

Targeting Inclusive Development: A Value Chain Approach to Sewer Infrastructure Investment



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Front cover: Biosolids Digester Facility, Southeast Treatment Plant, San Francisco. Photo credit: SFPUC.

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ACRONYMS

CIP	Capital Improvement Plan
CSO	Combined Sewer Overflows
CWA	Clean Water Act
CWSRF	Clean Water State Revolving Funds
EIP	Early Implementation Project
EPA	Environmental Protection Agency
JV	Joint Venture
LBE	Local Business Enterprises
LTCP	Long-Term Control Plan
MBE	Minority Business Enterprises
MBR	Membrane Bioreactor
MG	Million Gallons
MNC	Multinational Corporation
MSD	Louisville Metropolitan Sewer District
MWDSBE	Minority, Women, Disabled Business Enterprises
NEORS	Northeast Ohio Regional Sewer District
PLA	Project Labor Agreement
PWD	Philadelphia Water Department
SCS	Small Contractors and Suppliers
SEB	Small and Emerging Small Business
SBE	Small Business Enterprises
SDWA	Safe Drinking Water Act
SFMTA	San Francisco Municipal Transportation Agency
SFPUC	San Francisco Public Utilities Commission
SSIP	Storm Sewer Improvement Program
TBL	Triple Bottom Line
WBE	Women Business Enterprises
WTD	King County Wastewater Treatment Division

KEY TERMS

Targeted businesses: An overarching term that includes women, minority-owned, local and small business enterprises. The target population varies depending on the city—some local governments provide preference for Minority-owned or Women-owned Business Enterprises; others focus on Local Business Enterprises or Small Business Enterprises (or both).

Sewer infrastructure: A term that includes both stormwater and wastewater infrastructure.

EXECUTIVE SUMMARY

The American Society of Civil Engineers estimates the nation’s sewer systems will require \$298 billion worth of capital investments over the next 20 years to replace aging infrastructure and meet new demand (ASCE, 2013). As local governments plan how to maximize their investments, they seek not only larger systems with improved technical performance, but greener systems that help provide work and maintenance opportunities for local and small businesses, particularly for minority, women, and disabled-owned business enterprises.

The purpose of this report is to identify opportunities in the sewer infrastructure value chain for Minority, Women, Disabled, Small and Local Business Enterprises, which we call “targeted businesses” for short. We studied major sewer infrastructure capital improvement projects made by six cities, counties and water districts—Cleveland, Louisville, Omaha, Philadelphia, San Francisco, and Seattle (King County)—and used the value chain framework to provide a comprehensive assessment about where targeted businesses have been successful in green and gray infrastructure projects.

Our review of the value chains of 54 sewer infrastructure projects across the six cases found that:

- High levels of targeted business participation were found in specialized engineering and consulting, concrete and site preparation, public relations and advertising, and trucking.
- Medium levels of targeted business participation were found in surveying, architecture, construction materials manufacturing, nursery and garden wholesale, construction materials wholesale, construction management, some heavy & civil contracting, electrical sub-contracting, fence installation, sheet metal sub-contracting, sewage treatment monitoring, landscaping, administrative services, publishing, photography, and security guard services.
- Low levels of targeted business participation were found in mechanical sub-contracting, construction machinery manufacturing, construction equipment repair/rentals, law, and real estate assistance.
- On average, targeted businesses received between 10-25% of the total contract value. Prime contractors received between 65-80% of the contract value, while other sub-contractors received 5-20%.

On the following page, Table 1 offers a summary of the level of opportunity for targeted businesses in each segment of the sewer infrastructure value chain. The methodology associated with the high,” “medium-high,” “medium,” “medium-low,” and “low” distinctions

was based on three factors—contract dollars, share of targeted business contracts, and the raw number of contracts.

Table 1: Targeted Business Opportunities in Sewer Infrastructure Value Chain

VALUE CHAIN SEGMENT		LEVEL OF OPPORTUNITY		
DESIGN AND PLANNING				
Engineers		HIGH		
Architects		MEDIUM		
Surveying/mapping (includes geophysical mapping)		MEDIUM-HIGH		
Consultants		HIGH		
MATERIALS AND COMPONENTS				
Construction machinery manufacturing		LOW		
Construction materials manufacturing		MEDIUM		
Construction equipment repair/rentals		LOW		
Nursery and garden wholesalers		MEDIUM		
Construction machinery/materials wholesalers		MEDIUM-HIGH		
CONSTRUCTION AND INSTALLATION				
Construction management		MEDIUM-HIGH		
Heavy & civil contracting		MEDIUM-HIGH		
Specialty trade contractors				
	<i>Mechanical</i>	LOW		
	<i>Electrical</i>	MEDIUM-LOW		
	<i>Concrete/demolition/site preparation</i>	HIGH		
	<i>Excavation/foundation</i>	LOW		
	<i>Fence installation</i>	MEDIUM		
	<i>Sheet metal</i>	MEDIUM-LOW		
	<i>Other</i>	MEDIUM-LOW		
MAINTENANCE & MONITORING				
Waste management		LOW		
Sewage treatment facilities		MEDIUM-LOW		
Landscaping		MEDIUM		
SUPPORTING INDUSTRIES				
Accounting		MEDIUM-LOW		
Administrative services		MEDIUM		
Lawyers		LOW		
Public relations and advertising		HIGH		
Publishing		MEDIUM-HIGH		
Photography		MEDIUM-LOW		
Real estate		LOW		
Security guard services		MEDIUM-LOW		
Trucking		HIGH		
COLOR KEY				
HIGH	MEDIUM-HIGH	MEDIUM	MEDIUM-LOW	LOW

Source: Duke CGGC

Our review of green infrastructure installations found that the relatively small size of such contracts made them less attractive to lead firms that typically capture much of the value of sewer infrastructure projects. The green infrastructure features reviewed across the six cases relied on targeted businesses to perform environmental engineering, landscape architecture, nursery and garden supplies, and landscape maintenance and monitoring services. Construction and installation was almost exclusively performed by companies based in the region, although not all of these businesses were the targets of local benefits policies.

Lessons Learned

Our review of sewer infrastructure investments and local governments' targeted businesses programs leads us to articulate the following nine key lessons:

1. Targeted businesses can play meaningful roles in the sewer infrastructure value chain.

Because of the size and scope of large-scale gray infrastructure projects, CH2M Hill, AECOM, Kiewit Pacific, Weeks Marine, Tutor Perini and other multinational corporations are the lead firms in the chain. While these firms usually have the ability to self-perform many of the jobs on sewer projects, there is still a place for smaller businesses. The participation rate for targeted businesses across the sample of sewer infrastructure contracts was 16.7%.

2. The sewer infrastructure value chain is characterized by a relational governance structure.

Prime contractors in the chain often use the same sub-contractors across multiple projects. The relational nature of the governance structure has important implications for both companies and local authorities. Targeted businesses need to be active in participating in industry events or using matchmaking resources offered by local governments. Additionally, firms trying to crack into the network should communicate clearly what their business has to offer and how it can add value to a lead firm's supply chain. Targeted businesses should maintain websites that contain current, accurate and detailed information about products and services.

3. Local governments support the inclusion of targeted businesses with both demand and supply-side policies.

On the demand side, possible strategies include bid discounts, mandating that sub-contractors identified in proposals be offered work, provisions against targeted businesses serving as pass-throughs, micro set-asides, and policies that provide incentives for lead firms to form Joint Ventures arrangements with targeted businesses. On the supply side, programs that can boost targeted business participation include Project Labor Agreements (PLAs), capacity building initiatives, and matchmaking assistance.

4. Local governments can better understand the capabilities of their targeted businesses through diversity studies, strategic plans, and improved data collection.

Disparity studies, targeted business tracking systems and other efforts can help cities spot holes in their targeted businesses databases and institute targeted workforce development strategies that may bolster the capabilities of companies in a specific skill.

5. Local governments should explicitly articulate the goals of targeted business programs and develop supportive policies.

By using holistic evaluation models, local governments demonstrate an interest in providing economic benefits as part of their sewer infrastructure projects. In order to ensure actual results correspond with the aims of the Triple Bottom Line and other frameworks, participation goals should be explicit and transparent. Additionally, industry professionals believe cities and regional authorities can enhance existing programs by addressing whether the goal of targeted business programs is to help smaller companies improve their position in the value chain or simply to provide steady procurement opportunities.

6. Outreach activities and aggressive compliance monitoring by local governments are important to ensure the overall health of targeted businesses.

Targeted businesses interviewed repeatedly expressed frustration that at least three obstacles—delayed payments, insufficient enforcement of regulations, and limited access to information and business networks—impeded their participation in the sewer infrastructure value chain. While many local governments have programs and policies in place to address these concerns, additional steps can be taken to ensure these efforts have teeth.

7. Green Infrastructure presents both upgrading opportunities and challenges for targeted businesses.

Targeted businesses that can be expected to participate in the green infrastructure value chain include environmental engineers, landscape architects, nurseries and garden suppliers, and landscape maintenance and monitoring firms. Individual companies can improve or upgrade their position in the chain by mastering the skills necessary to design and install bio-swales and rain garden, bolstering product offerings to include a wide variety of tree box and soil mixes, acquiring grading, concrete and demolition capabilities, or by pursuing work with private developers. Additionally, industry professionals said there is a need for increased data gathering surrounding the performance of bio-swales, rain gardens, and other green features. There are a host of challenges that can be unique to individual sites or regions; however, the most successful professionals are those who understand the entire system rather than focusing on standalone components.

8. Local governments can leverage green infrastructure projects to assist the development of certifications and career ladder programs for green jobs.

In projects where green infrastructure comprises an important component of the overall investment, the local government should work with employers and, where appropriate, unions to create a certification program for green infrastructure construction and maintenance. The creation of certification programs for laying permeable pavement, installing rain gardens, or maintaining green infrastructure will help the industry better manage labor demand as well as send a signal to job-seekers regarding what skills they must learn in order to enter the industry.

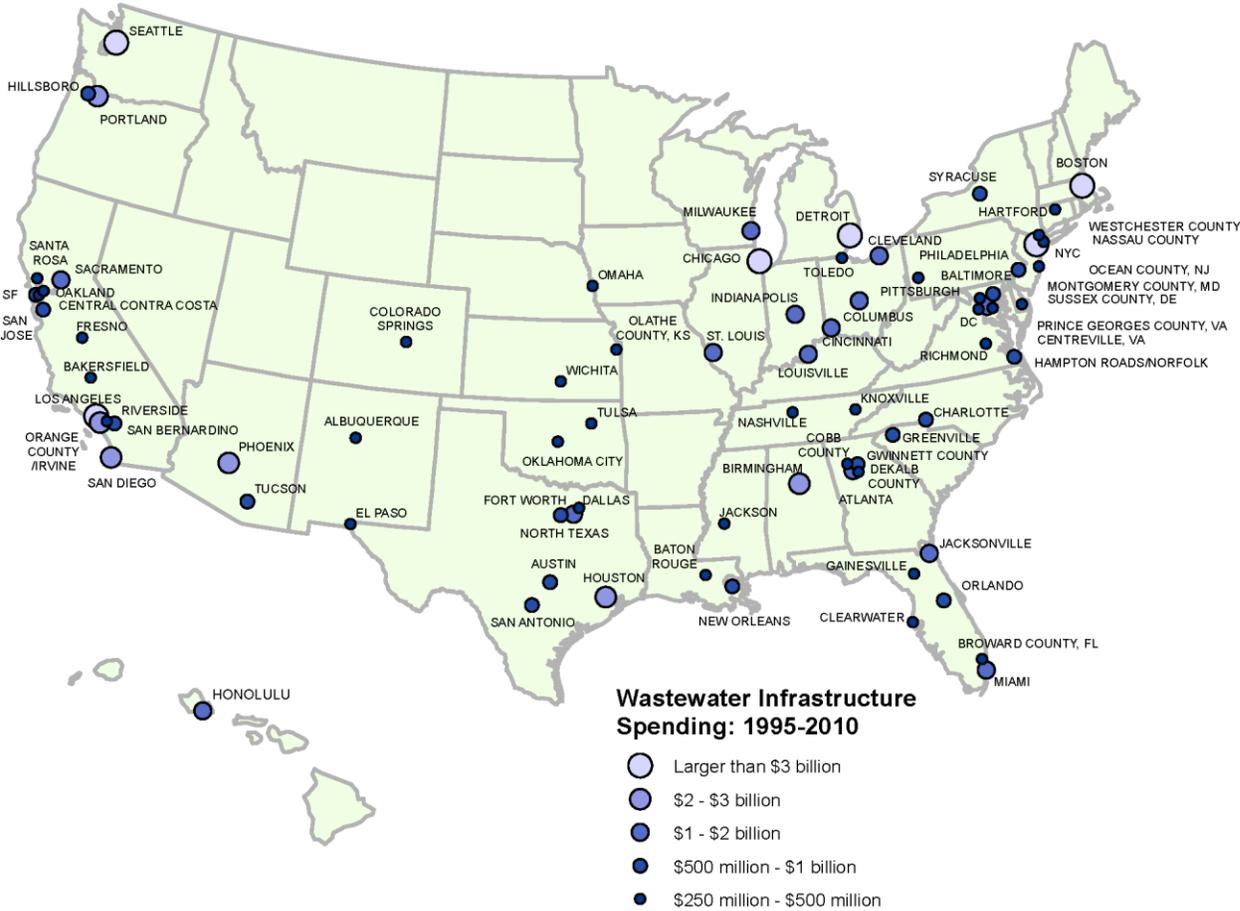
9. Local governments can bundle green infrastructure projects into larger contracts to increase their attractiveness to more capable actors.

Since green infrastructure installations can be technically complex, local governments have to be cognizant of the costs associated with poor work. One strategy might be to bundle multiple projects together so larger companies that have the requisite skills are motivated to bid.

1. INTRODUCTION

Many large and small U.S. municipalities have made capital improvements to their sewer infrastructure in recent years (see Figure 1). Municipalities are making these investments because of the age of existing infrastructure, population growth, and EPA mandates to reduce combined sewer overflows (CSOs), which pollute waterways with stormwater and sewage during heavy or prolonged rain events.¹

Figure 1: Sewer Infrastructure Expenditures for U.S. Cities from 1995-2010



Source: Duke CGGC; compiled from U.S Census of Governments data

Depending on the motivation of the local government and the characteristics of each city’s sewer system, officials may decide to invest in a range of traditional “gray” features such as

¹ Combined sewer systems carry stormwater runoff and sewage to treatment plants in a single pipe. Sanitary sewer systems separate sewer and stormwater, with the sewer line running to a treatment plant and the stormwater pipe conveying the water to surface outlets. According to the EPA, there are 772 combined sewer systems in the U.S. For more information about CSOs and the motivations of local governments for sewer infrastructure investments, please see Appendix A.

deep tunnels, pump stations, and plant improvements. Increasingly, municipalities also may investigate the benefits of green infrastructure installations. Green infrastructure, which includes features such as rain gardens, green streets, bio-swales and permeable pavement, can reduce the amount of stormwater collected by gray infrastructure and filter pollutants by mimicking natural water systems.

As local governments weigh potential investments, they employ a number of different strategies to evaluate alternatives. While engineering performance and financial cost are traditionally the largest considerations that guide the process, local governments and regional authorities have attempted to take more holistic approaches in recent years that incorporate social benefits into the process. The Triple Bottom Line (TBL) framework introduced by Elkington (1997) is one model that has gained widespread adoption. Industry professionals around the country have used that framework as a foundation to develop rankings that, importantly for this study, incorporate local economic development targets into the goals of projects.²

The idea that sewer infrastructure investments have significant economic effects has been explored in a number of recent studies. These reports have advanced a number of different conclusions, including the following:

- For every dollar spent on infrastructure, another \$1.44 is created as it ripples through the economy in supply chain effects and spending of wages earned by workers. Ten jobs are created for every \$1 million in spending (Green for All, 2011).
- Spending of \$1 billion on water and wastewater infrastructure leads to between 20,003-26,669 jobs. Those opportunities are spread through a diverse array of industries, with more than one half in industries other than water or wastewater construction (Clean Water Council, 2009).
- A sample of 30 water and wastewater utilities will generate \$524 billion to the nation's economy over the next 20 years through their annual capital and operating expenditures, supporting roughly 289,000 permanent jobs (WRF & WERF, 2014).
- Investments in green infrastructure in New York City, Portland and Philadelphia have led to the creation of 262-608, 67-160, 147-368 job-years of entry-level construction employment, respectively (MIT Co-Lab, 2013).

What is commonly left out of these aggregate figures is the amount of local purchasing that occurs in infrastructure investment; that is, the local businesses and workers conducting the design, construction, and maintenance of sewer infrastructure projects, and the local suppliers

² The SFPUC has developed a particularly robust TBL methodology for its SSIP program. The model has 19 total variables that it uses to evaluate proposals against the social, environmental, and financial pillars of the framework (Quinn & Kubick, 2014).

of equipment, machinery, and other inputs purchased to build the projects. Regions vary—sometimes quite significantly—in the presence of targeted businesses and workers skilled enough to help build sewer infrastructure as contractors or sub-contractors. The result of this variation is that the economic benefits of sewer infrastructure investments to targeted businesses and workers are uncertain. One way governments have sought to reduce the uncertainty is to enact procurement policies to ensure that local, disadvantaged, or other targeted businesses are included as contractors or sub-contractors. The purpose of this report is to investigate how six local governments investing in sewer infrastructure have successfully incorporated targeted businesses in capital improvements while also identifying which segments of the value chain have the highest levels of opportunity.

1.1 Case Selection and Methodology

In order to understand how sewer infrastructure projects have included targeted businesses, we examined six investments that different cities, counties, or regional authorities have committed to perform in recent years.

Table 2: Synopsis of Selected Case Studies of Sewer Infrastructure Projects

City	Governing Agency	Project Name	Years	Cost	Spending on GI	% of Total Spending on GI
Cleveland	NEORS	Project Clean Lake	2011-2036	\$3,000m	\$100m	3.3%
Louisville	MSD	Project WIN	2004-2024	\$850m	\$47m	5.5%
Omaha	City of Omaha Public Works	CSO Omaha	2009-2027	\$2,081m	\$50m	2.4%
Philadelphia	PWD	Green City, Clean Waters	2011-2036	\$2,400m	\$1,670m	69.6%
San Francisco	SFPUC	Storm Sewer Improvement Plan	2012-2032	\$6,933m	\$57m	0.8%
Seattle	King County WTD	Brightwater Treatment Plant	2000-2014	\$1,859m	\$31m	1.7%
LEGEND FOR AGENCY ABBREVIATIONS						
NEORS: Northeast Ohio Regional Sewer District; MSD: Metropolitan Sewer District; PWD: Philadelphia Water Department; SFPUC: San Francisco Public Utility Commission; WTD: Wastewater Treatment Division						

Sources: NEORS; MSD; Omaha Public Works; PWD; SFPUC; King County WTD

The six cases were selected because they all represented large- and medium-sized cities with substantial capital outlays to combined sewer systems. A brief synopsis of the six projects is provided in Table 2 above. In addition to the variance in timelines—one has been completed, four have advanced to the point where construction and installation has begun, and one remains in the planning and design phase—there are differences in the technical characteristics

of each. Table 3 below outlines the major gray and green features that, depending on the lifecycle of the project, were either implemented or will be installed. The percentages in the “Major Gray Investments” column in the table reflect the appropriate share of total project cost. Those figures build off the information presented in Table 2—in other words, the percentage of total spending on green infrastructure siphon off some of the total project cost (almost 70% in the case of Philadelphia). Expanded definitions and examples of each of the green infrastructure features are also available in Appendix B.

Table 3: Features of Selected Sewer Infrastructure Improvement Projects

City	Major Gray Investments (% of Project Cost)	Green Infrastructure Features
Cleveland	Deep tunnels (51%)	RG, PB, BS, PP, GS/A
	Sewer improvements (16%) Pump stations (12%) Plant improvements (10%)	
Louisville	Storage basins (66%)	DD, RH, RG, BS, PP, GS/A, GR
	Treatment plant upgrades (25%)	
Omaha	Sewer separation (26%)	DD, RG, PB, BS, PP, GS/A, LC
	Deep tunnels (19%)	
	Sewer improvements (10%) Treatment plant upgrades (8%)	
Philadelphia	Treatment plant upgrades (14%)	DD, RH, RG, PB, BS, PP, GS/A, GP, GR, UTC, LC
San Francisco	Treatment plant upgrades (53%)	RG, PB, BS, PP, GS/A
	Collection system (40%)	
Seattle	New treatment plant (46%)	BS, UTC, LC
	Conveyance system (52%)	
LEGEND FOR GREEN INFRASTRUCTURE FEATURES		
DD: Downspout disconnection; RH: Rainwater harvesting; RG: Rain gardens; PB: Planter boxes; BS: Bio-swales; PP: Permeable pavement; GS/A: Green streets/alleys; GP: Green parking lots; GR: Green roofs; UTC: Urban tree canopy; LC: Land canopy		

Sources: NEORS; MSD; Omaha Public Works; PWD; SFPUC; King County WTD; EPA

With each case, we studied annual reports, policy documents, and individual contracts to build the information contained in the report. Interviews with government officials, company representatives, and industry researchers supplemented the data, as did specific requests to city or regional authorities that preside over the relevant sewer systems. Details about specific companies came from business databases such as Mergent Intellect or One Source. Where appropriate, we identified the exact document that was the source of information, but in cases where there is not a specific citation, the material came from one of the aforementioned sources—annual reports, policy documents, contracts, business databases, author interviews, or individual data requests to local governments and regional authorities.

