the development of a single definitive approach. The growing literature, however, provides valuable lessons on the elements of an O&M plan, the sorts of occupations and positions needed, the training involved, and creative solutions to challenges around funding, staffing, and building career pathways.

O&M funding has been a significant obstacle to GI success elsewhere. By requiring the SCWP to address ongoing O&M, Los Angeles is ahead of the curve. In a national review of GI projects, the EPA found only 59 percent contained dedicated funding streams for O&M.[122] This has been a challenge associated with L.A. City's Proposition O, which was funded by a general obligation bond. In 2014, a decade after the passage of Proposition O, Enrique Zaldivar, the Director of the L.A. City Bureau of Sanitation, bemoaned how "[w]e're scrounging to maintain these projects . . . We're pulling funds from our department-based funding, which is very limited to begin with. It's not sustainable for a long period."[123] Learning from these past efforts, the Board of Supervisors directed staff to ensure funding for ongoing O&M.[124] A complete solution will likely involve many threads: ensuring sufficient parcel tax revenue, designing multi-benefit projects that can access different pools of funding, creating supplementary municipal funding, and bringing down O&M costs by increasing the supply of skilled workers.

Appropriate training in GI skills poses a different challenge. Some O&M work is akin to landscaping, and requires minimal training. Other work requires detailed, specialized, or even scientific knowledge. Most work lies in between, and a recent analysis from North Carolina State University (NCSU) demonstrates the link between proper training and successful outcomes: "prior to certification, roughly 95% of the 425 GI projects implemented in Cary, North Carolina failed inspections because they were not properly maintained. After owners better appreciated the value of maintenance and hired workers certified by NCSU, roughly 95% of BMPs *passed* a second inspection."[125] Given the necessity of training, questions center around the breadth and depth of training; the entity responsible for designing, conducting, and certifying training; and how best to incorporate career pathways. We will turn to these questions after examining what O&M work looks like.

O&M Keeps Projects Running Clean

Successful O&M practices and procedures begin by identifying—for each GI technique in its specific environment—the work needed, the frequency and cost of the work, who will perform the work, and how the work will be tracked. Some projects have minimal requirements: rain gardens, for instance,

need little more than periodic landscape care. Other projects may require simple maintenance commonly performed by community members or municipal landscaping crews, like picking up trash or paring back vegetation. Some projects require periodic visual inspection, either on a fixed schedule or following storm events. More complicated projects may require specialized equipment, equipment calibration, or water or soil testing by trained experts. Most projects require additional attention during the initial (one to three year) establishment period, though such "optimizations" are often conducted by the initial contractor and may be included in construction costs.

Virtually all techniques require a baseline level of routine maintenance: to remove weeds, trash, and debris; to replace ailing vegetation; to control pests; and to maintain aesthetics by trimming, harvesting, or mowing. The frequency of these activities may range from weekly to annually. Inspections indicate when additional maintenance work is required to improve performance. A brief description of O&M practices for common GI techniques follows.[126] For a summary of the BMPs themselves, please refer to pp. 14–16.

- Vegetated bioswales may require irrigation during the initial establishment period, and it is important to maintain the dimensions of the channel. Regular removal of sediment, trash, and debris ensures effective water flow, infiltration, and aesthetics. Excess pooling, and dead or damaged vegetation, indicate additional maintenance needs. Inspections should be conducted at least annually, and after heavy rains.
- Different sorts of green roofs have different maintenance needs, with the simplest requiring minimal irrigation and weeding, and needing only semi-annual inspection to remove debris, dead vegetation, and any drainage blockages, and to ensure there are no leaks. More complicated designs may require more frequent irrigation and/or inspections.
- Rain gardens require typical landscape care, and—depending on plant material—may require irrigation, trimming, and the removal of trash and debris. More frequent inspections will ensure soil and plant health, and will identify if sediment needs to be removed. Due to their aesthetic component, frequent upkeep—often monthly—is typical. A more technical inspection is necessary once or twice a year to check the levels of pollutant build-up in the soil.
- Maintenance for permeable pavement varies by the material (e.g., gravel, concrete, asphalt, pavers). Care is essential to prevent the pavement from getting clogged. Adjacent vegetation must be maintained to prevent sediment runoff, and weeds must be controlled to prevent cracking or other pavement damage. Once or twice a year the pavement should be vacuumed with special equipment to remove sediment. Damaged pavement should be repaired or replaced. Periodic inspections, including after heavy rains, should ensure no standing water.
- Constructed wetlands demand attention to water levels to ensure ecological health, particularly during initial establishment, following heavy rains, and during extended dry spells. Trash and debris should be removed regularly, and inspections will indicate whether maintenance is needed to stabilize water flows, replace vegetation, flush any clogged inlets or outlets, or if sediment levels are too high. In some cases, dredging may be required.

