Water Use Efficiency and Jobs

Economic Roundtable
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Patrick Burns and Daniel Flaming

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ECONOMIC ROUNDTABLE
A Nonprofit, Public Policy Research Organization
315 West Ninth Street, Suite 1209, Los Angeles, California 90015
www.economicrt.org

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Project Funders

Community Development Department and Workforce Investment Board, City of Los Angeles
Piping Industry Progress and Education Fund
International Association of Plumbing and Mechanical Officials
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Project Advisory Group

Paula Daniels
Senior Advisor on Food Policy, Special Projects in Water,
Office of Mayor Antonio Villaraigosa, City of Los Angeles

Mark Hanna, Associate, GeoSyntec Consultants, formerly of LADWP

Steve Bilson, Founder and Chief Executive Officer, ReWater

Caryn Mandelbaum, Freshwater Program Director, Environment Now

Cecilia V. Estolano, Estolano LeSar Perez Advisors

Nancy Steele, Executive Director, Council for Watershed Health

Shelley Luce, Executive Director, Santa Monica Bay Restoration Foundation

Data Providers

Ding Lee, Bureau of Engineering, City of Los Angeles
Edith de Guzman, TreePeople
Gil Crozes, Carollo Construction Engineers
Ken Deck, Rowland Water District
Leighanne Kirk, West Basin Municipal Water District
Marcus Castain, Generation Water
Mark Hanna, GeoSyntec
Michael Drennan, Weston Solutions
Nancy Steele and Edward Belden, Council for Watershed Health
Paula Daniels, Office of the Mayor of Los Angeles
Penny Falcon, Water Conservation, LA City Department of Water and Power
Rosa Castro, Metropolitan Water District
Shelley Luce, Santa Monica Bay Restoration Foundation
Sharon Green, Sanitation Districts of Los Angeles County
Steve Bilson, ReWater
Wendy Young, Department of Water and Power, City of Los Angeles

Feedback Contribution and Planning Meeting Attendees

Amir Tabakh, Department of Water and Power, City of Los Angeles
Angela Rashid, UCLA Urban Planning student, Green for All intern
Annabelle Garcia, Customer Service Division, Department of Water and Power, City of Los Angeles
Beth Jines, Mayor's Office, City of Los Angeles
Bill Luddy, Legal and Political Director, SW Regional Council, United Brotherhood of Carpenters
Blanche Burke, Community Development Department, City of Los Angeles
Celeste Cantu, Santa Ana Watershed Protection Authority

Claire Robinson, Amigos de los Rios
Edward Belden, formerly of the Los Angeles & San Gabriel Rivers Watershed Council
Elizabeth Willis, Mayor's Office, City of Los Angeles
Frank Pasker, Architect, Dvoretzky Bardovi Bunnell Architects
Gregory Irish, Workforce Investment Board; Community Development Department, City of Los Angeles:
Heather Cooley, Pacific Institute
James Maughan, Asst. Deputy Director, Div. of Fin. Assistance, State Water Resources Control Board
Jim Kemper, Department of Water and Power, City of Los Angeles
Jonathan Parfrey, Commissioner, Department of Water and Power, City of Los Angeles, Green LA Coalition
Kelli Bernard, Department of Water and Power, City of Los Angeles
Larry Frank, Deputy Mayor, City of Los Angeles
Larry McKenney, RBF Consulting / Moulton Niguel Water District
Laurie Kaye Nijaki, Provost Fellow, University of Southern California
Leneyde Chavez, Carollo Engineers, Inc.
Lenise Marrero, Wastewater Division, Bureau of Sanitation, Department of Public Works, City of Los Angeles
Margarita Gamero, Piping Industry Progress and Education Trust Fund
Mark Gold, Health the Bay
Mark Horne, EIP Associates
Mark Norton, Santa Ana Watershed Protection Authority
Martha Davis, Policy Development, Inland Empire Utilities Agency
Mia Lehrer, Mia Leherer + Associates
Michael Brown, Bureau of Engineering, Department of Public Works, City of Los Angeles
Michael Gagan, Rose & Kindel
Michael Prlich, MPS Construction Inc.
Michael Scaduto, Bureau of Sanitation, Department of Public Works, City of Los Angeles
Michael Winters, Water Solutions for Life, MW Environmental Technology
Mike Antos, Council for Watershed Health
Mike Massey, Piping Industry Progress & Education Trust Fund; Nat'l Inspection, Testing, Certification Corp.
Miu-Ying Tam, Bureau of Engineering, Department of Public Works, City of Los Angeles
Pamela Berstler, G3, The Green Gardens Group
Paul Herzog, Ocean Friendly Gardens Program Coordinator, Surfrider Foundation
Paul Liu, Department of Water and Power, City of Los Angeles
Rob Katherman, Water Replenishment District of Southern California
Robert Bernal, Community Development Department, City of Los Angeles
Robert Denver Smith, Painters and Allied Trades Local 36
Robert Sainz, Community Development Department, City of Los Angeles
Ron Maben, PSOMAS - Planning and Entitlements
Russ Chaney, International Association of Plumbing and Mechanical Officials
Russell Horning, Assistant Project Manager, Abode Communities
Shahram Kharaghani, Stormwater, Bureau of Sanitation, Department of Public Works, City of Los Angeles
Shelley Larson, California Stormwater Quality Association (CASQA)
Stella Catanzarite, Harbor Region, Community Development Department, City of Los Angeles
Steve Lehtonen, Internat'l Assoc. of Plumbing & Mechanical Officials
Susan Lien Longville, Water Resources Institute, California State University San Bernardino
Suzanne Dallman, Department of Geography, California State University Long Beach
Tom Polansky, Director of Facilities Management, Abode Communities
Tori Kjer, Project Manager - Parks for People, The Trust for Public Land
Traci Minamide, Bureau of Sanitation, Department of Public Works, City of Los Angeles
Wilson Fong, Department of Public works, Los Angele County