In writing our report on why and how local governments adopt inclusive development policies in sewer infrastructure projects, we consulted three recent reports on the topic. The 2011 Green for All “Water Works: Rebuilding Infrastructure Creating Jobs Greening the Environment” (supported by the Rockefeller Foundation) and the 2013 MIT Community Innovators Lab “Green Infrastructure & Economic Development: Strategies to Foster Opportunity for Marginalized Communities” reports both investigate how water infrastructure investments can be used for local economic development purposes; specifically, they are interested in not only the aggregate economic impacts to the local economy typical of economic impact assessments, but how targeted businesses can participate in the development of green and gray sewer infrastructure. Additionally, the 2014 UCLA Labor Center “Exploring Targeted Hire: An Assessment of Best Practices in the Construction Industry” assesses how local governments can be expected to engage targeted businesses in construction projects.

Our report on the topic differs from previous reports in four major respects. First, we focus on the process needed to design, build, and maintain sewer infrastructure. We call this process the *sewer infrastructure value chain*. The value chain serves as the analytical structure for understanding the complex bundle of activities in the pre-construction, construction, and post-construction phases needed to create sewer infrastructure. Second, we focus on the actors—the companies—that provide materials and services along the value chain. Focusing on actors allows us to understand who the actors are, their relative size and market power in each phase of the value chain, and how they relate to one another. We focus on actors because they have important effects on the conduct and performance of the value chain, and structure the opportunities available for small firms to participate in the value chain. We call this aspect *value chain governance*. Third, we are interested in the policies adopted by utilities and local governments to increase the participation of targeted businesses in the development of sewer infrastructure. Specifically, we are interested in why the policies were put in place, how they have been applied, and whether they have been successful in increasing the opportunity for targeted businesses. Four, we use a case study method to understand the opportunities and challenges for increasing the opportunities for targeted businesses, and to inform our conclusions about what has worked in other municipalities to increase opportunities for targeted businesses in sewer infrastructure investments.

1.2 Targeted Businesses

Project Labor Agreements (PLAs), Community Workforce Agreements (CWAs), Minority, Women, Disabled or Small Business Enterprise (MWDSBE) policies, and Local or Community Benefits (LBE/CBE) policies all seek to increase the participation of local businesses and workers in infrastructure projects. The participation rates they seek to achieve, the populations covered, the compulsory or voluntary nature of the agreements and the extent to which they are successful vary widely across the selected cases. Because of this variance, the report uses the term “targeted businesses” to refer to the targets of business opportunity programs. Table 4 below summarizes the characteristics of the programs in each city.

Target Group

The U.S. Small Business Administration’s 8(a) Business Development Plan provides the foundation for the categories of targeted businesses seen in the six selected cases—that organization’s definitions for Women, Minority, and Disabled Owned businesses are used by Cleveland, Louisville and Philadelphia for their respective policies. State laws in California, Nebraska, and Washington prohibit race-based and sex-based preferences, which is one reason San Francisco, Omaha, and Seattle have enacted variations of policies geared toward local businesses—San Francisco has a Local Business Enterprise (LBE) program, Omaha has a Small and Emerging Small Business (SEB) program, and King County has a Small Contractors and Suppliers (SCS) program (at the time of the Brightwater project, it was called the “Small Economically Disadvantaged Business” program, which was comparable to the current program). Philadelphia has both an MWDSBE program and a separate LBE category, but it is the MWDSBE that is the focus of the Office of Economic Opportunities’ participation reports and many of the city’s preferential policies.

Eligibility Standards and Economic Thresholds

With the U.S. SBA classification providing the framework for their programs, Cleveland, Louisville, and Philadelphia all share common elements in their eligibility standards. Louisville accepts certifications from the U.S. SBA, the National Minority Supplier Development Council (NMSDC), the National Women Business Owners’ Council (NWBOC), and the Women’s Business Enterprise National Council (WBENC) while Philadelphia recognizes certification from those four plus a variety of regional departments. The four cases (Cleveland, Omaha, San Francisco and Seattle) that have maximum economic thresholds all use the U.S. SBA guidelines as a general foundation; however, all four have implemented their own ceilings—at close to 100% of the U.S. SBA size standard, Cleveland’s are the highest, followed by Seattle, San Francisco, and then Omaha, which has the most restrictive thresholds.

Table 4: Eligibility Standards for Selected Cities' Targeted Business Programs

TARGET	ELIGIBILITY STANDARDS	ECONOMIC THRESHOLDS
Cleveland		
MWSBEs	Small Business Enterprises are businesses with functioning offices located within the NEORSD marketplace and that do not have annual gross receipts in excess of the economic thresholds at right. MBEs and WBEs are businesses where women or minorities own at least 51% of the equity of the business and are responsible for management. In addition, all MBEs and WBEs must comply with SBE size standards.	Engineers: \$14m Architects: \$4.5m Consultants: \$3.5m Heavy civil: \$33.5m Plumbing: \$33.5m Electrical: \$33.5m Other specialty: \$14m
Louisville		
MWBEs	The MSD relies on four external organizations to certify that women or minorities own at least 51% equity of the business and are also responsible for management.	None
Omaha		
SEBs	Omaha’s SEB program covers both Small Businesses (SBs) and Emerging Small Businesses (ESBs) , with different economic thresholds for both categories. In both cases, companies cannot be affiliates or subsidiaries of larger businesses and individual owners’ net worth cannot exceed \$1.3m. Additionally, a distinction is made between Tier I and Tier II businesses—Tier I businesses that is headquartered in a section of greater Omaha that has 30% of its residents living at or below poverty level.	SBs: 25% of U.S. SBA size standard for relevant NAICS code ESBs: 10% of U.S. SBA size standard for relevant NAICS code
Philadelphia		
M/W/DSBEs	The city of Philadelphia relies on 12 external organizations to certify that businesses comply with Minority/Women/Disabled BE standards.	None
LBEs	Philadelphia certifies companies as Local Business Entities if their headquarters is in the city or if more than 50% or 50 workers live in the city.	None
San Francisco		
LBEs	Local Business Enterprises are independent businesses that maintain a headquarters within the city of San Francisco. There are two tiers (LBE and SBAs) within the program that received different bid discounts based on economic thresholds.	Engineers: \$2.5m Architects: \$2.5m Consultants: \$2.5m Heavy civil: \$14m Specialty contractors: \$7m
Seattle		
SEDB/ SCS	At the time of Brightwater, King County’s targeted business program was called its “ Small Economically Disadvantaged Business Program; ” today, that program is known as the “ Small Contractors and Suppliers ” program.	50% of U.S. SBA size standard for relevant NAICS codes

Sources: NEORSD; MSD; Omaha Public Works; City of Philadelphia; SFPUC; King County WTD

With their use of tiers and fluctuating economic thresholds, Omaha’s and San Francisco’s standards are particularly nuanced. Omaha uses the term “Small Businesses (SB)” to describe an independent business that does not have owners with a net worth in excess of \$1.32 million or does not have average gross receipts from the previous three years in excess of 25% of the size standard outlined by the U.S. SBA.³ The maximum economic thresholds drop to 10% for the “Emerging Small Business (ESB)” category, which means the companies in this distinction are particularly small.⁴ The city then makes a further distinction between Tier I and Tier II businesses in an effort to give priority to companies based in the city’s economically stagnant neighborhoods—Tier I businesses are headquartered in a section of greater Omaha that has 30% of residents living at or below poverty level; Tier II businesses are those located outside the Tier I areas.

Meanwhile, San Francisco has two categories that receive priority: LBEs and SBAs. Businesses in both must be headquartered in San Francisco; however, LBEs’ maximum economic thresholds are between 35-41% of the SBA’s size standards.⁵ Due to their smaller size, LBEs benefit from higher discounts on proposals where they are bidding to be prime contractors (see Table 5 below); additionally, the participation targets for sub-contractors are geared toward LBEs.

In all cases, eclipsing the size standards is the only way firms can graduate out of the targeted business programs. While the development of the companies is a goal, there is not a time component where businesses do not continue to receive benefits after a prescribed number of years.

³ For engineering, surveying and consulting firms, that means the maximum economic threshold is \$3.75 million, for architects it is \$1.75 million, for heavy civil contractors, it is \$9.125 million, and for specialty trade contractors, it is \$3.75 million. The complete list of US SBA economic thresholds can be seen here:

https://www.sba.gov/sites/default/files/files/Size_Standards_Table.pdf.

⁴ In the ESB category, the maximum economic threshold is \$1.5 million for engineers, surveyors and consultants, \$750,000 for architects, \$3.5 million for heavy civil contractors, and \$1.5 million for specialty contractors.

⁵ The maximum economic thresholds for LBEs were presented in Table 3. The SBA size standards are: \$33.5 million for heavy civil contractors; \$17 million for specialty contractors, suppliers and general service providers; \$7 million for engineers, architects and consultants. The complete table of LBE and SBA thresholds can be here:

<http://sfgsa.org/modules/showdocument.aspx?documentid=10695>.

Table 5: Goals for Selected Cities’ Targeted Business Programs

PARTICIPATION GOALS AND TARGETS	RESOURCES OR PROCESSES THAT ASSIST GOAL FORMULATION	BID DISCOUNTS FOR PRIME CONTRACTS?
Cleveland		
Program goal: 15% Contract ranges: 10-20%	<ul style="list-style-type: none"> — Publication of disparity study — Internal review of specifications and targeted business database — Meetings with prime contractors 	No
Louisville		
Program goals: 15% MBE, 6% WBE (Materials is 5% MBE, 3% WBE) Contract ranges: 15% MBE, 6% WBE. ⁶	<ul style="list-style-type: none"> — Internal review of specifications and targeted business database — Prime contractors can request a waiver of M/WBE sub-contracting participation requirements six working days before the bid opening date 	No
Omaha		
City-wide program goal: 15% Contract ranges: 9-10%	<ul style="list-style-type: none"> — Internal review of specifications and targeted business database — Prime contractors can request change to participation goals prior to last addenda during review (5-7 days before bid day) 	No
Philadelphia		
City-wide M/W/DSBE program goal: 30% Contract ranges: 10-40%	<ul style="list-style-type: none"> — Publication of Economic Opportunity Strategic Plan and development of Participation Plan — Implementation of improved data collection — Annual disparity studies — Internal review of specifications and targeted business database 	LBEs receive 5% bid discount on contracts over \$1m and 10% on contracts less than \$1m.
San Francisco		
Program goal: N/A Contract ranges: 10-20%	<ul style="list-style-type: none"> — Implementation of improved data collection (LBE Utilization Tracking System) — Compliance officers meet with Project Managers to set LBE goals based on project specifications and review of targeted business database 	LBEs receive 10% discount on contracts up to \$10m; SBAs receive 2% up to \$20m.
Seattle		
Project Goals: 5-13%	<ul style="list-style-type: none"> — Internal review of specifications and targeted business database 	No

Sources: NEORS; MSD; Omaha Public Works; PWD; SFPUC; King County WTD

Participation Goals and Targets

All cities studied in this report articulate goals for targeted business participation in capital improvement projects. In Table 5 above, “program goal” in the Participation Goals and Targets

⁶ MSD does exempt some contracts from supplier diversity sub-contracting participation requirements if it believes the sub-contracting pool is not deep enough to perform the work. In those cases, the MSD determines whether a full or partial waiver of M/WBE goals is justifiable.

column refers to the citywide goal for the appropriate targeted business program. In these cases, the goal cuts across all city departments—in Philadelphia, for instance, the 42 city departments had an overall goal of a 25% participation rate for M/W/DSBE firms in the 2013 fiscal year; because of the city’s cumulative success, the target has been increased to 30% in the 2015 fiscal year (City of Philadelphia, 2013).

The Northeast Ohio Regional Sewer District (NEORS) and Louisville’s Metropolitan Sewer District (MSD) are regional authorities that are not part of local government entities, so the “program goal” tag has a slightly different connotation than Philadelphia’s or Omaha’s. However, both departments have set overall goals for their targeted business programs, and these “program goals” apply to the particular projects being analyzed in this report.

Not all cities or agencies studied were as systematic with their program or project goals. With the Brightwater Treatment Plant and Conveyance System (Brightwater), individual targets were set for the largest eight components of the project—these participation targets ranged from 5-13%. However, there was a Washington state law in place at the inception of Brightwater that prevented from King County from installing mandatory goals; ultimately, the King County WTD could only offer targets as a non-binding guideline for prime contractors.

Meanwhile, the San Francisco Public Utilities Commission (SFPUC) offers detailed reporting on its LBE participation rates, but neither it nor the city of San Francisco sets official targets for its program.⁷ The “contract ranges” in the San Francisco section of Table 5 are the participation rates for early projects and SFPUC data for recent years of sewer improvement projects. Across all cases, the figures seen in the “contract ranges” column represent the ranges that were most often required on individual contracts; however, there may be some specific instances with higher or lower participation rates.

Resources that Assist Goal Formulation

All cities in this report rely on targeted business databases and a review of contract specifications to help the appropriate entity set participation goals. Additionally, a number of municipalities have taken other steps that serve as resources—NEORS commissioned a 2010 disparity study that analyzed the capabilities of MWBEs firms in the greater Cleveland area (NERA, 2010);⁸ the city of Philadelphia implemented an improved contract and business data collection program after publishing an Economic Opportunity Study designed to aid in “meaningful city-wide goal setting” (City of Philadelphia, 2012); and the city of San Francisco

⁷ The average LBE subcontracting participation goal set by the SFPUC in the 2012/13 fiscal year was 14% (SFCMD, 2013).

⁸ The study also concluded that there was statistical evidence of historical discrimination against both MBE and WBE firms.

installed a data tracking system that provided greater ability to monitor LBE participation on contracts.

Bid Discounts

Bid discounts refer to preferences local governments provide targeted businesses by evaluating their proposals at a lower price. In all of the cities studied in this report, construction contracts are evaluated by cost—with a 10% bid discount, a targeted business that submits a bid for \$1 million would have their proposal evaluated at \$900,000 while still being paid the full \$1 million.

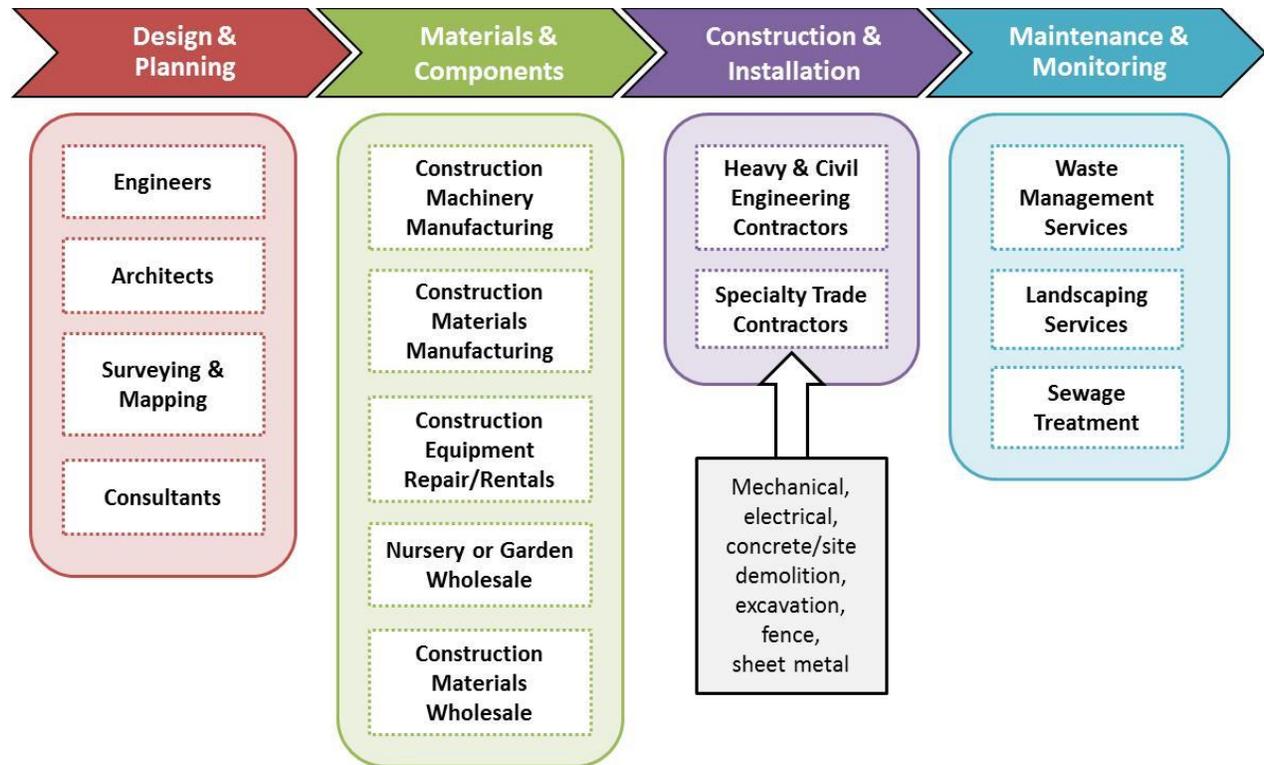
The bid discount column in Table 5 can be interpreted as an indication of whether each city views the development of prime contractors as a significant goal of its program. Only two have policies where targeted businesses receive preference—San Francisco offers LBEs 10% bid discounts on construction contract proposals under \$10 million while SBAs receive a 2% discount under \$20 million, while Philadelphia subtracts 5% off the final bid of LBEs (but not M/W/DSBEs) when evaluating the lowest responsible bidder. In each of those cases, bidding for engineers, architecture and consulting services follows a point system where the LBE receives additional points to its final score that is considered in the evaluation.

The above analysis is not meant to suggest the other cities are not interested in nurturing their targeted businesses and helping them become potential prime contractors. However, it is a reflection that the primary goal of the municipalities or regional authorities in these other cases is to promote sub-contracting opportunities for targeted businesses.

2. THE SEWER INFRASTRUCTURE VALUE CHAIN

The development of sewer infrastructure incorporates a complex set of activities, actors, and policies across pre-construction, construction, and post-construction phases. The sewer infrastructure value chain illustrates the complex set of actors needed to coordinate the construction of sewer infrastructure (see Figure 2 below).

Figure 2: Sewer Infrastructure Value Chain



Supporting Institutions & Organizations: LOCAL GOVERNMENT, UNIONS, EDUCATION, NON-PROFITS

Supporting Industries: ACCOUNTING, ADMINISTRATIVE SERVICES, LAWYERS, PUBLIC RELATIONS/ADVERTISING, PUBLISHING, PHOTOGRAPHY, REAL ESTATE, SECURITY GUARD SERVICES, TRUCKING

Source: Duke CGGC

The key actors in each segment of the value chain can be described across pre-construction, construction, and post-production phases. An overview of the actors is provided in Table 6 below followed by brief descriptions of each segment of the chain.

Table 6: Sewer Infrastructure Value Chain by Category with NAICS Codes

Major Category	Illustrative Examples/Descriptions	NAICS Codes
Design & Planning		
Engineering	Civil, environmental, construction, mechanical engineering services	541330
Architecture	Building and landscape architects	541310, 541320
Surveying & Mapping	Includes geophysical mapping of surfaces	541370, 541360
Consulting	Environmental consultants (including testing laboratories), management consultants	541620, 541690, 541611, 541612, 541618, 541380
Materials & Components		
Construction Machinery Manufacturing	Manufacturers of bulldozers, road graders, construction tractors, etc.	333120
Construction Materials Manufacturing	Pipes, cement and concrete, rebar, sewer pipe, sheet metal manufacturing	3271, 3273, 3279, 331221, 331314, 331511, 332919, 332332, 339991
Construction Equipment Repair/Rentals	Equipment rentals or repair	532412, 811310
Nursery or Garden Wholesale	Garden suppliers	424910, 424930, 444220, 111421
Construction Machinery & Materials Wholesale	Brick and stone, electrical apparatus, hardware, plumbing equipment, construction equipment, industrial equipment, petroleum products	423320, 423390, 432610, 423710, 423720, 423810, 423840, 423990, 424710
Construction & Installation		
Heavy & Civil Engineering Contracting	General contractors, construction management	237, 236210, 236220
Specialty Trade Contracting	Mechanical, electrical, concrete, excavation, fence, sheet metal	238
Maintenance & Monitoring		
Waste Management	Sewer, catch basin cleaning services	562998
Landscaping Services	Landscape contractors, plant maintenance	561730
Sewage Treatment	Water supply and irrigation systems	221320

Source: Duke CGGC; U.S. Census Bureau

Design & Planning

The Design & Planning phase of sewer infrastructure is comprised of engineers, architects, surveyors (both traditional and geophysical), and environmental and management consultants. The firms in this pre-construction phase of the value chain are the lead firms in the value chain, as they act as the prime contractors for many of the other phases of the chain.