Each project should include a formal, structured O&M plan to ensure accountability and compliance. The plan should detail the specific tasks to be completed, as well as the frequency for each task. The plan should be developed in conjunction with initial project design, and reviewed periodically for adjustments. Figure 11 provides an example of such a plan.

Task	Frequency	Year 2011				Year 2012				Year 2013				Year 2014				Year 2015			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Settling Tank Inspection	Quarterly	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Advantex Unit Inspection (Control Panel)	Quarterly	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
UV Disinfection System Inspection and Cleaning	Annually				X				X				X				X				X
Drip Irrigation Disposal Field Inspection	Quarterly	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Pump Inspections	Quarterly	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Constructed Wetland – Weed Control	Monthly	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Constructed Wetland – Native Plant Inspections	Monthly	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Constructed Wetland – Native Plant Pruning	Annual		X				X				X				X				X		
Constructed Wetland – Cutback Native Species	Annual		X				X				X				X				X		
Constructed Wetland – Inspect for anoxic conditions	Weekly	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W	W
UV Disinfection System Lamp Replacement	Every 2 Years								X								X				
Setting Tank Pumping	Every 3-5 Years, or as needed													X							
Advantex Unit Cleaning	Every 3-5 Years, or as needed													X							
Testing Remote Emergency Alarm System	Annual		X				X				X				X				X		

Figure 11: O&M Schedule, EcoCenter at Heron's Head Park (San Francisco)[127]

Each plan should include a tracking system to ensure the completion of the prescribed work. Tracking systems may use hard copy logbooks, but electronic systems provide maximum potential to capture and analyze data. In addition to documenting the work that keeps the GI running properly, tracking systems provide data on costs and staffing needs to improve future planning. Tracking may be tailored, but should generally include data on the work performed; the amount of time, staff, and other resources required; the condition of the project itself; and any problems requiring additional maintenance or repairs. The EPA recommends a coordinated, synthesized tracking system across a region.[128] It is best to start with as simple of a tracking system as possible "with the expectation that the system can evolve as more knowledge is gained on ways to improve maintenance and its documentation."[129]

Because the cost of O&M work is a function of a specific project in a specific location, there are no universally accepted figures. Even the few anecdotal accounts typically provide modeled costs rather than actual costs. One Water LA recently analyzed a set of Southern California E/WMPs comprising 1,142 distinct projects. After extracting the reported capital costs and O&M costs, they calculated annual O&M costs at 4.3 percent of capital costs.[130] This is consistent with the working assumption of five percent used by the County Department of Public Works.[131] To determine cost-effectiveness, O&M costs should be compared with project outcomes: one EPA memo cites research that "found that more distributed measures required higher percentages of 'predictive or proactive' maintenance activities but tended to have lower maintenance costs *per load [of pollutant] removed.*"[132]

Good Jobs in Stormwater Operations and Maintenance

Earlier, we examined how investments in GI create a particular *sort* of job: one accessible to workers without advanced education or formal training, and that provides family-sustaining wages and benefits. We now turn to modeling O&M jobs and examining them through the same lens.