About this Study

This report grew out of conversations in late 2009 between Paula Daniels, then serving as a Commissioner on the City of Los Angeles Board of Public Works, and Dan Flaming, President of the Economic Roundtable about the need for an *economic* analysis of an emerging growth sector: Water Use Efficiency. This phrase refers to the suite of activities that make our water use more efficient, including recycled water use, stormwater capture and reuse (also known as rainwater harvesting), groundwater clean-up and remediation, and water conservation measures, including graywater systems.

Paula and Dan shared their idea with prospective funders, who pooled scarce resources to make this research project possible. These funders – the City of Los Angeles' Community Development Department and Workforce Investment Board, the Piping Industry Progress and Education Fund, the International Association of Plumbing and Mechanical Officials, and the National Inspection, Testing, Certification Corporation – patiently supported this project's data gathering process, data analysis and report writing, while also allowing us to carry out the research independently.

Initial work on this study required a change in approach due to limited data availability about individual companies that make up Los Angeles' water sector, and instead focused on data that was available: detailed project budgets of local water efficiency investments. These data on various 'water projects' became a central focus of the study, allowing us to calculate the economic and job impacts of five categories of water use efficiency investments: *Stormwater*, *Recycled Water*, *Groundwater / Remediation*, *Water Conservation* and *Graywater Systems*.

An advisory group of Los Angeles area water advocates stepped forth to share their knowledge about building an infrastructure for water use efficiency. (See names in the preceding *Acknowledgements* page.) Their collective spirit, support, and belief in the changes needed to make Los Angeles' water resource use sustainable made this project possible.

While the study was in progress, the advisory group introduced the Economic Roundtable to staff of several public water agencies, as well as non-profit, labor and business leaders, in order to obtain budget data on local water projects. This outreach was invaluable for extending relationships of trust that allowed us access to water projects budget data, broadening and improving the analysis we then undertook.

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WATER USE EFFICIENCY AND JOBS

Introduction

At the peak of California's most recent drought in 2009, the Los Angeles economy was in severe recession, with unemployment above 12 percent.[1] These twin crises identified a policy opportunity to tackle both challenges together. Public investments in water use efficiency provide economic and job benefits alongside the environmental benefits from using less water. This report quantifies the economic and job benefits that result from investments in water use efficiency in Los Angeles.

Los Angeles is a major net importer of water and relies on sources several hundred miles away in Northern California and Colorado for two-thirds of its supply. The ecosystems of these source regions are significantly impacted by decades of diverting water for agricultural, industrial and municipal use. Combined with the periodic droughts afflicting the Southwest U.S., these circumstances put Los Angeles under increasing pressure to reduce reliance on imported water by using what we have more efficiently.

> *Water Use Efficiency* refers to the suite of activities that make our use of water more efficient, including using recycled water, capturing and reusing stormwater (also known as rainwater harvesting), cleaning-up and remediating groundwater, and conserving water, including graywater.