Materials & Components

The Materials & Components segment of the value chain serves as the inputs into the Construction & Installation phase. The Materials & Components suppliers include construction machinery manufacturing, construction material wholesalers, construction equipment repair/rentals, nursery and garden supplier wholesalers, and construction materials

manufacturing. The size of these firms vary between large multinational corporations for construction machinery manufacturing to small, local or regional firms in the construction material wholesalers and nursery and garden supplies wholesaler segments. Additionally, many of the lead firms in the Construction & Installation segment of the value chain also have diversified their product ranges and have capabilities in construction materials manufacturing, construction equipment repair/rentals, and construction machinery and materials wholesale.⁹

Construction & Installation

The Construction & Installation segment of the value chain is comprised of two groups: 1. Businesses whose primary activity is the construction of entire engineering projects; and 2. Companies that specialize in specific trades such as mechanical, electrical, concrete, excavation, fencing, sheet metal, site preparation and other contracting opportunities. The companies that fall into the first category (heavy and civil engineering contractors) are the lead firms in the Construction & Installation phase of the sewer infrastructure value chain; most often, these are large, multinational corporations that have capabilities to serve as contractors in a wide number of construction industries. Specialty contractors, on the other hand, are smaller businesses that have a national or regional focus.

Maintenance & Monitoring

Most often, Maintenance & Monitoring on sewer infrastructure projects is either performed by local governments or by businesses whose primary focus is Construction & Installation services. However, there are companies that specialize in sewer or catch basin cleaning, sewer system maintenance or landscape maintenance. The size of these firms vary between large multinational corporations that provide the construction on the largest sewer projects to smaller, local or regional firms that offer landscape maintenance or clean sewer pipes.

Supporting Industries

During the lifecycle of sewer infrastructure improvements, prime contractors or local governments can be expected to outsource activities that fall outside their core expertise. Examples of these tasks varies depending on the needs of a particular project—examples of the professions routinely used as sub-contractors on sewer infrastructure contracts include accounting, administrative services, lawyers, public relations, publishing, photography, real estate, security guard services and trucking (see Table 7 below).

⁹ Specific examples of this overlap can be found in Appendix D.

Table 7: Supporting Industries in Sewer Infrastructure Value Chain

Major Category	Illustrative Examples/Descriptions	NAICS Codes
Accounting	Certified Public Accountants, invoicing	541211
Administrative services	Day-to-day office administrative services	561110
Lawyers	Attorneys	541110
PR/Advertising	Advertising and Public Relations, direct mail advertising	541810, 541820, 541830, 541860
Publishing	Commercial printing, document preparation, graphic design services	323111, 561410, 541430
Photography	Commercial photography services	541922
Real Estate	Real estate agents and brokers	531210
Security guard services	Security and patrol services	561612
Trucking	Generalized and specialized freight trucking	484110, 484220, 484230

Source: Duke CGGC; U.S. Census Bureau

2.1 Firms in the Sewer Infrastructure Value Chain

Firms are of fundamental interest for studies that utilize the Global Value Chains (GVC) framework. At its core, GVC research attempts to categorize the companies that are doing the work in a particular industry, where those businesses are based, how powerful they are, and what the strategies different businesses might use to improve their position within the chain.¹⁰ This section uses the GVC framework as a guide as it seeks to identify the actors—both major and minor—that participated in each of the six sewer infrastructure projects studied. Additionally, Appendix D provides information compiled by Tulacz (2014) about the largest firms that participate in the sewer infrastructure value chain, regardless of whether they were represented in the selected cases in this report.

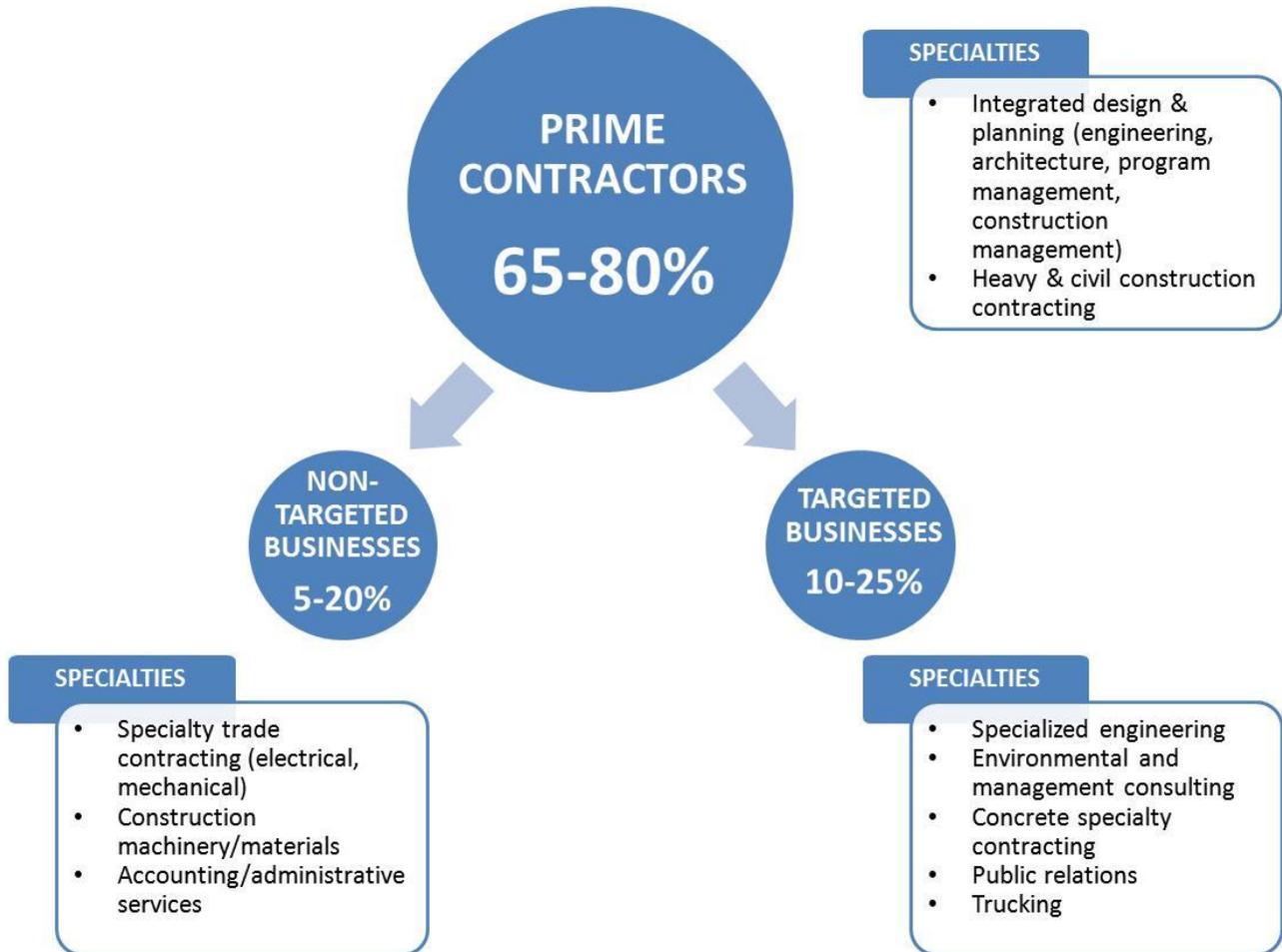
In an effort to chart the stages of the value chain where targeted business participation is concentrated, Duke CGGC used contract records and participation reports to build a sample of 54 contracts worth \$757 million to inform the discussion in this report.¹¹ There were a couple of obstacles that constrained Duke CGGC’s research efforts. Since the SFPUC is still in the early stages of the Storm Sewer Improvement Plan (SSIP), only design and planning contracts were available for that project; while Duke CGGC examined nearly all of the contracts the SFPUC awarded from 2012-2014, it ultimately limited the information contained in this report to SSIP. Meanwhile, in the case of the Brightwater, King County provided thorough details on all the prime contractors associated with the project and also identified key sub-contractors; however, it was unable to provide individual contract amounts for sub-contractors. Additionally, because

¹⁰ While the GVC literature is vast, Gereffi & Stark (2011) offer an introductory work that can serve as springboard for further study.

¹¹ The complete list of the 54 individual contracts can be found in Appendix E along with more extensive information about each case.

of the volume of contracts associated with Louisville’s Project WIN, Duke CGGC restricted its analysis to the MSD’s green infrastructure projects.

Figure 3: Breakdown of Sewer Infrastructure Contracts



Source: Duke CGGC

Lead Firms

In sewer infrastructure projects, multinational corporations (MNCs) in the Design & Planning and Construction & Installation segments of the value chain had the most lucrative contracts, acting as lead firms in the sense they captured between 65-80% of the total value and controlled much of the rest of the chain by dictating which contracts were distributed to smaller sub-contractors (see Figure 3 above). While there are tiers of prime contractors, with mid-size companies serving as primes on some contracts, the firms at the head of the value chain share a number of common characteristics. These companies all offer a range of services and are vertically integrated to various degrees—the Design & Planning firms can all be expected to have comprehensive range of engineering expertise as well as construction management capabilities, while the Construction & Installation companies have engineering

competencies. However, their focus most frequently revolves around particular segments of the chain (engineering or heavy and civil engineering construction).

Table 8: Companies that Earn Highest Revenue from Sewer and Water Infrastructure Projects

Design & Planning			Construction & Installation		
Lead Firm	Revenue from Sewer and Water Projects (USD millions)	% of Total Revenue from Sewer and Water Projects	Lead Firm	Revenue from Sewer and Water Projects (USD millions)	% of Total Revenue from Sewer and Water Projects
CH2M Hill	\$502	14%	Layne Christensen	\$395	47%
MWH Global	\$367	39%	Kiewit Corp	\$324	3%
AECOM	\$290	4%	Garney Holding	\$188	30%
CDM Smith	\$196	26%	The Walsh Group	\$161	4%
Tetra Tech	\$178	7%	Balfour Beatty	\$138	3%
HDR	\$176	10%	Skanska	\$134	2%
Brown and Caldwell	\$160	52%	Tutor Perini	\$125	3%
URS Corp.	\$158	3%	Granite Construction	\$113	5%
Black & Veatch	\$156	12%	American Infrastructure	\$86	17%
Hazen and Sawyer	\$113	70%	Primoris Services Corporation	\$78	4%

Source: Tulacz 2014a; Tulacz 2014b

The lead firms in the sewer infrastructure value chain can be expected to perform their core competencies in a diverse number of industries—few, in other words, concentrate the majority of their efforts on sewer or water infrastructure projects. Table 8 above depicts the 10 companies based in the U.S. that earn the highest revenues from sewer or water infrastructure contracts. Only two Design & Planning firms (Brown and Caldwell and Hazen and Sawyer) and zero Construction & Installation companies earn at least of 50% of their total revenue from work on sewer or water infrastructure. Further details about the profile of these and other lead firms can be found in Appendix D.

Many of the national lead firms were involved in the projects studied in this report. Most have at least 1,000 total employees and annual revenues exceeding \$500 million. Many are larger, although E-Z Construction serves as an outlier; that company, which is based in Louisville and is installing many of the green infrastructure features for the MSD’s Project WIN, has a vastly different profile compared to Kiewit, which is involved with the construction of the largest gray features of Project Clean Lake and Brightwater. Further details about the individual projects and the number of employees and annual revenue of each firm are displayed in Table 9 below.

Table 9: Profile of Firms with Largest Prime Contracts in Cases Studied

Company	Contract	Contract Value	Company Employees	Annual Revenue
Cleveland				
Hatch Mott MacDonald	Dugway Storage Tunnel; Euclid Creek Storage Tunnel	\$12.5; \$6.4	600	\$455
MWH Americas	Dugway Storage Tunnel	\$6.4	7,000	\$942
McNally ¹²	Euclid Creek Storage Tunnel	\$198	1,700	\$597
Kiewit	Dugway Storage Tunnel	\$198	14,700	\$10,787
Salini Impregilo	Dugway Storage Tunnel	\$153	9,047	\$3,081
S.A. Healy ¹³	Dugway Storage Tunnel	\$153	80	\$66
Louisville				
URS ¹⁴	Green Assessments and MS4 Program	\$2.8	54,000	\$5,270
E-Z Construction	CSO Basin 130	\$0.9	30	\$12
Omaha				
CH2M Hill	Program Management	\$7.8	30,000	\$3,585
Hawkins Construction	Missouri River Treatment Plant — Phases A&B	\$57.4	300	\$65
Philadelphia				
CDM Smith	Program Management	\$7.5	6,000	\$752
San Francisco				
AECOM	Program Manager for SSIP	\$150	43,400	\$7,240
Parsons	Program Manager for SSIP	\$150	11,500	\$1,506
Brown and Caldwell	Biosolids Digester Facility	\$80	1,500	\$307
Seattle				
CH2M Hill	Treatment Plant design engineer	\$83.1	30,000	\$3,585
Jacobs Engineering	Construction management	\$64.3	66,300	\$12,695
Hoffman	Treatment Plant (liquids)*	\$317.0	1,460	\$1,600
Vinci Grand Projets	Central Tunnel (Joint Venture)	\$225.6	5,119	\$1,265
Parsons	Central Tunnel (Joint Venture)	\$225.6	11,500	\$1,506
Frontier-Kemper	Central Tunnel (Joint Venture)	\$225.6	600	\$140
Kiewit	Treatment Plant (solids)	\$174.3	14,700	\$10,787
NOTES: Contract Values and Annual Revenues are in USD millions.				
* = King County WTD used a General Contractor/Construction Manager (GCCM) alternative delivery method for its construction contract with Hoffman.				

Sources: NEORS; MSD; Omaha Public Works; City of Philadelphia; SFPUC; King County WTD; OneSource

Non-Targeted Business Sub-Contractors

While the prime contractors often have capabilities across the value chain and the ability to self-perform much of the work associated with the individual projects listed above, they

¹² McNally's parent company is Weeks Marine. The data cited here is for McNally only.

¹³ Healy's parent company is Salini Impregilo. The parent and subsidiary formed a JV for the Dugway Storage Tunnel project.

¹⁴ URS was purchased by AECOM in August 2014. The data cited here for URS before the sale.

generally disbursed between 20-35% of the contracts studied to sub-contractors. Some of these subs were companies that were not part of business opportunity programs; while not every contract reviewed by Duke CGGC listed non-targeted sub-contractors, the ones that did indicated that non-targeted subs performed anywhere from 5-20% of the contract.

Table 10: Selected Non-Targeted Specialty Sub-Contractors in Cases Studied

Company	Specialty	City/Contract	Company Employees	Annual Revenue
Case Foundation	Foundation	Cleveland/ Dugway Storage Tunnel	220	\$102
Vadnais	Concrete/ micro tunneling	Cleveland/ Euclid Creek Storage Tunnel	100	\$14
Low Construction Company	Excavation	Cleveland/ Euclid Creek Storage Tunnel	42	\$5.5
Commonwealth Electric Company	Electrical	Omaha/Missouri River Wastewater Treatment Plant	700	\$98
Alindeska Electrical Contractors	Electrical	Seattle/Brightwater Central Tunnel	15	\$1.4
Valley Electric Co. of Mount Vernon	Electrical	Seattle/Brightwater Treatment Plant (solids)	351	\$100
Miller Sheetmetal	Sheet metal/ mechanical	Seattle/Brightwater Treatment Plant (solids)	25	\$5
J.P Francis & Associates	Mechanical/ electrical	Seattle/Brightwater Treatment Plant (solids)	10	\$1.8

NOTE: Annual Revenues are in USD millions.

Source: NEORS, Omaha Public Works, King County WTD

Non-targeted business sub-contractors can be expected to perform a variety of services on sewer infrastructure projects, although their presence was especially prominent among specialty trade contractors. Table 10 above highlights selected non-targeted business specialty trade contractors that performed work in the records reviewed—electrical and mechanical sub-contracting were frequent areas of non-targeted business participation. These companies tend to have a regional focus and are smaller than the lead firms in both revenue and employees. Appendix D provides information on the largest electrical and mechanical specialty trade contractors in the country.

Some of the cities or regional authorities featured in this report hired accountants, lawyers, and real estate brokers to perform services related to sewer infrastructure improvement projects. While the businesses that received these contracts were usually local, they were often not part of targeted business databases. This point is reinforced by Table 11 below, which lists all the businesses based in the state of Washington that had prime contracts to perform work on Brightwater. Of the 25, only four (denoted in bold and italics) are certified in King County’s SCS program.

Table 11: Prime Contractors for Brightwater Based in Washington State

Company	Contract Value	Brightwater focus	Company Size	
Design & Planning				
Triton Marine Construction	\$29,904,272	Marine Outfall design/build contractor	##	\$\$\$
Mithun	\$4,363,045	Architect at Treatment Plant	###	\$\$\$
Grette Associates	\$481,784	Eelgrass transplant & monitoring	##	\$\$
R W Beck Inc.	\$364,566	Oversight and monitoring	####	\$\$\$
Allen Brackett Shedd	\$71,280	Real estate appraisal	#	\$
John S Tinnea & Associates	\$41,077	Corrosion control	#	\$\$
Branch, Richards & Co.	\$40,936	Accounting	#	\$
Parametrix	\$40,635	Analysis of water discharge	####	\$\$\$
Herrera Environmental	\$26,201	Environmental engineering	##	\$\$\$
Johansen Mechanical	\$12,784	HVAC, metals, duct work	##	\$\$
Integra Inspection Group	\$4,782	Home and property inspection	#	\$
Gordon Derr	\$3,941	Dispute resolution	##	\$\$
Construction & Installation				
Frank Coluccio Construction	\$203,045,068	West Tunnel contractor	###	\$\$\$
Triton Marine Construction	\$29,904,272	Marine Outfall design/build contractor	##	\$\$\$
Harbor Pacific	\$2,739,574	Effluent drop structure	##	\$\$
Prospect Construction	\$1,991,394	Odor control	##	\$\$
McClure and Sons	\$825,129	Chemical injection facilities	##	\$\$
Scarsella Bros	\$804,271	Underground pipe installation	##	\$\$
Shoreline Construction	\$493,057	Geospatial surveying	##	\$\$
Gary Harper Construction	\$437,714	General contractor	#	\$\$
Hawk Mechanical Contractors	\$385,184	Pipe installation	##	\$\$\$
J Harper Contractors	\$333,754	Demolition	#	\$\$
Stouder General Construction	\$311,004	General contractor	#	\$\$
Manson Construction	\$115,000	Marine construction, dredging	####	\$\$\$
Dutton Electric	\$22,887	Industrial electrical	##	\$\$\$
LEGEND FOR COMPANY SIZE SYMBOLS				
# = 1-10 employees; ## 11-100 employees; ### =101-250 employees ; #### = 251+ employees				
\$ =<\$1 million; \$\$ = \$1-\$10 million; \$\$\$ = \$10.1-\$100 million; \$\$\$\$ = > \$100 million				

Source: King County WTD

Targeted Businesses

For the sample reviewed by Duke CGGC, targeted businesses received 16.7% of the total contract value. Specialty engineering and consulting, concrete contracting, public relations and advertising, and trucking were the areas with the highest participation rates. Medium levels of targeted business participation were found in surveying, architecture, construction materials manufacturing, nursery and garden wholesale, construction materials wholesale, construction management, some heavy & civil contracting, electrical sub-contracting, fence installation, sheet metal sub-contracting, sewage treatment monitoring, landscaping, administrative services, publishing, photography, and security guard services.