Using segregated figures on O&M spending for a subset of stormwater projects, the ERt study determined every million dollars of spending on stormwater O&M creates $1.99 million in economic activity and 7.4 direct jobs; including indirect and induced effects brings the total to 13.9 jobs per million dollars. The qualitative difference between construction employment and O&M employment allows for a conversion into actual full-time, permanent positions. After 30 years, $3.5 billion in O&M spending (as noted in Figure 8) yields 1,347 jobs; Figure 12 shows the consistent ramp-up over time. ERt's modeling also predicts, on average, the creation of an additional 293 upstream jobs and 480 downstream jobs annually. This $3.5 billion investment in GI operations and maintenance generates a total $7 billion in economic activity.[133]

Funding Year	O&M Jobs	Funding Year	O&M Jobs	Funding Year	O&M Jobs
1	83	**11**	728	**21**	1,123
2	163	**12**	776	**22**	1,153
3	239	**13**	823	**23**	1,182
4	311	**14**	867	**24**	1,209
5	379	**15**	909	**25**	1,235
6	445	**16**	949	**26**	1,259
7	507	**17**	988	**27**	1,283
8	566	**18**	1,024	**28**	1,305
9	623	**19**	1,059	**29**	1,326
10	676	**20**	1,092	**30**	1,347

Figure 12: Stormwater O&M Job Growth Under SCWP

Many O&M jobs are akin to construction jobs in that they are skilled jobs that require training, but rarely require advanced degrees or have formal prerequisites. As with construction, on-the-job training can play a critical role in building O&M skills around GI projects. In construction, a pre-apprentice with some classroom training becomes an apprentice, then a journeyperson, and eventually a master craftsperson, learning on the job as earnings rise. This ability to earn a paycheck while simultaneously developing the requisite skills for advancement is critical. O&M jobs can function in substantively the same way, using "stackable" training or certification. Though discussing training related to GI, a Harvard Law School analysis could just as easily be describing the construction industry:

> Stackable certifications may be especially attractive to workers, as they generally present workers with a low barrier to entry, while providing a transparent track for career advancement. They are particularly successful if the market is willing to pay a premium for each level of the stack. Therefore, each level must reflect mastery of additional skills that employers and customers find valuable.[134]

Though the career pathway principles and goals are the same, the current on-the-ground opportunities in GI differ radically from construction, where the career path is well-worn, institutionalized, and the relevant decision makers (building trades unions and contractor associations) are easily identified. With GI O&M, however, various paths are being forged by various entities, leading to a superfluity of self-appointed gatekeepers—universities, trade groups, governments, for-profit outfits—in the business of credentialing according to their own dictates.[135] Some of these programs are valuable, while others may be little more than money-making schemes.

The county should partner with experts and stakeholders to tailor a curriculum to its specific needs, which can be refined as the SCWP is developed. In general, most observers expect demand to be highest for a small number of occupations:[136]

- **Landscaping and groundskeeping** workers will perform the most common—and labor-intensive—tasks: mowing, trimming, weeding, irrigating, and removing trash and debris will keep BMPs functioning properly, and will maintain the enhanced neighborhood quality of life through aesthetic improvements. Workers can initially access these jobs with no advanced training; additional on-the-job training will allow them to perform site inspections at BMPs. Successful workers can move up a career ladder to supervisory positions in landscaping or, with additional training, to more specialized positions.
- **Maintenance and repair** workers will attend to basic machinery, like vacuums, pumps, filters, and other mechanical equipment. These jobs may be entry-level or may involve some on-the-job training or a vocational program, though rarely as extensive as a formal trades apprenticeship.
- **Skilled craftspeople—**plumbers, welders, pipefitters, and other construction laborers—will be required from time to time for more advanced repairs to equipment or machinery, when structural adjustments are necessary, or if certain equipment needs to be replaced.
- **Scientists, hydrologists, engineers, botanists, and horticulturalists** will perform the most advanced work: testing soil samples for contaminants, monitoring water flows and recommending adjustments, ensuring plant health as well as a proper match between vegetation and its environment. These positions generally do require specialized training or degrees, yet work can be shared: less experienced workers can be trained on taking soil or water samples, gaining skills on the job.

Many municipalities already have staff performing these functions—or substantively similar ones—in other contexts. These employees may be spread across various municipal departments: public works, sanitation, transportation, street services, parks, sewer, water, or any number of other departments or divisions, depending on the municipality. This is significant for two reasons. First, public employment is overwhelmingly unionized and tends to provide good wages and benefits. Second, most municipalities will not have to build a workforce from scratch, but instead can expand and upskill an already existing workforce, providing additional training in specific GI practices. To be sure, there are subtleties and nuances that workers will have to master well beyond "mow-and-blow" groundskeeping: greater attention to irrigation issues, soil health, native plants, and more. Under the county's leadership, on-the-job upskilling can capitalize on existing assets while developing new ones.