Significant investments by public agencies that build on previous efforts are required to achieve needed gains in water use efficiency. These investments take the form of stormwater capture and treatment infrastructure, groundwater treatment equipment and recharge systems, graywater systems for homes, sub-metering multi-family housing, water de-salting facilities, indoor appliance/fixture retrofit campaigns, ecosystem restoration, and irrigation system evaluation and repair.[2]

As dollars are spent on specialized civil engineering and construction services, the multiplier effects ripple through the local economy benefitting a wide range of employers that provide supplies and support for water use efficiency. Water use efficiency investments and their subsequent multiplier effects are quantifiable, enabling us to estimate the amount of business sales stimulated, numbers of jobs supported, top occupations hired, and average wages paid. Using this information, we identify clusters of jobs that offer career ladders to hopeful workers, industry trends of growth and decline, and opportunities for local business expansion.

We present this information in two ways. First we analyze Los Angeles' water *sector* – the establishments[3] that provide goods and services that directly build and maintain municipal

water infrastructure, manufacture specialized water systems equipment, provide engineering consulting services, and provide support services for these direct providers. Second, we analyze over 50 recent water use efficiency *projects* in the Los Angeles region, detailing their supplier networks and multiplier effects.

Los Angeles' Water Sector

Los Angeles' emerging water sector establishments do not have a separate industry code that would enable researchers and public agencies to quickly identify how many establishments are located here, how many people they employ, or other characteristics. To fill this gap, this study identifies six "*first tier*" industries that *capture* the businesses that build, operate and maintain our region's water and sewage system infrastructure, manufacture water systems equipment, and engineer improvements in water use efficiency. Within the first tier, the local *Water Systems Operations* and *Sewage Treatment* industries employ just over 7,500 workers countywide, adding about 38 employees per year since 1996. *Manufacturing* industries in the water sector are smaller and have declined since 1996. Average annual salaries of workers in these first tier industries range from $49,000 to $84,000. The annual direct sales (output) of establishments in Los Angeles' first tier water sector industries amount to $2.7 billion. Los Angeles shows competitive strength in the *Water Supply and Irrigation Systems* and *Sewage Treatment Facility* industries with a high share of its labor force employed in these industries compared to the nation as a whole.

Second tier industries indirectly support Los Angeles' water sector by supplying goods and services to municipal water utilities as well as water and wastewater industries.[4] Second tier industries have total employment of over 150,000 workers in Los Angeles County, with estimated annual direct sales (output) of $32.5 billion. The largest industries in this set include: professional services (*Engineering Services, Physical Sciences Research and Development,* and *Guidance Instrument Manufacturing*) that employ 64,258 workers countywide, and blue collar services (*Electrical Contractors, Plumbing, Piping, and Heating-Ventilation-Air-Conditioning (HVAC) Contractors,* and *Landscaping Services*) that employ 43,220 workers countrywide. The professional services industries pay an average salary exceeding $100,000 per year, while the blue-collar services pay wages that typically are less than $50,000 per year.

Jobs and Occupations in Los Angeles' Water Sector

Fourteen occupations in the Los Angeles economy are strongly involved with water use efficiency efforts. The jobs range from building and operating water infrastructure to researching and managing urban landscapes. They provide an estimated 34,350 jobs in Los Angeles County, or approximately one percent of the county's total employed workforce. Their mean wages vary from $13.65 to $47.80 per hour, or $28,390 to $99,430 annually. While some of these occupations are already common in the local economy, Los Angeles is under-represented in several of them compared with the nation's workforce. Relative underemployment indicates an opportunity for job growth, especially if we maintain or increase local investments in water use efficiency.

Four occupational clusters with potential career ladders for aspiring workers are identified for local workforce development agencies to utilize (Table A). These occupational clusters each currently employ 10,000 or more workers in Los Angeles County, across a total of 34 detailed occupations. Each cluster's career ladder starts with entry-level occupations with relatively low education, related work and skill level requirements on the bottom rung, and progresses to higher wage occupations on the top rung. One professional cluster, *Architecture and Engineering Workers*, employs workers who pursue university-level education that enables them to plan Los Angeles' water use efficiency future.

Table A
Occupational Clusters with Potential Career Ladders in Los Angeles' Water Efficiency Sector

Occupational Clusters	Number of Occupations	Current Employment	Mean Hourly Wage
Building & Grounds/Forest & Conservation Workers	6	23,590 Jobs	$14.49 / hr.
Construction Workers	16	71,220 Jobs	$24.89 / hr.
Maintenance and Repair Workers	6	12,480 Jobs	$22.26 / hr.
Architecture and Engineering Workers	6	10,020 Jobs	$40.64 / hr.