Table 12: Targeted Business Participation Rates across Value Chain for Cases Studied

Categories	Money Received	% of Total	Share	Number	Average Contract Value
Design & Planning					
Engineering	\$11,604,560	1.53%	9.2%	33	\$351,653
Architects	\$472,414	0.06%	0.4%	7	\$67,488
Surveying & mapping	\$2,921,344	0.39%	2.3%	15	\$194,756
Consultants	\$7,867,827	1.04%	6.2%	30	\$262,261
Materials & Components					
Construction machinery manufacturing	—	0%	0%	—	—
Construction materials manufacturing	\$1,832,621	0.24%	1.5%	7	\$261,803
Construction equipment repair/rentals	—	0%	0%	—	—
Nursery and garden supplier wholesalers	\$72,732	0.01%	0.1%	4	\$18,183
Construction materials wholesalers	\$2,677,867	0.35%	2.1%	8	\$334,733
Construction & Installation					
Construction management	\$14,129,100	1.86%	11.2%	9	\$1,569,900
Heavy & civil contracting	\$16,769,798	2.21%	13.2%	9	\$1,863,311
Specialty trade contractors	\$31,426,941	4.15%	24.8%	27	\$1,163,961
<i>Mechanical</i>	\$4,384,066	0.58%	3.5%	1	\$4,384,066
<i>Electrical</i>	\$2,410,090	0.32%	1.9%	3	\$803,363
<i>Concrete/demolition/site preparation</i>	\$22,536,400	2.97%	17.8%	17	\$1,325,671
<i>Excavation/foundation</i>	\$48,000	0.01%	0.1%	1	\$48,000
<i>Fence installation</i>	\$1,840,985	0.24%	1.5%	3	\$613,662
<i>Sheet metal</i>	—	0%	0%	—	—
<i>Other</i>	\$207,400	0.03%	0.2%	2	\$103,700
Maintenance & Monitoring					
Waste Management	—	0%	0%	—	—
Sewage Treatment	\$10,237,000	1.35%	8.1%	1	\$10,237,000
Landscaping	\$1,555,722	0.21%	1.2%	6	\$259,287
Supporting Industries					
Accounting	\$204,368	0.03%	0.2%	1	\$204,368
Administrative services	\$3,107,285	0.41%	2.6%	3	\$1,035,762
Lawyers	—	0%	0%	—	—
Public relations and advertising	\$5,093,807	0.67%	4.02%	14	\$363,843
Publishing	\$1,384,552	0.18%	1.09%	11	\$125,868
Photography	\$25,550	0.00%	0.02%	3	\$8,517
Real Estate	—	0%	0%	—	—
Security guard services	\$1,111,318	0.15%	0.88%	2	\$555,659
Trucking	\$14,160,611	1.87%	11.18%	11	\$1,287,328
TOTALS	\$126,655,416	16.7%	100%	201	\$630,126

Sources: Duke CGGC based on NEORS; MSD; Omaha Public Works; City of Philadelphia; SFPUC; KC WTD

Table 12 above depicts the total contract dollars captured by targeted businesses in each segment of the value chain in every case studied.¹⁵ The “% of Total” column is the percentage of the total contract value earned by targeted businesses; so in the case of engineering, targeted businesses with the primary NAICS code of 541330 (engineering services) earned \$11,604,560 against the value of the total sample (\$757,907,478): 1.53%. The “Share” column is the percentage of targeted business contracts that went to that particular category, while the “Number” category is the number of targeted businesses in each category that received sub-contracts across the sample.

Areas with High Participation

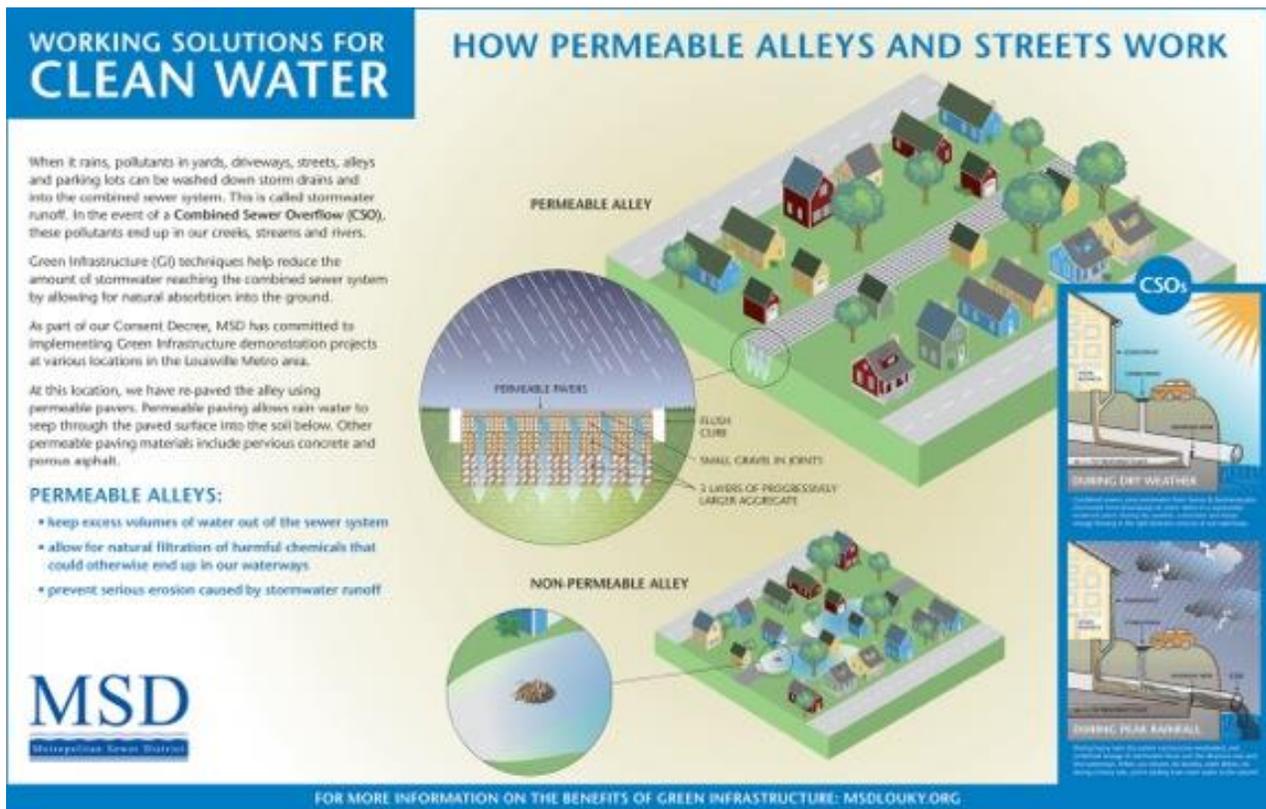
In the Design & Planning segment of the value chain, targeted businesses contributed specialty engineering and consulting services to the major sewer infrastructure projects studied. While the lead firms and prime contractors have diverse engineering capabilities, targeted businesses can be expected to offer scientific expertise into certain technical questions. For example, in Cleveland, Sigma International (a WBE and SBE) provided electrical and instrumentation engineering for the Dugway Storage Tunnel, Applied Science (a WBE and SBE) offered hydraulic modeling for the same project, and McGuiness Unlimited (a WBE and SBE) used its engineering expertise to perform cost estimates for the Union/Buckeye Green Infrastructure installation. In San Francisco, Geotechnical Consultants and Vibro-Acoustic Consultants (both LBEs) are providing geotechnical and noise analysis for the SE Plant Biosolids Digester Facility as part of SSIP. Historically, water resource and hydraulics consultants, geologists, and biologists have been among the most widely used LBE sub-contractors on SFPUC projects.

Across all cases where construction contracts were reviewed, targeted concrete and demolition specialty trade contractors and trucking companies were regular participants as sub-contractors. Many of the concrete contractors have a similar profile as Cook Paving & Construction, which is a sub-contractor on McNally/Kiewit’s Joint Venture (JV) to construct the Euclid Creek Storage tunnel as part of Project Clean Lake; in addition to providing paving and earthwork services, Cook Paving & Construction also acts as a brick, stone and construction material wholesaler. Meanwhile, all of the cities studied have a high number of trucking companies in their targeted business databases; the ample supply and relatively low levels of expertise required means that prime contractors home in on truck companies to help reach participation targets when the scale and technical demands of a project may be beyond the capabilities of MWDSBEs or LBEs.

¹⁵ It bears repeating that King County could not provide contract data on the dollar figures that were distributed to sub-contractors for Brightwater; instead it provided lists and dollars disbursed to all the prime contractors on Brightwater and the names of many of the sub-contractors. Duke CGGC used that information to determine the segments of the value chain where targeted businesses provided services on Brightwater, but it did not include any contractual data for that project in Table 11.

Finally, depending on the goals of the project, public relations or advertising firms may craft a marketing campaign or communicate the benefits to a broader audience. In cities where this is a priority, targeted businesses are active participants. In Louisville, the Cubero Group, a local marketing firm that is certified in MSD's supplier diversity database, was listed as a sub-contractor on four separate contracts, receiving \$339,500 to design, develop, and install site specific signage and education material within spaces where green infrastructure was selected for implementation (see Figure 4 below). The Cubero Group has seven employees and reports \$1.1 million in annual revenue.

Figure 4: Example of Cubero Group's Promotional Material for Project WIN



Source: Cubero Group

Areas with Medium Participation

While the next grouping of activities provided regular opportunities for targeted businesses, their involvement was not as frequent as the areas with high participation. These tasks included surveying, architecture, construction materials manufacturing, nursery and garden wholesale, construction materials wholesale, construction management, some heavy & civil contracting, electrical sub-contracting, fence installation, sheet metal sub-contracting, sewage treatment monitoring, landscaping, administrative services, publishing, photography, and security guard services.

Some of these—specifically, landscape architecture, and nursery and garden wholesale—can be expected to be more prominent in projects where there is demand for green infrastructure features. Others (publishing) can be expected to involve targeted businesses if there is a need for such services, however the demand for such companies can vary depending on the project. Still other areas may provide high levels of opportunity depending on the unique characteristics of each city—in San Francisco, for instance, there are a high number of certified LBE firms that offer construction management services, and the SFPUC’s participation rates in this category are higher than its peers.

Areas with Low Participation

There were a handful of categories that the selected sewer infrastructure projects did not provide meaningful contracting opportunities for targeted businesses. Some of these are in areas where lead firms often choose to self-perform or where non-targeted sub-contractors provide more expertise and ability to work on large-scale projects. This is especially the case with architecture (outside of landscape architecture), construction management, heavy & civil contracting, and specialty mechanical and electrical trade contractors. Others, such as construction machinery manufacturing, are the domain of large MNCs such as Caterpillar and Vermeer. Additionally, many of the tasks described in the Maintenance & Monitoring segment of the value chain are performed by the actors in the Construction & Installation portion of the chain and included in those contracts.

2.2 Firms in Green Infrastructure Value Chain

The green infrastructure value chain includes many of the same types of actors as the gray, although there are different areas of emphasis. The profile of Louisville’s targeted business participation can be considered illustrative—environmental engineers, landscape architects, nursery and garden wholesalers, and landscape maintenance and monitoring firms were more prominent than in the other cases. Project WIN had the highest targeted business participation rate (24.4%) of any of the cities selected, although it should be noted that the contracts reviewed by Duke CGGC were all relatively small—the average size of the sub-contracts distributed to targeted business was \$42,105, which contrasts sharply with the average size of the sub-contracts for targeted businesses in the NEORS sample (\$1,010,816). Table 13 below presents all of the contracts associated with Project WIN included in the sample as well as the number of targeted business sub-contractors and the participation rate for targeted businesses.

Table 13: Green Infrastructure Contracts for Louisville’s Project WIN

Project	Contract Value	Prime	Targeted Sub-Contractors	Participation Rate
Design & Planning				
Green Assessments & MS4 Program	\$2,800,000	URS	12	24.1%
GI Assistance	\$2,227,665	Strand Associates	11	25.1%
GI Consulting	\$1,682,235	O’Brien & Gere	9	29.9%
Construction & Installation				
CSO Basin 130	\$995,290	E-Z Construction	4	21.7%
Office of Employment Green Demonstration	\$423,266	MAC Construction & Excavating	2	27.2%
Federal Building Green Demonstration	\$236,500	Basham Construction	3	23.4%
Magnolia Filtration Trench	\$209,740	E-Z Construction	3	25.3%
Paris/Germantown Rain Garden	\$104,999	E-Z Construction	2	25.5%
Adams St. Permeable Pavement	\$53,304	E-Z Construction	0	0%
Congress Alley green street	\$39,935	Basham Construction	2	21.5%
GI maintenance	\$23,067	Dropseed Nursery	0	0%
Kennedy Ct. GI	\$12,550	E-Z Construction	0	0%
Green alley maintenance	\$11,950	E-Z Construction	0	0%

Source: Louisville MSD

The model in Louisville is for national firms such as URS, Strand Associates, and O’Brien & Gere to coordinate the Design & Planning for green infrastructure, and local or regional businesses to handle the bulk of the rest—E-Z Construction, MAC Construction, Basham Construction, and Dropseed Nursery are all based in the Louisville region, although only Dropseed Nursery is a certified WBE. That pattern was also seen in other locations. In Cleveland, CDM Smith and Strand are responsible for engineering while regional firms such as Nerone & Sons provide Construction & Installation. For “Green City, Clean Waters,” CDM Smith and AKRF are the dominant companies on the engineering side, while Philadelphia-based construction businesses are active downstream participants.¹⁶

Most of these national actors have departments that focus on green infrastructure within their larger suite of engineering services. However, AKRF is an example of environmental engineering firm that specializes in green infrastructure projects—the 150-employee company, which is based in New York, has provided general planning services while also helping Philadelphia run its maintenance and design assistance programs.

¹⁶ Putting aside the question of certification in targeted business programs, Philadelphia city officials told Duke CGGC that 60% of all businesses involved in “Green City, Clean Waters” were local (based in Philadelphia), 17% were regional (based in Pennsylvania, New Jersey, and Delaware), and 23% were national.

Philadelphia is somewhat unique in that it has instituted a stormwater utility fee that charges non-residential properties a fee based on the ratio of impervious surface area to total property area while also offering a tax credit for permeable pavement and other green features as part of a parcel-based billing system. Additionally, the PWD and the Philadelphia Industrial Development Corporation have implemented a Greened Acre Retrofit Program that offers grants to contractors to retrofit properties across the city. Those initiatives create demand in the private sector for businesses to provide aggregated green infrastructure management services (Valderrama et al., 2012). While there are obstacles that have prevented the emergence of one-stop green infrastructure retrofit companies in the region thus far (Valderrama et al., 2013), the sewer infrastructure value chain for a city such as Philadelphia or Louisville, which plans on implementing a similar parcel-based stormwater fee in 2015,¹⁷ can be expected to have a slightly different composition moving forward than the value chain in cities with more traditional funding models, with retrofit green infrastructure companies potentially functioning as lead firms.

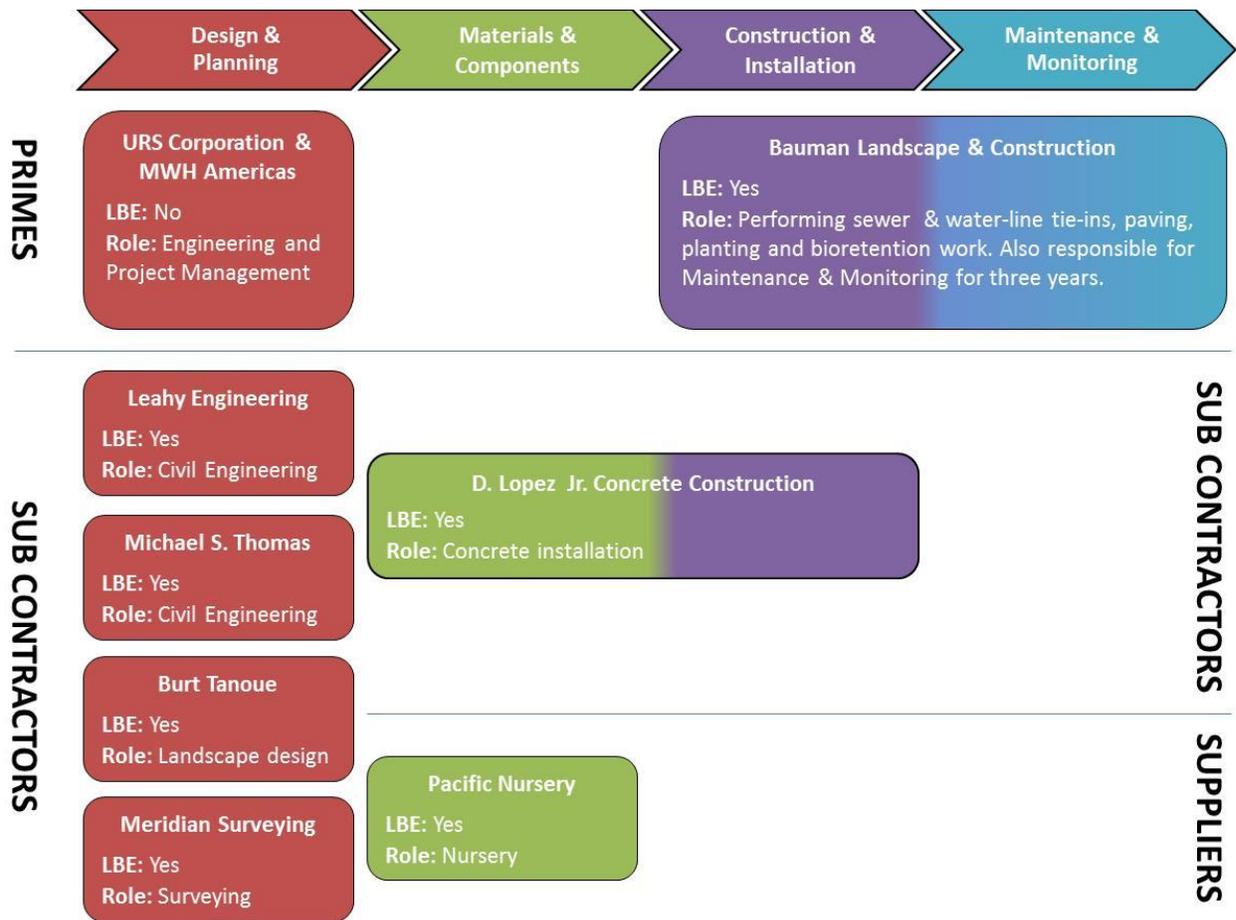
Value Chain for Oak & Fell Pedestrian and Bike Safety Project

This section fills in further detail about actors in the green infrastructure value chain by focusing on one particular project that the SFPUC is implementing as a precursor to the eight Early Implementation Projects (EIPs) of SSIP. Technically, the Oak Street and Fell Street Pedestrian and Bike Safety Project (Oak & Fell) is not part of SSIP; however, the work is similar to what will be seen in SSIP and can be considered representative.¹⁸ Figure 5 below depicts the value chain for the project as well as the business profile of each actor who is participating.

¹⁷ MSD also has a partnership model for many of its green infrastructure installations where it provides a stipend to an organization to install green infrastructure features on their property. The city reimburses the owner the amount based on how much water the installation captures and how much is saved by MSD not having to construct downstream gray features such as pump stations. Additionally, the property owner receives a credit toward drainage fees.

¹⁸ The SFPUC is partnering with the San Francisco Municipal Transportation Authority (SFMTA) to integrate stormwater management features into the traffic calming project. The green infrastructure features rain gardens in four of the planned bulb-outs (or curb extensions). Additionally, the design called for bio-swales and permeable pavement to help filter and reduce stormwater runoff.

Figure 5: Green Infrastructure Value Chain for Oak & Fell Pedestrian and Bike Safety Project



Sources: One Source; Mergent Intellect; Duke CGGC research

The green infrastructure department of URS was instrumental in the initial stages of Oak & Fell, performing engineering and design services as part of a JV with MWH Americas. In order to boost LBE participation on the project and take advantage of individual expertise, URS enlisted the help of the following four LBEs to serve as sub-contractors: Meridian Surveying, a small-LBE that employs 12 workers, provided initial surveying work of the site; Leahy Engineering, a one-person civil engineering company, provided a general evaluation of the design of the rain gardens and permeable pavement; Michael S. Thomas, another sole proprietor, focused on the hydrology; and Burt Tanoue, a self-employed landscape architect, provided landscape design services.

Bauman Landscape & Construction was awarded a \$1.1 million contract to perform the construction work. The company, which has 50 employees and earns \$12 million in annual revenue, specializes in landscape and concrete contracting. As the prime contractor, it used a three-or-four person crew to install sewer and water-line tie-ins, build bio-retention basins,

plant vegetation, and provide paving. While much of that was analogous to work that Bauman Landscape & Construction had performed on previous jobs, the bio-swales for Oak & Fell featured small monitors designed to gauge water flows into the landscape elements. Officials at Bauman Landscape & Construction said the company had not used such devices previously and that the installation was technically challenging.