Creating Pathways and Pipelines in O&M Work

Career pathways into O&M work can pull residents out of poverty. Employing O&M workers as direct government employees provides the strongest balance of control, accountability, and pipelines to good jobs for local and disadvantaged residents. The county should partner with individual cities to customize solutions: some cities will use their own municipal staff, while other cities will contract with county staff. In certain cases—particularly small and localized BMPs and small cities with financial hardships—further flexibility may be appropriate, and there may be a role for private contractors or nonprofits to operate under county oversight.

A 2015 EPA report on best practices in structuring O&M work speaks to Southern California's need for a range of tailored approaches. The report focused on Southeast Wisconsin, where the regional Milwaukee Metropolitan Sewerage District (MMSD) covers 28 cities and includes parts of six watersheds. The EPA stressed an approach balancing regional goals with local flexibility:

> The 28 municipalities in the MMSD service area have a range of capabilities and resources to perform green infrastructure maintenance. Some prefer to do the maintenance work in-house and others wish to retain the services of local contractors. The strategic business model for green infrastructure developed at a regional level must acknowledge and account for these varying perspectives and resources, allowing flexibility and not locking municipalities into an approach that is counter to their vision for achieving their own green infrastructure maintenance goals.[137]

In short, the EPA concluded "there is no one business model for green infrastructure maintenance." With this lesson in mind, we reviewed the literature with an eye toward maximizing career pathways.

Direct Municipal Employees

Many cities will find the simplest approach takes advantage of existing assets: skilled city employees who already perform these or similar functions. A review of O&M plans for seven Proposition O-related projects in L.A. City, for instance, places most maintenance responsibility on existing city employees in the Department of Recreation and Parks, and in Sanitation's Wastewater Collection Systems Division.[138] This model may lend itself better for larger cities with substantial existing public works staff and more resources.

The **Targeted Local Hire Program (TLHP)** recently implemented in L.A. City illustrates how cities can approach staffing challenges to meet multiple needs. In partnership with the Coalition of L.A. City Unions, the city agreed "to develop innovative workforce development strategies to meet the needs of city residents and stakeholders, strengthen delivery of city services, and provide career opportunities to local residents."[139] Similar to an apprenticeship program under a CCP, the TLHP partners with worksource centers to create alternative pathways to civil service jobs for disadvantaged residents via on-the-job training, thereby removing barriers and improving equity. The city will return services to pre-recession levels while saving money by paying a lower initial wage, and existing workers are protected as trainees move up the ladder rather than constituting a permanent second tier. Figure 13 illustrates the career ladder.

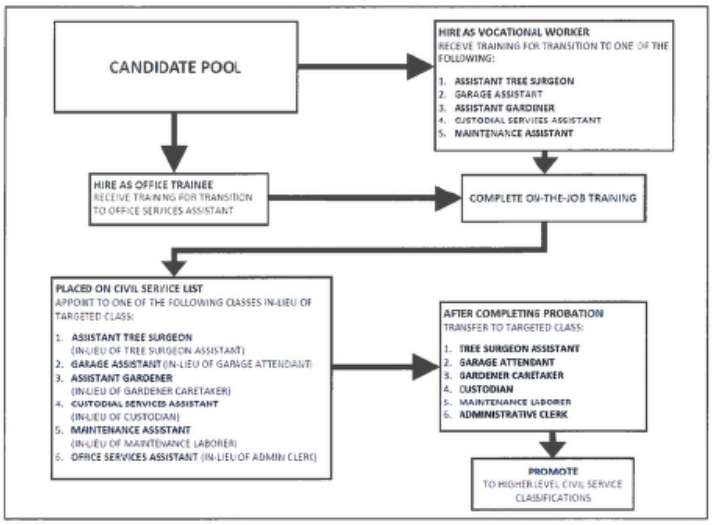


Figure 13: Targeted Local Hire Program Career Ladder[140]

L.A.'s TLHP builds off the success of two earlier programs: the L.A. City Jobs Program, and LADWP's Utility Pre-Craft Trainee (UPCT) Program.