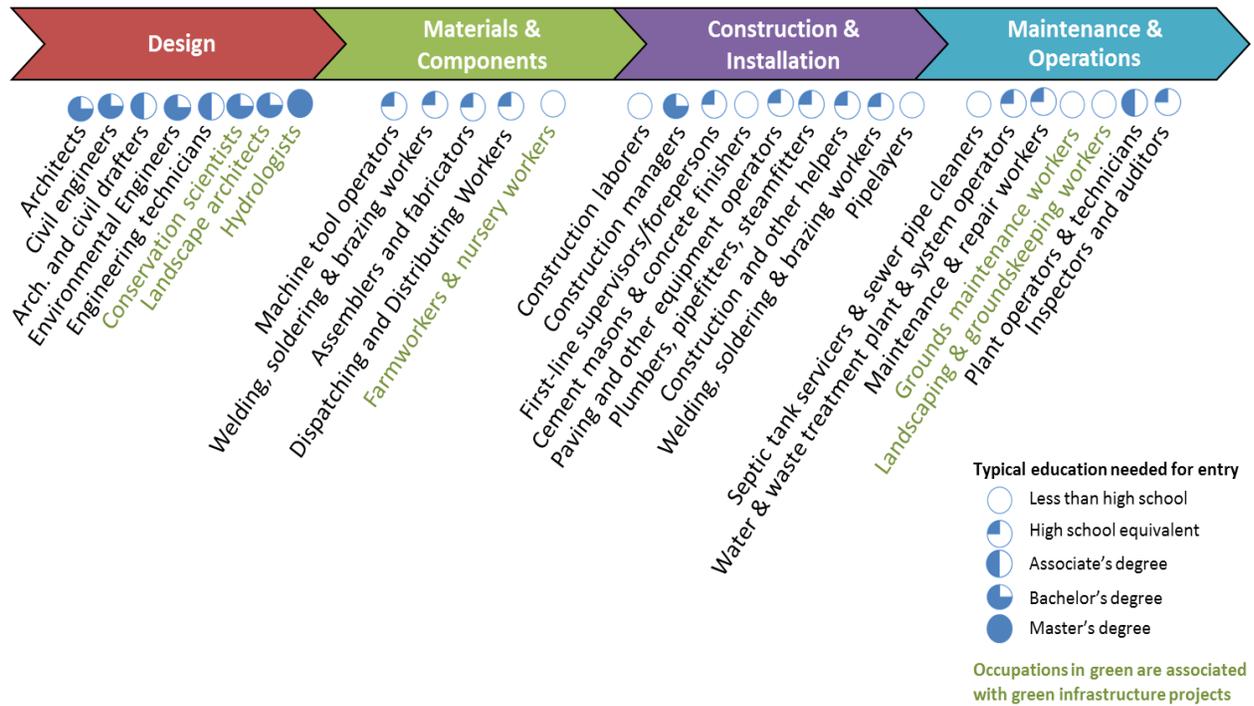
The company was using one sub-contractor, D. Lopez Jr. Concrete Construction, to help with the concrete work, and the supplier for the plants and mulch was Pacific Nursery. Bauman Landscape & Construction will be responsible for performing maintenance on the green infrastructure features for the first three years of the project, after which the SFPUC will be responsible for the work.

2.3 Jobs in the Sewer Infrastructure Value Chain

Implementing sewer infrastructure projects generates jobs across the value chain. This section of the report identifies the main job categories for which both gray and green projects generate substantial demand in the labor market. It then identifies key opportunities and barriers for local and community employment in the value chain. This analysis is differentiated from the breakdown in the “Firms in the Sewer Infrastructure Value Chain” section of the report that preceded it in that it approaches opportunities from the perspective of the individual worker.

As detailed in the previous section, different types of firms are associated with the various segments of the sewer infrastructure value chain; as a result, the demand for various occupations also differs across major activities. Figure 6 below identifies the occupations that are engaged in sewer infrastructure work at each segment of the value chain, as well as the educational attainment typically required of workers in order to gain entry into jobs in those occupations. Further information regarding the average wage, projected employment growth and education and training requirements for each job may be found in Appendix F.

Figure 6: Occupations and Educational Requirements in Sewer Infrastructure Value Chain



Sources: BLS, 2013; Green for All, 2011; Pacific Institute, 2013

Figure 6 illustrates the occupations that require the highest levels of formal education (architects, civil engineers, hydrologists, and landscape architects) are concentrated in the Design & Planning segment of the chain. Occupations associated with lower levels of educational attainment—and thus lower barriers to entry—are found in the other three segments. However, occupations found in the component manufacturing, construction and maintenance segments of the value chain also receive lower wages than design-oriented occupations. In addition, much of the work in the Materials & Components segment of the chain can be performed outside of urban settings, where land is less expensive for manufacturing firms and nurseries.

In the previous section of the report, Duke CGGC outlined the areas where targeted businesses can be expected to participate in the sewer infrastructure value chain. The corresponding opportunities in the Materials & Components and Construction & Installation segments of the chain not only represent high numbers of overall job creation, but they also present the lowest barriers to entry with respect to educational credentials (BLS, 2013; Green for All, 2013). Many of these jobs, particularly in the construction segment, fall within unionized trades, so placing local residents into these jobs requires insertion into union apprenticeship programs.

Green Jobs in Sewer Infrastructure Value Chain

Green jobs can be found in all segments of the chain, though the greatest growth in demand generated by green infrastructure projects generally accrue to professional service providers, such as architects, engineers, financial specialists and technical consultants (Pacific Institute, 2013). While Figure 7 does not highlight any particular job areas in the Construction & Installation phase of the chain as “green occupations” per se, this does not mean that green jobs will not be found in these segments; construction work on green infrastructure projects should be considered green by definition. Nevertheless, the green work carried out on these projects will be done by workers within established job categories that can also be found in gray infrastructure projects (Estolano et al., 2012; Green for All, 2013).

Jobs on green infrastructure projects are, at this phase in the industry’s development, largely “hybrids of traditional occupations” such as concrete finishers and construction laborers (Sustainable Business Network, 2010). Still, the nature of the work on green infrastructure in some cases requires slightly higher capabilities among the workforce than analogous gray projects, opening the possibility for the creation of career pathways. For example, laying permeable pavement or placing the curb cuts around rain gardens typically requires that employees are able to work according to much tighter specifications than are found in analogous gray infrastructure projects.

As green infrastructure becomes more established, demand for specialized landscaping jobs will increase, especially in cities such as Philadelphia that are making sizeable investments. However, such jobs typically offer fewer opportunities for upward mobility, as they are not attached to the union-based career development structures that are found in the trades. Thus, an important challenge with respect to promoting skill formation and ensuring high job quality for green infrastructure landscaping positions will be the development of career pathways.

3. LESSONS LEARNED

The goal for this report was to use the value chain framework to provide a sense of the profile of the businesses that perform work on sewer infrastructure projects. Since the central research question guiding this report was identifying areas where targeted businesses participate in sewer infrastructure projects, the lessons learned start there.

1. Targeted businesses can play meaningful roles in sewer infrastructure projects

The participation rate for targeted businesses across the sample of sewer infrastructure projects was 16.7%. The presence of local or disadvantaged companies was most often concentrated in select areas—specialized engineering and consulting, concrete and/or site preparation, advertising and public relations, and trucking were the most frequent, although surveying (including geospatial), construction materials wholesale, construction management, some heavy & civil contracting, and publishing also offered relatively high levels of opportunity. Still others, including landscape architecture, construction materials manufacturing, nursery and garden wholesale, fence installation, landscaping, and administrative services, offered more limited prospects but chances nonetheless.

Because of the size and scope of large-scale gray infrastructure projects, CH2M Hill, AECOM, Kiewit Pacific, Weeks Marine, Tutor Perini and other multinational corporations are the lead firms in the chain. These large multinational companies offer a range of services and are vertically integrated to various degrees with few of them specializing solely in sewer infrastructure work; however, their primary focus revolves around particular segment of the chain (engineering or heavy civil construction). Non-targeted companies also play an important role, most often serving as a prime contractor on smaller contracts or performing specialty trade sub-contracting on the larger projects.

2. The sewer infrastructure value chain is characterized by a relational governance structure

At the same that it prioritizes identifying the actors in a particular value chain, the GVC literature places an emphasis on assessing the power dynamics between the companies that provide goods and services in each segment of the chain. This area, called *value chain*

governance, allows one to understand how a chain is controlled and coordinated when some actors have more power than others (Gereffi, 1994). Broadly speaking, the following five types of governance structures have been identified in the GVC literature:

- **Market:** When transactions are relatively simple and power dynamics are controlled by market forces (prices).
- **Modular:** When complex transactions are relatively easy to codify, and suppliers generally design to lead firm's specifications.
- **Relational:** When buyers and suppliers (or prime and sub-contractors) develop strong relationships and share complex information that is not easily learned. These power dynamics are characterized by trust and mutual reliance.
- **Captive:** When small suppliers are dependent on a small number of buyers or prime contractors and have little leverage against those lead firms, who are actively involved in monitoring and controlling the final product.
- **Hierarchy:** When chains are characterized by vertical integration and product specifications that cannot be codified. Lead firms in these chains possess high degrees of power (Gereffi & Stark, 2011).

While there is a certain degree of fluidity in these governance structure, the lead firms in the sewer infrastructure value chain most often prefer a relational governance model, with market, modular and captive dynamics persisting when that is not possible. In its review of individual contracts, Duke CGGC detected that prime contractors used the same sub-contractors across multiple projects. Interviews with prime contractors indicated lead firms have a strong preference to work with sub-contractors who qualify as “known quantities”—officials from more than one company said they prefer not to use sub-contractors who they have not relied on previously or have not heard about, even if the “unknown” sub-contractor would be more cost effective and count toward targeted business participation goals.

The relational nature of the governance structure has important implications for both companies and local authorities. Some of these relationships were the result of previous work arrangements—an engineer who used to work for a lead firm might be expected to still work on projects with that lead firm if they start their own consulting company—but just as often, they were the result of networking efforts made by targeted businesses. Targeted businesses need to be active in participating in industry events or using matchmaking resources offered by local governments (see Lesson Learned No. 3). Additionally, companies trying to crack into the networks of lead firms should communicate clearly what their business has to offer and how it can add value to the supply chain. Related to the last point, targeted businesses should maintain websites and LinkedIn profiles that contain current, accurate and detailed information about their products and services.

3. Local governments support the inclusion and development of targeted businesses with both demand and supply-side policies

In order to help businesses reach targets, local governments take a number of steps to support targeted companies. These support mechanisms can be divided into two categories: policies that help shape the procurement process (demand-side); and programs that attempt to nurture fledgling businesses or help develop the skills of the workforce (supply-side).

Demand Side: Policies to Boost Targeted Business Participation

This section proceeds by first examining the policies the six selected cities, counties or regional sewer authorities have adopted to boost opportunities for targeted businesses in the procurement process.

Bid Discounts

Two of the cities studied—Philadelphia and San Francisco—provide bid discounts to local businesses in order to help them be more competitive on proposals. Bid discounts refer to preferences local governments provide targeted businesses by evaluating their proposals at a lower price. Policies toward bid discounts were introduced on Page 16 as a proxy for whether each location prioritized the development of targeted businesses into prime contractors as a goal of its certification program.

Identification of Sub-Contractors in Proposal

Every city studied requires prime contractors to specify in the contract proposal the sub-contractors that will perform the designated tasks in the event of a successful bid. NEORS is studying the possibility of changing this policy to where prime contractors would only sign an affidavit where they commit to an overall MWSBE target; the prime would then parcel out sub-contracts to selected businesses as the work materializes. In essence, this would change the identification of targeted sub-contractors from the front end of the procurement process to the back end.

Sub-Contractors Identified in Proposal Must be Offered Work

While each city or regional authority studied in this report has contract language that strongly encourages prime contractors to utilize the specific sub-contractors that were delineated in proposals, being part of a winning bid is not a guarantee of work for targeted businesses. Depending on the city, selected sub-contractors may not be given the opportunity to perform the tasks they were included in the proposal to execute for a number of reasons—the city may decide to self-perform the work, the Scope of Work could change, or the prime contractor may opt to self-perform or utilize a different sub-contractor.

It should be stressed that every city studied affords prime contractors the opportunity to substitute sub-contractors for non-performance or after non-response to good-faith efforts to engage in projects. In these cases, each city or regional authority has a multi-step Change Order procedure and tracking system.

Self-Performance by Sub-Contractors

All of the cities or regional authorities studied for this report have instituted specific clauses to discourage the practice of sub-contractors serving as pass-throughs.¹⁹ Seattle, Omaha, and Louisville have the strongest provisions against such situations, mandating that sub-contractors self-perform at least 50% of the contract. NEORS (30%) is more lenient, followed by San Francisco (25%), and Philadelphia (20%). To ensure that its MWDBEs are not serving as pass-throughs, the city of Philadelphia analyzed its targeted business database and removed non-stocking suppliers from the system.

Set-Asides

Three of the cities reserve a pool of contract for the targets of their targeted business program. In San Francisco, the maximum amount of these set-asides varies depending on the NAICS codes of the business—the threshold for engineering firms is \$50,000, while construction set-asides can go as high as \$400,000. In Omaha, the city looks to disaggregate contracts into smaller components and reserve those smaller tasks for the Tier I firms and the Tier II ESB pool. The priority for set-asides in Omaha is Tier I ESBs, Tier I SBs, Tier II ESBs and then Tier II SBs. In Seattle, contracts under \$25,000 do not require a public solicitation. Finally, Philadelphia's 2012 annual disparity study highlighted the growing national trend of set-aside programs in its recommendations section (Econsult Solutions and Milligan & Company, 2013). Philadelphia used to have such a program for minority businesses, but a 1990 U.S. District Court decision banned its sheltered-market program; however, the city is not prevented from instituting such a program for local businesses.

Joint Ventures

Joint Ventures offer valuable opportunities for technology transfer and knowledge sharing that can help targeted businesses upgrade their position in the sewer infrastructure value chain. The SFPUC incentivizes the formation of JVs between LBEs and non-LBEs in the Design & Planning segment of the value chain by awarding a ratings bonus of 7.5% to JV proposals where the LBE is slated to perform at least 40% of the work and 5% for proposals where the LBE is schedule to

¹⁹ In pass-through situations, a third party who is not part of the targeted business database uses the targeted company to gain an advantage on bid proposals; the third party then performs the majority of the work and receives much of the financial benefit.

perform at least 35% of the scope.²⁰ Partly as a result of that policy, JVs are common between lead firms and LBEs for engineering services. While it was not for contracts associated with SSIP, eight LBEs were part of successful JV bids with the SFPUC in the period from July 1, 2012-June 30, 2013, partnering with large companies such as CH2M Hill, Brown and Caldwell, and Kennedy/Jenks Consultants. On average, the eight LBE firms had 10.9 employees and \$2 million in annual revenue compared to the billion-dollar enterprises they collaborated with.

The SFPUC is the only local government studied that incentivizes JVs between targeted businesses and lead firms. Officials with NEORS and Philadelphia both said they have discussed implementing similar policies but that there are legal impediments. King County's preference is to let lead firms determine how they are going to reach the participation goals delineated in each contract.

Supply-Side: Programs Designed to Boost Targeted Business Participation

In large, heavy civil construction projects such as sewer infrastructure improvement programs, a key barrier for targeted business participation is the lack of relevant skills and certifications among individuals and companies that comprise the workforce. Surmounting such challenges requires major stakeholders to engage in workforce development programs in addition to the sorts of policy initiatives outlined in the preceding sub-section. Fostering a cooperative relationship between utilities, workforce development and training agencies, unions and employers is key to both ensuring that training is well-aligned with industry needs and increasing placement rates for program participants (Estolano et al., 2012; Green for All, 2011; Pacific Institute, 2013). The discussion that follows outlines the strategies that cities have implemented in three specific areas: Project Labor Agreements (PLAs); capacity building; and matchmaking assistance.

Because of the volume of materials provided by the SFPUC, Duke CGGC focused on the commission's efforts as part of SSIP. Almost all of the cities have taken similar steps; because of the overlap in initiatives, Duke CGGC believed it most appropriate to focus primarily on the examples of one particular city. While many of the SFPUC's initiatives can be considered best practices, the focus on San Francisco is not intended to denigrate the outreach efforts of Philadelphia and other cities.

Project Labor Agreements

The cornerstone of SFPUC's approach to ensuring that SSIP will offer quality employment to local workers is the agency's PLA. The PLA was initiated as part of the SFPUC's multi-county Watershed System Improvement Program (WSIP) as a means of overcoming bottlenecks in the

²⁰ On Design & Planning proposals, the SFPUC evaluates proposals based on ratings assigned to each bid. Each proposal can receive a maximum score of 100, and a ratings bonus of 7.5% adds .75 points onto the respective proposal.

construction labor market and ensuring decent work for residents of affected communities.²¹ It provides a structure to facilitate the partnership and information-sharing between the SFPUC, unions, and contractors while also providing for peaceful settlement of labor disputes.

A core goal of the PLA is to place disadvantaged residents into jobs with SFPUC contractors. The Job Opportunities and Training Program (JTOP) is the key element of the PLA that guides the process. JTOP creates five steps that SFPUC and its contractors should follow for each project in order to create employment opportunities for local and disadvantaged workers (SFPUC, 2009). First, the SFPUC and contractors work together to establish apprenticeship targets for disadvantaged workers. Second, PLA staff work with referral agencies and training programs, including CityBuild, in order to provide notification of upcoming job opportunities.²² Contractors work with these agencies in order to identify and dispatch workers to job sites. Third, contractors are expected to make a “good faith effort” to engage in local hiring. Fourth, PLA staff monitors the performance of contractors, unions, referral agencies, apprentices and local workers, and the agency reports back out to these participating actors. Finally, PLA staff may choose to engage in a Grievance and Arbitration proceeding if it determines that the prime contractor, sub-contractors and/or one or more of the signatory unions have failed to show good faith in meeting local hiring goals.

For Brightwater, the King County WTD instituted a PLA with the express goal of insuring that “all construction work proceed continuously and without interruption, efficiently, economically, and with due consideration for the projection of labor standards, wages, and working conditions” (King County WTD, 2005). Since PLAs had not been widely used previously for major construction projects in the region, King County’s WTD set up a service where the agency helped coach potential contractors through the requirement. Despite those efforts, Brightwater project managers reported that some smaller companies remained hesitant to sign PLA-related documents even after making use of the mentorship King County provided.

Managers at NEORSD have held internal discussions about entering into a PLA for Project Clean Lake. However, as of early 2015, negotiations with local unions had failed to gain traction; NEORSD management indicated there were concerns that the existing proposals did not provide for robust enough apprenticeship programs for economically disadvantaged residents of the region.

²¹ WSIP was a five-year, \$4.6 billion project that ran from 2009-2014.

²² Under the PLA, contractors participating in SFPUC work are obliged to bring on union workers through the referral process, though crews may be brought in on a “one-to-one” basis. One union referral is required for every “core” (non-union) worker brought onto the job. The PLA, in combination with the local hiring policy, obliges the unions to fill many of these referrals with targeted workers, thus ensuring that disadvantaged workers are included on SFPUC-funded projects (SFPUC, n.d.).

Capacity Building

Capacity building often takes two complimentary forms—enhancing skills of the existing workforce, and developing the skills of those who are outside the system. On the first point, all cities studied for this report devote resources to help would-be sub-contractors on the procurement process. The SFPUC’s Contractors Assistance Center is an example of this practice. The center attempts to provide businesses not only with assistance on how to comply with the SFPUC’s regulations and certifications, but also offer training on broader topics such as how to implement business development plans and secure access to capital.

If the Contractors Assistance Center is designed for current professionals, the SFPUC has also engaged with a number of training programs in order to promote relevant skill formation among residents who might wish to work on SSIP projects. The primary training program for connecting local residents—particularly those from disadvantaged backgrounds—is CityBuild, a collaborative program between the municipal government, the City College of San Francisco (the local community college), and unions.²³ CityBuild Academy, a CityBuild program, provides pre-apprenticeship training in both remedial skills and industry-specific skills through a combination of classroom instruction and hands-on training. Crucially, CityBuild provides not only skills training but also job placement assistance in apprentice- and journey-level construction jobs, thus allowing the agency to serve as an intermediary between workers, unions and employers. Since 2010, over 670 San Francisco residents have graduated from CityBuild Academy, and 570 graduates have entered union apprenticeship programs in various construction trades (OEWD, 2014). CityBuild, in partnership with the City College, also offers a Construction Administration Training Program that focuses on training for administrative positions in the construction industry, such as accountants and project managers. Since 2010, 136 San Francisco residents have completed the program, and 91 graduates have been placed in administrative positions (OEWD, 2014).

Beyond CityBuild, the SFPUC has supported a handful of youth training programs in order to both create job opportunities and internships for youth, particularly in disadvantaged neighborhoods. Project PULL is a paid summer internship program that inserts high school students into positions with SFPUC and other city departments. Finally, SFPUC supports a program known as Earth Stewards, which is led by an organization called the Garden Project. Earth Stewards offers life-skills programming and job training focused on environmentally based jobs to local at-risk youth and young adults.

²³ Relevant union-based programs include the Carpenters’ Training Committee of Northern California, the Northern Laborers’ Training Center (NCLTC), and the Cement Mason Pre-Apprenticeship Training Program.

Matchmaking Assistance

By virtue of having online databases that prime contractors can utilize to search for targeted businesses, all of the selected cities provide matchmaking services to an extent. However, most also take additional steps, arranging pre-bid meetings that serve not only as chances for all sides to get more information about a particular project but also as networking opportunities. If the prime contractor is having difficulty finding qualified sub-contractors or if the sub-contractor that was included in a proposal is not performing, the cities, counties or regional authorities will intervene to work to locate a suitable option or replacement from the targeted business database.

4. Local governments can better understand the capabilities of their targeted businesses through diversity studies, strategic plans, and improved data collection

NEORSB initiated its 2010 Disparity Report to better understand the landscape of small businesses that existed in the greater Cleveland region. Part of the goal of that project was to determine if there were discrimination against MWBE firms, but another aspect of the motivation was to draft a blueprint for attaching meaningful MWSBE goals to individual contracts. Philadelphia publishes annual diversity reports that assist its discussions about MWDSBE participation and has also commissioned Economic Opportunity Strategic Plans. San Francisco has taken similar steps and recently installed an LBE Utilization Tracking System. These efforts can help cities spot holes in their targeted businesses databases and institute targeted workforce development strategies that may bolster the capabilities of companies in a specific skill.

5. There is benefit for local governments in explicitly articulating goals of targeted business programs and instituting policies that match those aims

By using holistic evaluation frameworks such as the TBL, all six cities selected for this report have a demonstrated interest in providing economic benefits as part of their sewer infrastructure projects. Additionally, each of the cities or regional authorities attach participation targets to contracts, which reinforces the idea local governments have made it a priority to provide procurement opportunities for local or minority or women or disabled or

small businesses. In order to ensure actual results correspond with the motivations that animate the TBL and other frameworks, participation goals should be explicit and transparent.

Industry professionals who have wide-ranging experiences in the sewer infrastructure value chain believe local governments can enhance targeted business programs by asking additional questions: Is the goal to help targeted businesses improve their position in the value chain and become prime contractors? Or is it to provide maximum volume of work? If the interest is in helping sub-contractors become primes, local governments can consider bid discounts among other preferences; if not, the focus can be on informing targeted businesses of impending procurement opportunities and strengthening professional networks.

Another possible conversation topic is whether the goal of the business opportunity programs is to serve as an incubator for fledgling companies or to act as a more permanent resource. If the ultimate objective is to nurture targeted businesses in the critical early years of their lifecycle, instituting a time component may be appropriate. If it is preferable to provide more lasting assistance to targeted businesses, then installing a graduation feature may not be desirable.

6. Outreach activities and aggressive compliance monitoring by local governments are important to ensure the overall health of targeted businesses

In its report on construction industry best practices, UCLA's Labor Center identified the following five hurdles for WMBE participation in the construction industry: delayed payments and limited cash flow; difficulty obtaining bonding and insurance; insufficient enforcement; limited access to information and business networks; and difficulty accessing capital (Herrera et al., 2014). In interviews with Duke CGGC, targeted businesses in the sewer infrastructure value chain repeatedly expressed frustration about at least three of those obstacles—delayed payments, insufficient enforcement, and limited access to information and business networks. Most frequently, smaller sub-contractors said they felt they did not hold enough power to confront negligent prime contractors who may be self-performing tasks or using non-certified sub-contractors.

Local governments in every city selected for this report have regulations that detail steps that constitute a “good-faith effort” by prime contractors to engage with sub-contractors; however, cities or regional authorities need to be vigilant in monitoring potential abuses. Additionally, some of the local governments studied in this report reserve the right to self-perform individual

jobs that are included in contracts even after that proposal has been accepted. Given the hardship this imposes on the sub-contractor affected, such steps should be taken sparingly.

In order to ensure a local government's compliance system has "teeth," UCLA's Labor Center advocated for the creation of an advisory board that features stakeholders from the major groups involved in construction contracts (local government, targeted businesses, prime contractors, among others). Based on its research into the sewer infrastructure value chain, Duke CGGC sees the merit in such a recommendation.

7. Green Infrastructure projects presents both upgrading opportunities and challenges for targeted businesses

The sustainability departments of lead firms often provides overall engineering services and program management for green infrastructure projects, although medium-sized companies with a more narrow focus have emerged in locations such as Philadelphia. On the construction side, installation was performed by a mixture of non-targeted and targeted businesses, although almost all were based in the community or surrounding region. While the green infrastructure projects studied had high targeted business participation rates (24.4% in the case of Louisville's Project WIN), the size of the contracts were relatively small, which limits the job creation potential. For example, the average size of the sub-contracts disbursed to targeted businesses in Louisville was \$42,105, which contrasts sharply with the average size of the sub-contracts given to targeted businesses in the NEORS sample (\$1,010,816).

Upgrading Opportunities for Targeted Businesses in Green Infrastructure

At the same time that it analyzes value chains from the vantage point of lead firms, the GVC literature also takes a bottoms-up perspective by assessing how smaller businesses can improve their position. This process, known as *upgrading* in the literature, has five typologies: product, process, functional, chain, and end market. Through its interviews with green infrastructure professionals, Duke CGGC identified the potential upgrading trajectories identified in Table 14 below.

Table 14: Potential Upgrading Trajectories in Green Infrastructure Value Chain

Upgrading Form	Description	Trajectory
Product	Moving into a more sophisticated product line	<ul style="list-style-type: none"> — Design & Planning and Construction & Installation firms master ability to construct or design rain gardens and bio-swales — Materials & Maintenance businesses offer tree box, media and soil mixes with wide range variety of filtration capabilities that are necessary for green infrastructure features — Design & Planning companies developing ability to collect data about green infrastructure installation
Process	Improving efficiency or introducing superior technology	<ul style="list-style-type: none"> — Construction & Installation firms improve technical upgrades to install features at precise elevations
Functional	Acquiring new functions or abandoning existing ones at different stages of value chain	<ul style="list-style-type: none"> — Landscape architecture firms add grading, concrete and demolition capabilities — Construction & Installation companies acquire ability to perform some Design & Planning functions — Materials & Components or Maintenance & Monitoring businesses add ability to install green infrastructure features
End Market	Serving new buyers or markets	<ul style="list-style-type: none"> — Progressing from working with local governments to installing green infrastructure features for private developers (apartments, shopping centers, etc.)

Sources: Gereffi & Stark, 2011; Duke CGGC research based on interviews with industry professionals

Green infrastructure experts stress that much of the design is consistent with previous training but that existing skills must be used in new ways. Because of this, there are opportunities for businesses to refine existing capabilities, enter the industry, and ultimately perform the valuable activities within the sector. The green infrastructure projects studied relied on targeted businesses to provide environmental engineering, landscape architecture, nursery and garden supplies, and landscape maintenance and monitoring services in greater numbers than gray work.

Engineering professionals said there is need for increased data gathering surrounding the performance of bio-swales, rain gardens, and other green features. The Oak & Fell project in San Francisco involved the installation of small monitors into the bio-retention structures to

gauge water flows, but experts reported that the collection of performance data has been sporadic. As such, there could be an opportunity for individuals or specialized engineering companies that have GIS and data manipulation capabilities to collect additional data in an effort to understand which designs work best.

Bauman Landscape & Construction could provide a representative example of both the opportunities and upgrading trajectory for companies in the Construction & Installation segment of the value chain. Bauman Landscape & Construction was highlighted in the discussion on the Oak & Fell—the landscape contractor, founded in 1977, had an initial focus on landscaping and irrigation. Over the years, it added grading, concrete, underground utilities and demolition to its repertoire to bolster its construction capabilities and position it for green infrastructure work.

Mastering the ability to design or construct features such as rain gardens or bio-swales is an important product upgrade for businesses in both the Construction & Installation and Design & Planning segments of the green infrastructure value chain. Restoration Design Group is a landscape architecture firm based in Berkeley, Calif., that has specialized in the design of creek restoration since its founding in 2003. As a response to increasing demand from both public and private clients, it has added the design of rain gardens and bio-swales to its core practice. Because of its expertise in creek restoration, the work on more urban green infrastructure was not a huge leap for the firm, although it reported that local and state regulations surrounding the performance of the features has grown more complex.

Challenges for Targeted Businesses in Green Infrastructure

Even if similar actors are involved in installing green infrastructure features, there are challenges that can make implementation demanding. A summary of each, based on interviews with professionals and industry, is presented in Table 15 below.

Table 15: Challenges Associated with Green Infrastructure for Private Actors

Value Chain Segment	Challenges
Design & Planning	<ul style="list-style-type: none"> — Some of the tenants contradict engineers’ general training. Goal is to hold or infiltrate water through pavement or to pond water in planters, which is usually not desirable. If on-site infiltration is not possible, complicated analysis of re-use and treatment process is necessary. — Requires understanding of proper vegetation, soils and mulch. If installed improperly, mulch can float away and clog permeable pavement. Not all plants and shrubs can withstand stressful roadside environment. — Getting water into bio-retention features without it being hazard for bikers or walkers. Also providing necessary volume and depth for bio-retention features without compromising overall aesthetic.
Materials & Components	<ul style="list-style-type: none"> — The tree box, media and soil mixes that have the right mix of infiltration and carbon capacity are sometimes proprietary to individual companies. Biosolids (treated sewage sludge) also have patents.
Construction & Installation	<ul style="list-style-type: none"> — Requires diverse skill set, including ability to handle pipe work, sub-surface pipe work and drainage structures. — Crew must be flexible and competent enough to recognize small surprises that could impair performance of entire system. — Small scale and technical difficulty of projects discourages some contractors from bidding on work.
Maintenance & Monitoring	<ul style="list-style-type: none"> — Often an underserved market; businesses, by and large, have not invested in skills to maintain a rain garden. — Needs are site specific, and sometimes there is ambiguity surrounding the frequency of upkeep that is necessary. — When there is a shock to the system (flood, drought, build-up of garbage, etc.), who pays for upkeep?

Source: Duke CGGC, based on interviews with industry professionals

The landscape architects and civil, geotechnical and structural engineers that comprise the Design & Planning segment of the value chain reported that the difficulty of each job varies depending on local circumstance. San Francisco, for instance, presents a dense urban environment where the soil conditions change dramatically depending on the neighborhood. The most successful professionals are those who understand the entire system rather than focusing on standalone components, but there are challenges that are unique to each segment.

One of the SFPUC’s eight green infrastructure EIPs as part of SSIP is the Mission Valencia Green Gateway. There is a significant amount of roadwork involved in the installation, which meant that the construction contractor need to understand both traffic control and the technical specifications of the project. The green infrastructure department at URS reported there is

sometimes difficulty finding companies that have experience with both traditional roadway and utility-type work, but that also have the ability to install rain gardens. The latter component is not necessarily straight-forward—contractors have to adjust pavement, curb, gutter and planter-area grades to drain and hold water as designed, all the while hitting precise elevations and working around existing and proposed utilities. There are certainly firms that have such technical acumen, but many of them are unwilling to bid on smaller-scale projects. Underscoring these challenges, design firms specializing in green infrastructure in the region said that they regularly see completed installations where imprecise construction work compromised the performance of the entire system.

8. Leveraging green infrastructure projects can assist the development of certifications and career ladder programs for green jobs

The labor market for jobs in green infrastructure remains highly fragmented across the United States, as contractors, engineers, local governments and other stakeholders do not yet know which technologies will be ecologically feasible across different urban markets. These uncertainties have served as an important, if temporary, barrier to the consolidation of certification programs and career ladders for green jobs in the construction and wastewater management industries in many localities (Pacific Institute, 2013). However, in projects where green infrastructure comprises an important component of the overall investment, the local government should work with employers and, where appropriate, unions to create a certification program for green infrastructure construction and maintenance. Whereas some of the construction work is likely to take place within the unionized trades, maintenance work will largely be performed by landscapers, which is not a unionized trade. The creation of certification programs (for example in laying permeable pavement, installing rain gardens, or maintaining green infrastructure) will help the industry better manage labor demand as well as send a signal to job-seekers regarding what skills they must learn in order to enter the industry.

The creation of training and certification programs can also aid in the development of career ladders that provide a pathway from entry-level positions to jobs with greater stability and higher remuneration. For example, the PWD has formed a partnership with the Sustainable Business Network of Greater Philadelphia to identify and map out potential pathways between related jobs (pipelayers' helpers, pipelayers, and plumbers) as well as the formal credentials and on-the-job training necessary for upward mobility along the career ladder (Estolano et al., 2012; Green for All, 2013; Sustainable Business Network, 2010).

9. Bundling green infrastructure projects into larger contracts may provide social benefits and improve effectiveness of installations

The previous lesson outlined the certification programs that can be implemented to eliminate these openings; however, in the short term, local governments have to be cognizant of ineffective installations and the costs associated with poor work (see challenges associated with Lesson Learned No. 7). One strategy that may warrant consideration is bundling multiple green infrastructure projects together so slightly larger companies that have the requisite skills are motivated to bid. Targeted businesses would still be expected to contribute to these projects through appropriate participation targets.

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APPENDIX A: Motivation for Sewer Infrastructure Investments

Our interviews and review of materials revealed three major reasons why the selected cities invested in sewer infrastructure: consent decrees, capacity issues, and the age of the system.

Consent Decrees

Cities that have combined sewer systems are at-risk of having CSOs, which are overflows that discharge raw sewage into the environment during rain events that overwhelm the system. Under the Clean Water Act (CWA), it falls under the EPA's mandate to enforce standards designed to reduce and eliminate unlawful sewer discharges. In cases where there are repeated or large-scale CSOs, the EPA will initiate legal proceedings against municipalities. The final agreement in these cases is referred to as a Consent Decree; in the five years from 2010-2014, the EPA reached Consent Decree settlements with at least 39 municipalities throughout the country (EPA, n.d.).

Four of the cases selected for this report were the result of Consent Decrees or formal arrangements between the local government and the EPA. Louisville signed its original agreement with the EPA in 2005 before modifying it in 2009; Cleveland finalized its negotiations with the federal government in 2010; and Philadelphia and the EPA entered into a Partnership Agreement in 2012. Instead of the EPA, Omaha signed its Consent Decree with the state of Nebraska in 2009—the city reached that arrangement with the state instead of the EPA by partnering with the Nebraska Department of Environmental Quality (NDEQ) to craft its Long Term Control Plan (LTCP) to address CSOs.

Capacity Issues

The combined sewer systems in San Francisco and Seattle both confront regular CSOs; however, the particular infrastructure projects that are being analyzed in this report were not initiated as a response to Consent Decrees. The King County Wastewater Treatment Division (WTD) is responsible for the sewer system and water quality in a 415-square-mile service area that includes Seattle—located in King County—and parts of neighboring Snohomish and Pierce counties. As the region experienced population growth, the system approached 85% of its capacity, forcing the King County WTD to formulate a Regional Wastewater Services Plan that ultimately proposed the construction of Brightwater for the northern portion of the service area. While the construction of the new facility eased some of the strain on the system, CSOs persisted in other parts of the region, forcing King County and the city of Seattle to reach Consent Decrees with the EPA in 2013.²⁴

²⁴ As part of the Consent Decree, King County agreed to spend \$850 million on capital improvements to its sewer infrastructure by 2030. As part of that program, at least \$81 million will be spent on green infrastructure.

Age of System

With the exception of the Oceanside Treatment Plant, much of the sewer system in San Francisco was constructed more than 60 years ago. In addition to the age of the infrastructure, the desire to reduce the system's seismic vulnerability pushed the SFPUC to begin actively planning in 2005 for what became SSIP. As part of that effort, early construction will begin in 2015 on a handful of smaller green infrastructure projects before installation of the larger gray features begins in 2018.

APPENDIX B: Why Green Infrastructure? And what is it?

The EPA has actively encouraged municipalities to adopt sustainable technologies since at least 2007, releasing a Green Infrastructure Strategic Agenda in 2013 that outlined a number of key objectives as the agency partners with communities and organizations (EPA, 2013). As part of that emphasis, the EPA encourages municipalities that it enters into Consent Decree agreements with to adopt a variety of sustainable features, including downspout disconnections, rainwater harvesting, rain gardens, planter boxes, bio-swales, permeable pavement, green streets and alleys, green parking, green roofs, urban tree canopies, and land conservation (expanded definitions and examples of each of these elements is available in Appendix A

Cost Savings

For many of the cities studied for this report, the rationale for adopting green infrastructure follows the idea that, as one gets closer to full CSO compliance, the marginal cost of green infrastructure is significantly cheaper than gray infrastructure (Gunderson et al., 2011; Wise et al., 2010; Roseen, 2015; EFC, 2014). There is a wide literature of studies analyzing the economic benefits of green infrastructure in specific locales,²⁵ but the data can be somewhat mixed on a national level. In a study of 479 landscape professionals across the country, 44.1% reported that using green infrastructure reduced costs; however, 31.4% indicated that it had no effect, and 24.5% said it pushed them higher (American Society of Landscape Architects et al., 2012).

In the 2009 Integrated Overflow Abatement Plan associated with its Consent Decree, the Louisville MSD estimated that its green infrastructure projects would save \$40 million in initial costs with the potential of future savings of double or triple that amount (MSD, 2009).

As noted, Project Clean Lake is a predominantly gray investment, with deep tunnels, sewer improvements, pump stations, plant improvements and other traditional features being constructed to capture roughly 4,037 million gallons (MGs) of CSOs at more than 95% of the total project cost. To reach the final reduction target mandated by the Consent Decree, NEORS D determined that it would be cheaper to commit to spending \$42 million on green infrastructure projects that were designed to contain 44 MG of wastewater rather than building more gray features.²⁶

For Philadelphia, part of the appeal of green infrastructure was overall cost savings, not just as the city approached full CSO compliance. Mami O’Hara, the deputy commissioner chief of staff of the Philadelphia Water Department (PWD), says that relying on gray infrastructure solutions

²⁵ The EPA has aggregated many of them in its section on green infrastructure: http://water.epa.gov/infrastructure/greeninfrastructure/gi_costbenefits.cfm.

²⁶ Since signing the Consent Decree, NEORS D estimates that the cost of its green infrastructure projects has increased to \$100 million, which is the figure that was used for Project Clean Lake in **Table X**.

for the city’s CSOs would have cost at least \$8 billion, with the price of each underground storage unit estimated at about \$2 billion.

Demonstration Potential

Beyond cost savings, some cities’ spending on green infrastructure can be considered first steps that will likely lead to more ambitious investments in future years, even if those future investments were not outlined at the outset of the project studied for this reports. Notably, the SFPUC has committed to eight green infrastructure EIPs in the first phase of SSIP; if the technologies demonstrate quantifiable benefits, the SFPUC plans to incorporate additional features in the second and third phases of the project.

In one sense, the city of Philadelphia was on the opposite end of the spectrum as San Francisco, spending billions where the SFPUC only committed millions. However, the ultimate goal of each place is similar—the city of Philadelphia and the EPA were explicit when they announced their partnership agreement that one of their aims was to serve as a model for other municipalities in demonstrating the potential of green infrastructure.

Figure 7: NEORS D Community Outreach on Behalf of Green Infrastructure

Benefits of GI for Cleveland

- Potential increase in green jobs
- Improved air quality
- Additional recreational space
- Increased property values

Concerns with Green Infrastructure

- Design & construction
- Operation & maintenance
- Long-term responsibility & funding/cost

 *Your Sewer District* Keeping our Great Lake great.  #neorsdGREEN

Source: NEORS D

Economic Development

Across many of the cases, there was a belief that green infrastructure provided economic and social benefits, whether those advantages were for targeted businesses, local property owners,

or community aesthetics. Figure 7 above was part of a NEORS presentation on Project Clean Lake and is representative of how the issue was often framed. In public discussions, leaders with the PWD outlined a “virtuous cycle” where investments in green infrastructure enhance overall livability and economic health of the city.

EPA Definitions and Descriptions of Benefits for Green Infrastructure Features

Downspout Disconnection: Downspout disconnection refers to the rerouting of rooftop drainage pipes to drain rainwater to rain barrels, cisterns, or permeable areas instead of the storm sewer. Downspout disconnection stores stormwater and/or allows stormwater to infiltrate into the soil. This simple practice may have particularly great benefits in cities with combined sewer systems.