- Implementation of the **City Jobs Program** began in 1999 in response to federal welfare reform. The program boasted a 71 percent retention rate and placed participants in city departments including street services, engineering, and sanitation. Participants and city managers alike valued the program, but a lack of dedicated funding forced its closure in 2003.[141]
- The **UPCT program** at LADWP combines elements of the City Jobs Program with those of a traditional construction apprenticeship. It began in 2011 as a partnership between the utility and its union: LADWP needed to replace an aging workforce and affordably staff emerging new environmental programs; local residents needed jobs and the savings from energy

efficiency improvements; the union needed to recruit and train new workers and to develop expertise in a new program field. As of a 2016 program review, the UPCT program had an 88 percent retention rate. The majority of UPCTs come from areas with high unemployment and high poverty, and the program has been particularly successful at bringing women and African Americans, traditionally underrepresented, into the utility.[142]

Baltimore's Department of Public Works developed the Water Mentoring Program in 2015 to train residents; every single one of the dozens of students has been hired into either a permanent DPW position or a job with a private company.[143]

County Employees

Cities could also contract with the county for maintenance: economies of scale yield cost savings, and a centralized process can streamline job pathways. County staff will develop native expertise on BMP maintenance both through coordinating the regional program and because county staff will themselves presumably maintain projects in unincorporated areas. Contracting with the county may be an attractive option for smaller cities lacking in infrastructure, resources, or staff.

This is a model already widely adopted across the county for service provision and regulatory oversight:

- The L.A. County **Sheriff's Department** not only provides law enforcement in 90 unincorporated communities across the county, but also to 40 of the county's 88 cities.[144] A city's contract with the Sheriff's Dept. is tailored to that city's needs, and the city saves money by drawing on the county's economies of scale. The approach has become a national model, and a similar arrangement exists at the County **Fire Department,** as well as the County **Department of Public Health,** which, among other things, conducts restaurant inspections for 85 cities.
- The County **Department of Consumer and Business Affairs** is newly responsible for enforcing wage and hour violations in unincorporated parts of the county. The City of Santa Monica contracts with the county to enforce Santa Monica's wage ordinance, and the department director anticipates other cities will follow suit.[145]

Potential advantages of scale could bring down costs for participating cities. Some BMP maintenance, for instance, requires specialized, expensive equipment that is used infrequently. The county could develop a program to invest in this equipment and rent it to cities at affordable prices.

The county has developed its own pipelines and training programs in the same spirit as apprenticeships and L.A. City's TLHP. For example, the nonprofit **Worker Education and Resource Center (WERC)** grew out of a 2002 partnership between the County's Department of Health Services (DHS) and the union representing over 16,000 DHS workers. WERC creates customized curricula and career pathway programs, in partnership with local colleges and community-based organizations, to prepare current and aspiring county workers for career advancement. WERC's initial focus on training for health-related occupations has expanded over time, growing to include a green environmental services program for DHS custodians. Over 25,000 workers have gone through WERC programs, and participants in career track programs have seen an average annual wage increase of $16,600.[146]

Private Contractors

Some cities may want to contract with a private maintenance firm (potentially the entity that constructed the project). Because proper maintenance is critical to the successful functioning of a BMP, the county must protect taxpayers' investment through strong accountability measures and oversight of the private sector. Robust governmental oversight is particularly important if

the SCWP contains an incentive program vesting individual property with responsibility for O&M. An "**approved vendor" list** is a common approach to balance flexibility with oversight.

The county should establish a program to certify vendors who meet threshold criteria, such as familiarity with county BMP maintenance practices, appropriate worker training, a commitment to standardized reporting practices, as well as meeting job quality and workforce development standards. The county already uses this approach: for some county construction projects, the contractor must select a jobs coordinator from an approved list; the jobs coordinator then partners with the contractor, nonprofits, and trade schools to understand workforce needs and to provide training.