Rainwater Harvesting: Rainwater harvesting systems collect and store rainfall for later use. When designed appropriately, rainwater harvesting systems slow and reduce runoff and provide a source of water. These systems may be particularly attractive in arid regions, where they can reduce demands on increasingly limited water supplies.

Rain Gardens: Rain gardens (also known as bioretention or bioinfiltration cells) are shallow, vegetated basins that collect and absorb runoff from rooftops, sidewalks, and streets. Rain gardens mimic natural hydrology by infiltrating and evapotranspiring runoff. Rain gardens are versatile features that can be installed in almost any unpaved space.

Planter Boxes: Planter boxes are urban rain gardens with vertical walls and open or closed bottoms that collect and absorb runoff from sidewalks, parking lots, and streets. Planter boxes are ideal for space-limited sites in dense urban areas and as a streetscaping element.

Bio-swailes: Bio-swailes are vegetated, mulched, or xeriscaped channels that provide treatment and retention as they move stormwater from one place to another. Vegetated swailes slow, infiltrate, and filter stormwater flows. As linear features, vegetated swailes are particularly suitable along streets and parking lots.

Permeable pavements: Permeable pavements are paved surfaces that infiltrate, treat, and/or store rainwater where it falls. Permeable pavements may be constructed from pervious concrete, porous asphalt, permeable interlocking pavers, and several other materials. These pavements are particularly cost effective where land values are high and where flooding or icing is a problem.

Green streets and alleys: Green streets and alleys integrate green infrastructure elements into the street and/or alley design design to store, infiltrate, and evapotranspire stormwater. Permeable pavement, bio-swailes, planter boxes, and trees are among the many green infrastructure features that may be woven into street or alley design.

Green parking: Many of the green infrastructure elements described above can be seamlessly integrated into parking lot designs. Permeable pavements can be installed in sections of a lot and rain gardens and bio-swales can be included in medians and along a parking lot perimeter. Benefits include urban heat island mitigation and a more walkable built environment.

Green roofs: Green roofs are covered with growing media and vegetation that enable rainfall infiltration and evapotranspiration of stored water. Green roofs are particularly cost effective in dense urban areas where land values are high and on large industrial or office buildings where stormwater management costs may be high.

Urban tree canopy: Many cities set tree canopy goals to restore some of the benefits provided by trees. Trees reduce and slow stormwater by intercepting precipitation in their leaves and branches. Homeowners, businesses, and cities can all participate in the planting and maintenance of trees throughout the urban environment.

Land conservation: Protecting open spaces and sensitive natural areas within and adjacent to cities can mitigate the water quality and flooding impacts of urban stormwater while providing recreational opportunities for city residents. Natural areas that are particularly important in addressing water quality and flooding include riparian areas, wetlands, and steep hillsides.

Source: EPA (n.d.a.)

APPENDIX C: Financing for Sewer Infrastructure Projects

The financing of major sewer infrastructure projects is a subject that is of interest both to academic researchers and local government leaders. Among the ways this attention manifests itself are finance manuals,²⁷ research centers,²⁸ and a range of academic papers.²⁹ From a value chain perspective, the financing for major sewer infrastructure projects is of only moderate importance, which is why analysis of the funding mechanisms for the cases studied was only mentioned in passing. However, innovative models such as the ones seen in cities such as Philadelphia and Louisville can influence the characteristics of the value chain.

Traditionally, cities have funded their investments through one of two primary sources: bonds and ratepayer increases, or Clean Water State Revolving Funds (CWSRF). When a city enters the bond market, it often pursues revenue bonds that are disbursed in increments over a set time period; sewer fees can then be used to pay off those bonds over time. On the other hand, CWSRFs are loans from the EPA that filter through states to local communities. Along the way, states are required to match 20% match of the original EPA amount, and cities and municipalities apply to either the state government or water authority for low-interest loans.

Local Level

The cities featured in this report all relied predominantly on local money. Brightwater was funded exclusively by Seattle-area residents—in addition to the standard sewer service fees, King County implemented a connection or capacity charge that billed new ratepayers a monthly fee for 15 years. In both Cleveland and Omaha, more than 90% of the total investment is being funded through municipal bonds and ratepayer increases. Project Clean Lake is receiving some federal and state loans through the Ohio Water Development Authority, which is the organization in the state of Ohio that handles the financial management of CWSRF funds (the Ohio EPA handles administrative control); in 2013, NEORS received a \$57.5 million loan from OWDA as part of the Dugway West Interceptor Relief Sewer project. Meanwhile, CSO Omaha is using \$55 million of CWSRF loans (administered in Nebraska by NDEQ) for its LTCP and smaller amounts of federal earmarks and stimulus money.

²⁷ The EFC (2014) manual highlighted in the discussion about the process framework (see page 2) can be viewed here: <http://efc.umd.edu/localgovernmentstormwaterfinancingmanual.html>.

²⁸ The Environmental Finance Center at the University of North Carolina-Chapel Hill has a robust program that researches investments in wastewater and drinking water with the aim of providing sustainable solutions for policy professionals. Its work can be seen here: <http://www.efc.sog.unc.edu/>.

²⁹ Megan Mullin of Duke University's Nicholas School of the Environment provided valuable research guidance for this report.

Stormwater Fees

As part of Philadelphia's emphasis on green infrastructure, the city instituted a stormwater utility fee that charges non-residential properties a fee based on the ratio of impervious surface area to total property area. In addition to the tax credit for permeable pavement and other green features as part of the parcel-based billing system, the PWD and the Philadelphia Industrial Development Corporation have implemented a Greened Acre Retrofit Program that offers grants to contractors to retrofit properties across the city. Those initiatives create demand in the private sector for businesses to provide aggregated green infrastructure management services, which, if they develop, creates the potential change the composition of the value chain.

APPENDIX D: Lead Firms by Category

Table 16: Top 20 Design & Planning Firms by Sewer and Water Infrastructure Revenue

Company	Headquarters	Employees	Primary Value Chain Activities	Estimated Revenue from Sewer Projects*	% of Total Revenue from Sewer Projects
CH2M Hill	Englewood, Colo.	30,000	E	\$502	14%
MWH Global	Broomfield, Colo.	7,000	E	\$367	39%
AECOM	Los Angeles	43,400	EA	\$290	4%
CDM Smith	Cambridge, MA	6,000	E	\$196	26%
Tetra Tech	Pasadena	14,000	E	\$178	7%
HDR	Omaha	6,000	EA	\$176	10%
Brown and Caldwell	Walnut Creek, CA	1,500	E	\$160	52%
URS Corp.^	San Francisco	54,000	E	\$158	3%
Black & Veatch	Overland Park, Kan.	9,600	E	\$156	12%
Hazen and Sawyer	New York City	1,500	E	\$113	70%
Arcadis US	Highlands Ranch, Colo.	4,000	E	\$111	8%
Parsons	Pasadena	11,500	E, H&C	\$105	7%
SCS Engineers	Long Beach, CA	685	EC	\$104	73%
Carollo Engineers	Walnut Creek, CA	660	E	\$95	61%
Jacobs Engineering Group	Pasadena	66,300	EA	\$68	1%
Greeley and Hansen	Chicago	350	E	\$68	90%
Hatch Mott Macdonald	Iselin, NJ	600	E	\$50	11%
Woodard & Curran	Portland, ME	180	E	\$42	29%
Burns & McDonnell	Kansas City	4,300	EA	\$31	3%
AMEC Americas	Alpharetta, GA	7,500	E	\$30	1%
NOTES & LEGEND					
E = Engineering; A = Architecture; C = Consulting. H&C=Heavy & Civil Contractors					
* = Revenues in USD millions; ^ = URS purchased by AECOM in 2014					

Source: Tulacz 2014a; One Source

Table 17: Top 20 Construction & Installation Firms by Sewer and Water Infrastructure Revenue

Company	Headquarters	Employees	Primary Value Chain Activities	Estimated Revenue from Sewer Projects*	% of Total Revenue from Sewer Projects
Layne Christensen	Woodlands, Texas	4,100	H&C, CMM	\$395	47%
Kiewit Corp	Omaha	14,700	H&C	\$324	3%
Garney Holding	Kansas City	950	H&C	\$188	30%
The Walsh Group	Chicago	6,000	H&C	\$161	4%
Balfour Beatty	Dallas	1,496	H&C	\$138	3%
Skanska	New York	7,400	H&C, CMM	\$134	2%
Tutor Perini	Sylmar, CA	10,206	H&C, ST	\$125	3%
Granite Construction	Watsonville, CA	4,000	H&C, CMM	\$113	5%
American Infrastructure	Worcester, PA	2,000	H&C, CMM	\$86	17%
Primoris Services Corporation	Dallas	1,279	H&C	\$78	4%
Kokosing Group	Westerville, Ohio	1,500	H&C, CMM, CMW, ERR	\$75	8%
McCarthy Building Companies	St. Louis	1,700	H&C	\$65	2%
Colas USA	Morristown, NJ	10,000	H&C, CMM	\$64	5%
Flatiron Construction	Firestone, Colo.	2,000	H&C, CMM	\$58	5%
Traylor Bros	Evansville, Ind.	1,075	H&C, ERR, CMW	\$54	17%
FH Paschen, SN Nielsen & Associates	Chicago	250	H&C	\$42	8%
Weeks Marine Inc.	Cranford, NJ	1,700	H&C, ERR, CMW	\$42	7%
Parsons	Pasadena	11,500	H&C, E	\$25	3%
Herzog Contracting	St. Joseph	75	ST; CMM	\$10	2%
Sundt Construction	Tempe	697	H&C	\$9	1%
NOTES & LEGEND					
H&C = Heavy & Civil Contractors; CMM = Construction Materials Manufacturing; ST = Specialty Trade Contractors; CMW = Construction Machinery/Materials Wholesalers; ERR = Construction Equipment Repair/Rentals					
* = Revenues in USD million					

Source: Tulacz 2014b; One Source

Table 18: Top 10 Mechanical Sub-Contractors by Sewer Infrastructure Revenue

Company	Headquarters	Employees	Estimated Revenue from Sewer Projects*	% of Total Revenue from Sewer Projects
Emcor Group	Norwalk, Conn.	27,000	\$257	4%
Foley Co.	Kansas City	400	\$42	40%
Northeast Remsco Construction	Farmingdale, NJ	288	\$36	20%
Worth & Co.	Pipersville, PA	200	\$33	22%
J.F. Ahern Co.	Fond du Lac, Wis.	250	\$26	12%
Murray Company	Rancho Dominguez, CA	120	\$22	10%
John E. Green	Highlands Park, Mich.	395	\$17	10%
Harris Companies	St. Paul	500	\$12	5%
Grunau	Oak Creek, Wis.	400	\$10	10%
Arden Building Companies	Pawtucket	200	\$9	10%

NOTE: * = Revenues in USD million

Source: Tulacz 2014c; One Source

Table 19: Top 10 Electrical Sub-Contractors by Sewer Infrastructure Revenue

Company	Headquarters	Employees	Estimated Revenue from Sewer Projects*	% of Total Revenue from Sewer Projects
Emcor Group	Norwalk, Conn.	27,000	\$257	4%
Greenstar^	Mt. Vernon, NY	1,900	\$117	15%
E-J Electrical Installation	Long Island City, NY	121	\$50	15%
Walker Engineering	Irving, Texas	500	\$38	20%
M.C. Dean	Dulles, VA	1,500	\$36	5%
Helix Electric	San Diego	2,000	\$35	10%
Guarantee Electrical	St. Louis	750	\$32	19%
Bergelectric Corp.	Los Angeles	1,900	\$26	5%
Wayne J. Griffin Electric	Holliston, MA	750	\$17	6%
Valley Electric	Everett, WA	401	\$17	20%

NOTES: * = Revenues in USD million; ^=Subsidiary of Tutor Perini

Source: Tulacz 2014c; One Source

APPENDIX E: Additional Information on Case Studies

CLEVELAND—Project Clean Lake

PROFILE

Agency: Northeast Ohio Regional Sewer District (NEORS D)

Years: 2011-2036

Cost: \$3 billion

Green Infrastructure Spending: \$100 million

Percentage of Total Spending on Green Infrastructure: 3.3%

Major Gray Features: Deep tunnels (51% of total investment); sewer improvements (16%), pump stations (12%), plant improvements (10%)

Green Infrastructure Features: Rain gardens, planter boxes, bio-swales, permeable pavement, green streets/alleys

Motivation: Consent Decree

Funding Mechanisms: Rate increases, Clean Water State Revolving Funds

BUSINESS OPPORTUNITY PROGRAM

Target for Targeted Business Program: Minority, Women and Small Business Enterprises (MWSBEs)

Participation Goals: 15% for program; 0-20% on most contracts

Resources that Assist Goal Setting: 2009 publication of Disparity Study, internal review of specification and targeted business database, meetings with prime contractors

Bid Discounts for Prime Contracts: No

Policies that Apply to Procurement Process: Subs must be identified in proposal

Support that Local Government Provides: Capacity building, matchmaking assistance

INSTALLATION

Contracts Reviewed: Euclid Creek storage tunnel (design & construction), Dugway East Interceptor, Dugway Storage Tunnel (design & construction), Southerly Plant Preliminary Design, Westerly Plant Improvement, E. 140th Consolidation, Union-Buckeye Green Infrastructure, Green Ambassador Slavic Village.

Lead Firms: Hatch Mott MacDonald (Dugway Storage Tunnel, Euclid Creek Storage Tunnel), MHW Americas (Dugway Storage Tunnel), McNally (Euclid Storage Tunnel), Kiewit (Dugway Storage Tunnel), Salini Impregilo (Dugway Storage Tunnel), S.A. Healy (Dugway Storage Tunnel).

Notable Characteristics: Project Clean Lake is notable for its focus on major gray infrastructure features. The project will construct seven tunnels ranging from two to five miles in length. NEORS D's 2010 disparity report also provides a foundation for helping the regional authority understand the skillsets of its targeted businesses.

Table 20: Targeted Business Participation in Project Clean Lake

Categories	Money Received	% of Total	Share	Number	Average Contract Value
Design & Planning					
Engineering	\$3,668,568	0.91%	4.97%	10	\$366,857
Architects	\$18,257	0.00%	0.02%	1	\$18,257
Surveying & mapping	\$1,459,289	0.36%	1.98%	6	\$243,215
Consultants	\$674,216	0.17%	0.91%	7	\$96,317
Materials & Components					
Construction machinery manufacturing	—	0%	0%	—	—
Construction materials manufacturing	\$1,791,978	0.44%	2.43%	3	\$597,326
Construction equipment repair/rentals	—	0%	0%	—	—
Nursery and garden supplier wholesalers	—	0%	0%	—	—
Construction materials wholesalers	\$2,533,359	0.63%	3.43%	4	\$633,340
Construction & Installation					
Construction management	\$185,100	0.05%	0.25%	1	\$185,100
Heavy & civil contracting	\$13,162,285	3.26%	17.84%	7	\$1,880,326
Specialty trade contractors	\$23,182,370	5.75%	31.42%	11	\$2,107,488
<i>Mechanical</i>	—	0%	0%	—	—
<i>Electrical</i>	\$2,410,090	0.60%	3.27%	3	\$803,363
<i>Concrete/demolition/site preparation</i>	\$18,762,620	4.65%	25.43%	5	\$3,752,524
<i>Excavation/foundation</i>	—	0%	0%	—	—
<i>Fence installation</i>	—	0%	0%	—	—
<i>Sheet metal</i>	\$1,811,760	0.45%	2.46%	2	\$905,880
<i>Other</i>	\$197,900	0.05%	0.27%	1	\$197,900
Maintenance & Monitoring					
Waste Management	—	0%	0%	—	—
Sewage Treatment	\$10,237,000	2.54%	13.87%	1	\$10,237,000
Landscaping	\$1,382,388	0.34%	1.87%	2	\$691,194
Supporting Industries					
Accounting	\$204,368	0.05%	0.28%	1	\$204,368
Administrative services	\$257,285	0.06%	0.35%	2	\$128,643
Lawyers	—	0%	0%	—	—
Public relations and advertising	\$52,564	0.01%	0.07%	1	\$52,564
Publishing	\$227,952	0.06%	0.31%	5	\$45,590
Photography	\$25,550	0.01%	0.03%	3	\$8,517
Real Estate	—	0%	0%	—	—
Security guard services	\$1,111,318	0.28%	1.51%	2	\$555,659
Trucking	\$13,615,722	3.37%	18.45%	6	\$2,269,287
TOTALS	\$73,789,568	18.3%	100%	73	\$1,010,816

LOUISVILLE—Project WIN

PROFILE

Agency: Metropolitan Sewer District (MSD)

Years: 2004-2024

Cost: \$850 million

Green Infrastructure Spending: \$47 million

Percentage of Total Spending on Green Infrastructure: 5.5%

Major Gray Features: Storage basins (66%), treatment plant upgrades (25%)

Green Infrastructure Features: Downspout disconnections, rainwater harvesting, rain gardens, bio-swales, permeable pavement, green streets/alleys, green roofs

Motivation: Consent Decree

Funding Mechanisms: Rate increases, stormwater fees

BUSINESS OPPORTUNITY PROGRAM

Target for Targeted Business Program: Minority and Women Business Enterprises (M/WBEs)

Participation Goals: 15% MBE, 6% WBE on most contracts

Resources that Assist Goal Setting: Internal review of specification and targeted business database, prime contractors can request a waiver of M/WBE requirements six days prior to bid opening date

Bid Discounts for Prime Contracts: No

Policies that Apply to Procurement Process: Subs must be identified in proposal, subs identified in proposal must be offered work, subs must self-perform at least 50% of contract

Support that Local Government Provides: Capacity building, matchmaking assistance

INSTALLATION

Contracts Reviewed: Green Assessments & MS4 Program, Green Infrastructure Assistance, Green Infrastructure Consulting, CSO Basin 130, Office of Employment Green Demonstration, Federal Building Green Demonstration, Magnolia Filtration Trench, Paris/Germantown Rain Garden, Adams St. Permeable Pavement, Congress Alley Green Street, Green Infrastructure maintenance, Kennedy Ct. Green Infrastructure, Green Alley Maintenance

Lead Firms: URS, Strand Associates, O'Brien & Gere, E-Z Construction, MAC Construction & Excavating, Basham Construction, Dropseed Nursery

Notable Characteristics: Louisville's targeted business participation rate (24.4%) was the highest of any of the cases studied. With some exceptions, the MSD attaches 15% MBE and 6% WBE participation targets to every contract over \$50,000.

Table 21: Targeted Business Participation in Project WIN

Categories	Money Received	% of Total	Share	Number	Average Contract Value
Design & Planning					
Engineering	\$865,551	9.84%	40.31%	10	\$86,555
Architects	\$104,157	1.18%	4.85%	2	\$52,078
Surveying & mapping	\$90,000	1.02%	4.19%	1	\$90,000
Consultants	\$212,145	2.41%	9.88%	7	\$30,306
Materials & Components					
Construction machinery manufacturing	—	0%	0%	—	—
Construction materials manufacturing	\$40,644	0.46%	1.89%	4	\$10,161
Construction equipment repair/rentals	—	0%	0%	—	—
Nursery and garden supplier wholesalers	\$72,732	0.83%	3.39%	4	\$18,183
Construction materials wholesalers	\$132,508	1.51%	6.17%	3	\$44,169
Construction & Installation					
Construction management	—	0%	0%	—	—
Heavy & civil contracting	—	0%	0%	—	—
Specialty trade contractors	\$128,921	1.47%	6.00%	5	\$25,784
<i>Mechanical</i>	—	0%	0%	—	—
<i>Electrical</i>	—	0%	0%	—	—
<i>Concrete/demolition/site preparation</i>	\$128,921	1.47%	6.00%	5	\$25,784
<i>Excavation/foundation</i>	—	0%	0%	—	—
<i>Fence installation</i>	—	0%	0%	—	—
<i>Sheet metal</i>	—	0%	0%	—	—
<i>Other</i>	—	0%	0%	—	—
Maintenance & Monitoring					
Waste Management	—	0%	0%	—	—
Sewage Treatment	—	0%	0%	—	—
Landscaping	\$12,180	0.14%	0.57%	3	\$4,060
Supporting Industries					
Accounting	—	0%	0%	—	—
Administrative services	—	0%	0%	—	—
Lawyers	—	0%	0%	—	—
Public relations and advertising	\$379,243	4.31%	17.66%	7	\$54,178
Publishing	\$40,600	0.46%	1.89%	2	\$20,300
Photography	—	0%	0%	—	—
Real Estate	—	0%	0%	—	—
Security guard services	—	0%	0%	—	—
Trucking	\$68,679	0.78%	3.20%	3	\$22,893
TOTALS	\$2,147,359	24.4%	100%	51	\$42,105

OMAHA—CSO Omaha

PROFILE

Agency: City of Omaha Public Works

Years: 2009-2027

Cost: \$2.081 billion

Green Infrastructure Spending: \$50 million

Percentage of Total Spending on Green Infrastructure: 2.4%

Major Gray Features: Sewer separation (26% of total investment), deep tunnels (19%), sewer improvements (10%), treatment plant upgrades (8%)

Green Infrastructure Features: Downspout disconnections, rain gardens, planter boxes, bio-swales, permeable pavement, green streets/alleys, land conservation

Motivation: Consent Decree

Funding Mechanisms: Rate increases, Clean Water State Revolving Funds

BUSINESS OPPORTUNITY PROGRAM

Target for Targeted Business Program: Small and Emerging Small Businesses (SEBs)

Participation Goals: 15% city-wide program goal; 9-10% on most contracts

Resources that Assist Goal Setting: Internal review of specifications and targeted business database, prime contractors can request change to participation goals prior to last addenda during review (5-7 days before bid day)

Bid Discounts for Prime Contracts: No

Policies that Apply to Procurement Process: Subs must be identified in proposal, subs identified in proposal must be offered work, subs must self-perform at least 50% of contract, targeted business set-asides

Support that Local Government Provides: Capacity building, matchmaking assistance

INSTALLATION

Contracts Reviewed: OPW 51875 (construction and engineering); OPW 51962 (construction and engineering).