Similar programs have demonstrated being on an exclusive vendor list is ample enticement for contractors to commit to county goals:

- In 2003, to incentivize the private sector to meet the city's recycling goals, L.A. established a certification program for waste processing facilities. In 2011, waste haulers of construction and demolition materials were restricted to city-certified facilities. This approach was expanded under the city's recycLA program, and all private sector waste haulers are required to use certified facilities. To be certified, facilities "will include minimum standards for operation, compliance with laws, regulations and standards, material tracking, safety and training program, compliance with state minimum standards, and management of materials on-site."[147]
- The Milwaukee Metropolitan Sewerage District maintains a "Green Vendor" list of firms approved to perform maintenance on GI projects.[148]
- The San Francisco Public Utilities Commission incorporated community benefits requirements into all vendor agreements over a certain size. Contractors can receive a higher score on their bid by committing to strong community benefits in their proposal.[149]
- The Department of the Environment in Prince George's County, Maryland built extensive community benefits into its relationship with private firm Corvias Solutions. A recent report concluded that "as opposed to a traditional procurement model, the public-private partnership shifts many of the program's risks to the private sector, while the county retains ownership over the program and ensures accountability to community interests."[150]

Nonprofit Partnerships

Similar in structure to contracting with a company, a city might partner with a nonprofit specializing in workforce development. Community organizations can build lasting pipelines while providing necessary services and saving taxpayer money. Community involvement can also increase a community's sense of investment in the success of a project. Governments in Southern California already do this:

- For over 30 years, **Los Angeles Conservation Corps (LACC)** has trained at-risk youth for jobs and careers in the natural environment by combining classroom education with paid on-the-job training. LACC has moved people from poverty to careers while strengthening and beautifying communities: they have planted over 100,000 trees and built over 50 community gardens across Southern California.[151] LACC partners with private sector companies and all levels of government. In 2016 alone, LACC restored 18 acres of habitat, provided over 300,000 hours of on-the-job training, and saw 69 participants graduate to a job or college.[152] The program has expertise in landscaping, irrigation, stormwater, erosion control, and tree planting.
- The L.A. City Bureau of Sanitation has partnered with the **Trust for Public Land** and **Equipo**

Verde to develop green alleys in disadvantaged neighborhoods.[153] These multi-benefit projects improve water capture, add green space, beautify neighborhoods, and build a community's ownership of the space.

- A number of other Southern California nonprofits follow a model combining classroom education, vocational training, and partnerships with employers to create pipelines for at-risk and disadvantaged populations. **YouthBuild** has built affordable housing in the county; **Chrysalis** provides a variety of services including street services; **Homeboy** and **GRID Alternatives** install solar panels and provide related services.

Greater Than the Sum of Its Parts

These models to develop a qualified O&M workforce are not mutually exclusive, and using them in creative combination can maximize benefits. For instance, the county could provide initial staffing via a dedicated trained team, while simultaneously working with schools and nonprofits to develop a formal training and certification program. That program could then feed trained staff into city departments or private contractors on an approved vendor list. Over time, the county could scale back as cities and private entities ramp up. Alternatively (or additionally), the county could develop a dedicated training and pre-apprenticeship program for stormwater maintenance, sending newly trained staff to maintain projects for cities. Or nonprofits could develop a training program and conduct outreach, placing credentialed staff with public departments or approved private contractors.

Regardless of the structure, proper training is critical. The tools and curricula used to prepare workers for careers in construction and other established industries are not as fully developed in the burgeoning field of GI. By partnering with worksource centers, schools like the Los Angeles Trade Technical College, job training programs like PVJOBS, and nonprofits like North East Trees (which provides a Certificate of Completion in environmental practices), the county should set a baseline definition of appropriate training customized to the needs of the program. L.A. City is currently in the earliest stages of developing the Stormwater Green Infrastructure Academy, "a certification program to educate local workers on design, construction, operation and maintenance (O&M) of green infrastructure facilities or Best Management Practices."[154]

We have an opportunity not only to achieve our goals around water resilience, environmental quality, and economic benefits, but to make L.A. County the national leader in this crucial and growing field. The lack of generally accepted national standards is both a challenge and an opportunity. The SCWP will create a massive demand for skilled O&M workers. With scores of different projects of different sizes using different techniques built across the county every year, Southern California may quickly become the epicenter of GI knowledge in the U.S. Careful planning and thorough stakeholder engagement could transform a local program into an established industry cluster, a hub for further advances in the field, yielding additional economic and reputational benefits for the region.