Lead Firms: CH2M Hill, Hawkins Construction, Roloff Construction

Notable Characteristics: Omaha has the most stringent classifications for size standards attached to its targeted business program, which means the lower participation rate was not altogether unexpected.

Table 22: Targeted Business Participation in CSO Omaha

Categories	Money Received	% of Total	Share	Number	Average Contract Value
Design & Planning					
Engineering	\$32,080	0.04%	0.43%	1	\$32,080
Architects	—	0%	0%	—	—
Surveying & mapping	\$23,080	0.03%	0.31%	3	\$23,080
Consultants	\$9,000	0.01%	0.12%	1	\$9,000
Materials & Components					
Construction machinery manufacturing	—	0%	0%	—	—
Construction materials manufacturing	—	0%	0%	—	—
Construction equipment repair/rentals	—	0%	0%	—	—
Nursery and garden supplier wholesalers	—	0%	0%	—	—
Construction materials wholesalers	—	0%	0%	—	—
Construction & Installation					
Construction management	—	0%	0%	—	—
Heavy & civil contracting	\$2,141,513	2.84%	28.46%	1	\$2,141,513
Specialty trade contractors	\$5,158,069	6.83%	68.55%	4	\$5,158,069
<i>Mechanical</i>	\$4,384,066	5.80%	58.26%	1	\$4,384,066
<i>Electrical</i>	—	0%	0%	—	—
<i>Concrete/demolition/site preparation</i>	\$744,778	0.99%	9.90%	2	\$744,778
<i>Excavation/foundation</i>	—	0%	0%	—	—
<i>Fence installation</i>	\$29,225	0.04%	0.39%	1	\$29,225
<i>Sheet metal</i>	—	0%	0%	—	—
<i>Other</i>	—	0%	0%	—	—
Maintenance & Monitoring					
Waste Management	—	0%	0%	—	—
Sewage Treatment	—	0%	0%	—	—
Landscaping	\$161,154	0.21%	2.14%	1	\$161,154
Supporting Industries					
Accounting	—	0%	0%	—	—
Administrative services	—	0%	0%	—	—
Lawyers	—	0%	0%	—	—
Public relations and advertising	—	0%	0%	—	—
Publishing	—	0%	0%	—	—
Photography	—	0%	0%	—	—
Real Estate	—	0%	0%	—	—
Security guard services	—	0%	0%	—	—
Trucking	—	0%	0%	—	—
TOTALS	\$7,524,896	9.96%	100%	11	\$684,081

PHILADELPHIA—Green City, Clean Waters

PROFILE

Agency: Philadelphia Water Department

Years: 2011-2036

Cost: \$2.4 billion

Green Infrastructure Spending: \$1.6 billion

Percentage of Total Spending on Green Infrastructure: 69.6%

Major Gray Features: Treatment plant upgrades (14% of total investment)

Green Infrastructure Features: Downspout disconnections, rainwater harvesting, rain gardens, planter boxes, bio-swales, permeable pavement, green streets/alleys, green pavements, urban tree canopies, land conservation

Motivation: Agreement with EPA

Funding Mechanisms: Rate increases, Clean Water State Revolving Funds, stormwater fees

BUSINESS OPPORTUNITY PROGRAM

Target for Targeted Business Program: Minority, Women, Disabled Business Enterprises (M/W/DSBEs); Local Business Enterprises

Participation Goals: 30% city-wide M/W/DSBE program goal, 10-40% on most contracts

Resources that Assist Goal Setting: Publication of Economic Opportunity Strategic Plan, development of Participation Plan, implementation of improved data collection, annual disparity studies, internal review of specifications and targeted business database

Bid Discounts for Prime Contracts: LBEs receive 5% preference

Policies that Apply to Procurement Process: Bid discount for prime contracts, subs must be identified in proposal

Support that Local Government Provides: Project Labor Agreement, Capacity building, matchmaking assistance

INSTALLATION

Contracts Reviewed: Water Resource Consultant (Contract #102026804), Sustainable Organization (#1320541), Stormwater Plan Review (#112016203), General Engineering for Treatment Plant (#1220480), GSI Green Infrastructure (#1320353), Treatment Plant Engineering (#122027701), JPC Group (#134037), C&T Associates (#134068), AP Construction (#134128)

Lead Firms: CDM Smith, Duffield Associates, Arcadis, AKRF, Black & Veatch, JPC Group, C&T Associates, AP Construction.

Notable Characteristics: The size of Philadelphia's investment in green infrastructure is unique; in time, the scale of the expenditure could allow for the development of businesses specializing in green infrastructure retrofits. Philadelphia is also a leader in initiating studies to better understand the capabilities of its targeted businesses, publishing annual disparity reports.

Table 23: Targeted Business Participation in Green City, Clean Waters

Categories	Money Received	% of Total	Share	Number	Average Contract Value
Design & Planning					
Engineering	\$855,361	2.13%	11.00%	6	\$142,560
Architects	\$200,000	0.50%	2.57%	3	\$66,667
Surveying & mapping	\$612,975	1.53%	7.88%	4	\$153,244
Consultants	\$1,124,466	2.80%	14.46%	10	\$112,447
Materials & Components					
Construction machinery manufacturing	—	0%	0%	—	—
Construction materials manufacturing	—	0%	0%	—	—
Construction equipment repair/rentals	—	0%	0%	—	—
Nursery and garden supplier wholesalers	—	0%	0%	—	—
Construction materials wholesalers	\$12,000	0.03%	0.15%	1	\$12,000
Construction & Installation					
Construction management	—	0%	0%	—	—
Heavy & civil contracting	\$1,466,000	3.65%	18.86%	1	\$1,466,000
Specialty trade contractors	\$2,957,581	7.37%	38.04%	7	\$422,512
<i>Mechanical</i>	—	0%	0%	—	—
<i>Electrical</i>	—	0%	0%	—	—
<i>Concrete/demolition/site preparation</i>	\$2,900,081	7.23%	37.30%	5	\$580,016
<i>Excavation/foundation</i>	\$48,000	0.12%	0.62%	1	\$48,000
<i>Fence installation</i>	—	0%	0%	—	—
<i>Sheet metal</i>	—	0%	0%	—	—
<i>Other</i>	\$9,500	0.02%	0.12%	1	\$9,500
Maintenance & Monitoring					
Waste Management	—	0%	0%	—	—
Sewage Treatment	—	0%	0%	—	—
Landscaping	—	0%	0%	—	—
Supporting Industries					
Accounting	—	0%	0%	—	—
Administrative services	—	0%	0%	—	—
Lawyers	—	0%	0%	—	—
Public relations and advertising	\$60,000	0.15%	0.77%	1	\$60,000
Publishing	\$10,000	0.02%	0.13%	1	\$10,000
Photography	—	0%	0%	1	\$60,000
Real Estate	—	0%	0%	—	—
Security guard services	—	0%	0%	—	—
Trucking	\$476,210	1.19%	6.13%	2	\$476,210
TOTALS	\$7,774,593	19.4%	100%	36	\$215,961

SAN FRANCISCO—Sewer System Improvement Project (SSIP)

PROFILE

Agency: San Francisco Public Utility Commission (SFPUC)

Years: 2012-2032

Cost: \$6.933 billion

Green Infrastructure Spending: \$57 million

Percentage of Total Spending on Green Infrastructure: 0.8%

Major Gray Features: Treatment plant upgrades (53%), collection system improvements (40%)

Green Infrastructure Features: Rain gardens, planter boxes, bio-swales, permeable pavement, green streets/alleys

Motivation: Age of system

Funding Mechanisms: Rate increases, Clean Water State Revolving Funds

BUSINESS OPPORTUNITY PROGRAM

Target for Targeted Business Program: Local Business Enterprises (LBEs)

Participation Goals: N/A

Resources that Assist Goal Setting: Implementation of improved data collection (LBE Utilization Tracking System), compliance officers meet with Project Managers to set LBE goal on project specifications and review targeted business database

Bid Discounts for Prime Contracts: 10% on certain contracts for LBEs, 2% on some contracts for SBAs

Policies that Apply to Procurement Process: Bid discounts for prime opportunities, subs must be identified in proposal, targeted business set-asides, incentives for Joint Ventures

Support that Local Government Provides: Project Labor Agreement, capacity building, matchmaking assistance

INSTALLATION

Contracts Reviewed: Southeast Plant Biosolids Digester Facilities project (CS-235), SSIP Program Management services (CS-165)³⁰

Lead Firms: Brown and Caldwell, AECOM, Parsons

Notable Characteristics: The SFPUC has developed a TBL methodology for SSIP that will evaluate proposals against 19 variables that correspond with the social, environmental and financial pillars of the framework.

³⁰ As of publication of this report, none of the individual projects associated with SSIP had advanced to the construction phase. Partially for this reason, the tables for targeted business participation featured in the Appendix and the Installation section of the main report are best used for descriptive and not comparative purposes.

Table 24: Targeted Business Participation in SSIP

Categories	Money Received	% of Total	Share	Number	Average Contract Value
Design & Planning					
Engineering	\$6,183,000	2.69%	17.46%	6	\$1,030,500
Architects	\$150,000	0.07%	0.42%	1	\$150,000
Surveying & mapping	\$736,000	0.32%	2.08%	1	\$736,000
Consultants	\$5,848,000	2.54%	16.51%	5	\$1,169,600
Materials & Components					
Construction machinery manufacturing	—	0%	0%	—	—
Construction materials manufacturing	—	0%	0%	—	—
Construction equipment repair/rentals	—	0%	0%	—	—
Nursery and garden supplier wholesalers	—	0%	0%	—	—
Construction materials wholesalers	—	0%	0%	—	—
Construction & Installation					
Construction management	\$13,944,000	6.06%	39.37%	8	\$1,743,000
Heavy & civil contracting	—	0%	0%	—	—
Specialty trade contractors	—	0%	0%	—	—
<i>Mechanical</i>	—	0%	0%	—	—
<i>Electrical</i>	—	0%	0%	—	—
<i>Concrete/demolition/site preparation</i>	—	0%	0%	—	—
<i>Excavation/foundation</i>	—	0%	0%	—	—
<i>Fence installation</i>	—	0%	0%	—	—
<i>Sheet metal</i>	—	0%	0%	—	—
<i>Other</i>	—	0%	0%	—	—
Maintenance & Monitoring					
Waste Management	—	0%	0%	—	—
Sewage Treatment	—	0%	0%	—	—
Landscaping	—	0%	0%	—	—
Supporting Industries					
Accounting	—	0%	0%	—	—
Administrative services	\$2,850,000	1.24%	8.05%	1	\$2,850,000
Lawyers	—	0%	0%	—	—
Public relations and advertising	\$4,602,000	2.00%	12.99%	5	\$920,400
Publishing	\$1,106,000	0.48%	3.12%	3	\$368,667
Photography	—	0%	0%	—	—
Real Estate	—	0%	0%	—	—
Security guard services	—	0%	0%	—	—
Trucking	—	0%	0%	—	—
TOTALS	\$35,419,000	15.4%	100%	30	\$1,180,633

SEATTLE—King County Brightwater Treatment and Conveyance System

PROFILE

Agency: King County Wastewater Treatment Division

Years: 2000-2014

Cost: \$1.859 billion

Green Infrastructure Spending: \$31 million

Percentage of Total Spending on Green Infrastructure: 1.7%

Major Gray Features: New treatment plant (46%), conveyance system (52%)

Green Infrastructure Features: Bio-swales, urban tree canopy, land conservation

Motivation: Capacity issues

Funding Mechanisms: Implementation of connection charge

BUSINESS OPPORTUNITY PROGRAM

Target for Targeted Business Program: Small Economically Disadvantaged Business Program/Small Contractors and Suppliers program.

Participation Goals: State law at the time of Brightwater prevented King County from installing mandatory participation targets, although the WTD did attach voluntary goals of 5-15%.

Resources that Assist Goal Setting: Internal review of specifications and targeted business database

Bid Discounts for Prime Contracts: No

Policies that Apply to Procurement Process: Subs must be identified in proposal, targeted business set-asides, subs must self-perform at least 50% of contract.

Support that Local Government Provides: Project Labor Agreement, capacity building, matchmaking assistance

INSTALLATION

Records Reviewed: Treatment Plant—design engineering, architecture, program support, liquids facility construction, solids facility construction; Conveyance System—geotechnical, design engineer, predesign engineer, tunnel engineer, Marine Outfall engineering/construction (design-build), East Tunnel construction, Central Tunnel construction, Central Tunnel completion, West Tunnel construction, Influent Pump station construction

Lead Firms: CH2M Hill, Mithun, URS, CDM Smith, HDR, Jacobs Civil, Hoffman Construction, Kiewit Pacific, Vinci Grand Projets, Parsons, Frontier-Kemper, Jay Dee, Coluccio, Taisei Corporation

Notable Characteristics: The King County WTD instituted a PLA for Brightwater and set up a service where the agency helped coach potential contractors through the requirement. Brightwater project managers reported that some smaller companies remained hesitant to sign PLA related documents even after making use of the mentorship King County provided.

Table 25: Targeted Business Participation on Brightwater

Categories	SEA ³¹
Design & Planning	
Engineering	X
Architects	X
Surveying & mapping	X
Consultants	X
Materials & Components	
Construction machinery manufacturing	
Construction materials manufacturing	
Construction equipment repair/rentals	
Nursery and garden supplier wholesalers	X
Construction materials wholesalers	X
Construction & Installation	
Construction management	X
Heavy & civil contracting	X
Specialty trade contractors	X
<i>Mechanical</i>	X
<i>Electrical</i>	
<i>Concrete/demolition/site preparation</i>	X
<i>Excavation/foundation</i>	
<i>Fence installation</i>	
<i>Sheet metal</i>	
<i>Other</i>	X
Maintenance & Monitoring	
Waste Management	
Sewage Treatment	X
Landscaping	
Supporting Industries	
Accounting	X
Administrative services	
Lawyers	
Public relations and advertising	X
Publishing	
Photography	
Real Estate	X
Security guard services	
Trucking	X

³¹ While King County WTD was able to provide a list of sub-contractors, individual contract values for sub-contractors associated with Brightwater were unavailable.

Table 26: Value of Prime Contracts for Brightwater by Category

Account	Treatment Plant	Conveyance System	Total
Engineering	\$60,385,391	\$62,866,401	\$123,251,792
Professional services	\$3,784,917	\$7,650,962	\$11,435,878
Consulting services	\$2,712,750	\$1,597,451	\$4,310,201
Machinery/equipment	\$27,876,204	\$1,675,650	\$29,551,854
Materials testing	\$2,556,541	\$557,248	\$3,113,789
Construction engineering	\$17,325,305	\$22,306,129	\$39,631,434
Construction planning	\$1,932,056	—	\$1,932,056
Construction management	\$20,094,543	\$64,234,531	\$84,329,074
Construction	\$454,233,210	\$713,360,543	\$1,167,593,753
Construction mitigation	\$24,883,237	\$4,038,819	\$28,922,055
Utility relocation	\$5,923,124	\$4,573,824	\$10,496,948
Miscellaneous*	\$11,566	\$3,515	\$15,081
TOTAL	\$621,718,844	\$882,865,072	\$1,504,583,916

NOTES

* = Smaller consultants/contractors were combined by King County WTD into a category called Miscellaneous

Source: King County WTD

APPENDIX F: Key Characteristics of Sewer Infrastructure Occupations

Table 27: Sewer Infrastructure Occupations

Occupation		Occupational Characteristics		
CPS Code	Occupational Title	Median hourly wage	Projected Employment Growth 2012-2022	Workers with High School diploma or less
17-2081	Environmental Engineers	\$39.53	15%	4%
19-3051	Urban and Regional Planners	\$31.56	10%	0%
13-1199	Business Operations Specialists, All Other (Environmental auditors)	\$31.78	7%	14%
19-1031	Conservation Scientists	\$29.43	1%	0%
19-4093	Forest and Conservation Technicians	\$16.79	-4%	17%
17-3025	Environmental Engineering Technicians	\$22.19	18%	27%
17-1011	Architects, Except Landscape and Naval	\$35.63	17%	2%
17-1012	Landscape Architects	\$31.15	14%	2%
19-2043	Hydrologists	\$36.40	10%	0%
17-3011	Architectural and Civil Drafters	\$23.46	1%	13%
17-2051	Civil Engineers	\$38.83	20%	3%
17-3022	Civil Engineering Technicians	\$22.97	1%	27%
47-2221	Structural Iron and Steel Workers	\$22.36	22%	66%
51-4041	Machinists	\$19.03	9%	56%
51-2041	Structural Metal Fabricators and Fitters	\$17.49	8%	62%
51-4121	Welders, Cutters, Solderers, and Brazers	\$17.66	6%	72%
51-1011	First-Line Supervisors of Production and Operating Workers	\$26.29	-2%	49%
37-3012	Pesticide Handlers, Sprayers, and Applicators, Vegetation	\$14.82	11%	75%
45-1011	First-Line Supervisors of Farming, Fishing, and Forestry Workers	\$20.90	-3%	60%

Occupation		Occupational Characteristics		
45-2092	Farmworkers and Laborers, Crop, Nursery, and Greenhouse	\$9.00	-5%	83%
47-2152	Plumbers, Pipefitters, and Steamfitters	\$24.13	21%	63%
37-3011	Landscaping and Groundskeeping Workers	\$11.51	12%	75%
47-4011	Construction and Building Inspectors	\$26.18	12%	28%
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	\$16.80	6%	49%
13-1041	Compliance Officers	\$30.93	5%	12%
47-3015	Helpers--Pipelayers, Plumbers, Pipefitters, and Steamfitters	\$13.19	28%	79%
47-2111	Electricians	\$24.28	20%	47%
47-2051	Cement Masons and Concrete Finishers	\$17.37	29%	85%
47-2061	Construction Laborers	\$14.64	24%	74%
47-2071	Paving, Surfacing, and Tamping Equipment Operators	\$18.16	20%	82%
47-2073	Operating Engineers and Other Construction Equipment Operators	\$20.45	19%	75%
11-9021	Construction Managers	\$40.58	16%	34%
17-3031	Surveying and Mapping Technicians	\$19.55	14%	31%
17-1022	Surveyors	\$27.21	10%	0%
47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	\$29.03	24%	56%
47-2151	Pipelayers	\$17.44	21%	63%
47-2073	Operating Engineers and Other Construction Equipment Operators	\$20.45	19%	75%
47-2031	Carpenters	\$19.47	24%	67%
37-3013	Tree Trimmers and Pruners	\$15.67	19%	75%

Occupation		Occupational Characteristics		
37-1012	First-Line Supervisors of Landscaping, Lawn Service, and Groundskeeping Workers	\$20.47	13%	49%
37-3019	Grounds Maintenance Workers, All Other	\$13.52	10%	75%
51-8031	Water and Wastewater Treatment Plant and System Operators	\$20.77	8%	43%
47-4071	Septic Tank Servicers and Sewer Pipe Cleaners	\$16.60	26%	63%
47-2031	Carpenters	\$19.47	24%	67%
11-1021	General and Operations Managers	\$46.36	12%	18%
37-2011	Janitors and Cleaners, Except Maids and Housekeeping Cleaners	\$10.86	12%	72%
49-9071	Maintenance and Repair Workers, General	\$17.14	9%	58%
51-8021	Stationary Engineers and Boiler Operators	\$26.26	3%	46%
49-9012	Control and Valve Installers and Repairers, Except Mechanical Door	\$25.47	-1%	53%
43-5041	Meter Readers, Utilities	\$17.51	-19%	47%

Source: BLS, 2013.