A number of inspiring examples from around the country illustrate how a creative approach to problem-solving can achieve multiple successes simultaneously:

- In Baltimore, the nonprofit Civic Works partnered with the Center for Watershed Protection to train disadvantaged residents for green jobs. With foundation grants as well as funding from the city's Department of Public Works, Civic Works provides a mix of classroom teaching and—through partnerships with local businesses—on-the-job training in GI management. Civic Works pays a portion of trainees' salaries while they're employed; after

successfully completing the program they can be hired directly by the private business.[155]

- With a grant from the U.S. Department of Labor, a number of community groups came together with a workforce training organization and community colleges in Portland, Oregon to create the Green Careers Training Project in 2010. During its two year run, the project trained hundreds of residents with barriers to employment, successfully placing 60 percent in jobs.[156]
- In Buffalo, the community organization People United for Sustainable Housing (PUSH) formed a social enterprise, PUSH Blue, to address GI related to stormwater. PUSH Blue recruits from underrepresented groups and partners with local nonprofits, schools, and workforce development programs, employing workers at living wages. With initial government funding, PUSH Blue now generates revenues from service provision, and has become an approved general contractor in GI under the Buffalo Sewer Authority.[157]
- Like PUSH Blue, Verde Landscape in Portland, Oregon is a green contracting company with a social mission, hiring and training disadvantaged residents in sustainable landscaping practices, and contracting for those services with governments and private businesses. Trained staff ultimately transition to private contractors.[158]
- Working with community groups, Philadelphia established PowerCorps PHL in 2013 to train at-risk youth for GI careers. Following the six-month program in stormwater maintenance practices, alumni have joined the apprenticeship program at the Philadelphia Water Department, eventually moving into regular, full-time positions. Other alumni have been hired by planning and contracting firms.[159]
- In 2007, New Haven's Urban Resources Initiative (URI) started GreenSkills, a summer program to train youth in urban forestry. Early successes, along with a city contract, allowed the nonprofit to expand and GreenSkills now partners with other local nonprofits on job placement. URI has continued to grow and has now built more than a dozen stormwater management projects and has worked on a state prevailing wage construction project.[160]
- In Syracuse, schools, governments, and nonprofits developed the Green Infrastructure Worker Training Program. The program is geared toward low-income residents and provides classroom training followed by an internship with a private employer. Graduates get a certificate, and local employers get trained staff for the new GI projects coming down the pike.[161]



With all stakeholders focused on meeting performance standards for individual BMPs, participating in regionwide coordination, tracking, and monitoring, and committed to workforce development to bring disadvantaged communities into this growing field, GI maintenance work can provide economic and environmental benefits to all stakeholders while strengthening our water resilience.

Conclusion

Having survived the region's worst drought in a millennium, we cannot allow a return to business as usual. On our current path, we will experience a future of water instability and shortages, potentially marked by forced rationing, reliance on ever more expensive and controversial water imports, and the constant risk of a sudden shock to the system leaving us high and dry. At the same time, we will not make the necessary environmental improvements to our lakes, streams, and beaches: contaminants will continue to cause illness, and some of our most beautiful natural assets could be restricted, or ultimately lost entirely.

By investing in nature-based solutions, we can capture billions of gallons of stormwater each year rather than flushing it out to the ocean. At the same time, we'll be cleaning our waterways, reducing greenhouse gas emissions by using less energy, and adding desperately needed green space throughout the region.

An investment in GI is also fundamentally an investment in our regional economy. Over 30 years, the County Program would create nearly 8,000 direct construction and maintenance jobs; including secondary effects raises the job creation total to over 10,000 jobs. Construction and maintenance jobs in GI are particularly well-suited to economic development: they have the potential to be high-road, family sustaining jobs, and are initially accessible without specialized training or education. By building off past local successes and learning lessons from other efforts, we can connect our neighbors who most need good jobs with the work that we desperately need to complete. By taking the challenge seriously, by approaching the issues holistically, and through deep engagement with communities, we are well-positioned to become a national leader, and to help build a more fair, equitable, and resilient Los Angeles.



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