Source: Economic Roundtable analysis, U.S. Bureau of Labor Statistics. 2011. *Occupational Employment and Wages, May 2010*. Washington, D.C. O*NET, U.S. Department of Labor, Employment and Training Administration. 2011. *O*NET Version 15.0 Databases*: Education, Training & Experience and Skills Tables.

Impacts of Recent Water Use Efficiency Projects in Los Angeles

We studied over $1.2 billion of investments in recent water use efficiency projects in the Los Angeles area, including a sample of 53 recent local *Stormwater*, *Water Conservation*, *Graywater*, *Groundwater Management / Remediation* and *Recycled Water* projects, to find how they affect the local economy. This cumulative *direct* investment stimulated an additional:

- $534 million in *indirect* sales – The "upstream" demand stimulated for materials and services used in the projects.
- $718 million in *induced* sales – The "downstream" demand stimulated by household spending of workers involved directly and indirectly in water conservation projects.
- $2.4 billion in *total* sales – Sum of the direct, indirect and induced sales stimulated by investments in these water use efficiency projects.

These 53 projects provided an estimated 8,654 *direct* person-years of employment[5] in Los Angeles. Those investments stimulated an additional:

- 3,016 *indirect* person-years of employment – Jobs added in "upstream" employers supplying goods and services to establishments directly carrying out the 53 projects.
- 4,909 *induced* person-years of employment – Jobs added "downstream" in the local economy through induced spending by worker households.
- 16,579 *total* person-years of employment – Sum of the direct, indirect and induced employment stimulated by investments in these water use efficiency projects.

These *indirect* and *induced* impacts are the economic 'ripple effects' that result when demand for goods and services in one set of industries carrying out local water use efficiency projects in turn generates demand for more goods and services in related local industries.

Establishments directly involved in Los Angeles' water use efficiency projects are found in a variety of industry sectors: construction, utilities, manufacturing, wholesale trade, professional services (including engineering, architectural, scientific, legal and technical services), environmental organizations, and local government agencies (Figure A).[6] The mix of industries involved in each type of water use efficiency project type differs, with most projects dominated by construction and professional services, except for water conservation programs that draw upon a variety of non-construction industries.

Figure A
Sectors of Businesses Carrying Out Water Use Efficiency Projects, by Project Type

Source: See Water use Efficiency Projects Contributors List in Appendix C of the full report. Chart data appear in end notes.

An investment of one-million dollars in these five types of water use efficiency projects creates 12.6 to 16.6 jobs in Los Angeles' economy, and stimulates $1.91 to 2.09 million in total sales (Table B and C). Mean annual wages for these jobs rage from $33,286 to $52,828. Water conservation projects have particularly high multiplier effects for local manufacturing, professional services, utilities and wholesaling establishments, along with local environmental organizations, recreation sites, museums and parks.

In comparison, Los Angeles' water use efficiency projects stimulate more jobs per $1 million invested than the *Motion Picture and Video Production* (8.35 person-years of employment) and *Housing Construction* (11.3) industries, but less than the *Grocery Stores* (18.5) and *Cut and Sew Apparel Contractors* (24.5) industries. Los Angeles' water use efficiency projects stimulate similar numbers of jobs as the *Commercial Construction* (13.6) and the *Utility System Construction* (13.7) industries (Table C). These differences in local job multiplier effects can be attributed to several factors that vary by industry, including the portion of direct investment that "leaks" out of the local economy to non-local suppliers of goods and services,

Table B
Economic Impacts of Water Use Efficiency Projects in Los Angeles, per Million Dollars Invested

Project Type	Direct Sales (Investment)	Indirect Sales Stimulated	Induced Sales Stimulated	Total Sales Stimulated	Mean Annual Wages
Water Conservation	$1,000,000	$429,705	$665,193	$2,094,898	$37,558
Graywater Systems	$1,000,000	$457,068	$453,894	$1,910,962	$33,286
Stormwater	$1,000,000	$408,934	$583,740	$1,992,674	$52,828
Groundwater	$1,000,000	$407,550	$558,349	$1,965,899	$50,001
Recycled Water	$1,000,000	$411,548	$544,608	$1,956,156	$49,092

Table C
Job Impacts of Water Use Efficiency Projects, with Comparison to Energy Efficiency Retrofits and Traditional Industries in Los Angeles, per Million Dollars Invested

Project Type	Direct Jobs Stimulated	Indirect Jobs Stimulated	Induced Jobs Stimulated	Total Jobs Stimulated	Average Wages
Water Conservation	9.1	3.0	4.5	16.6	$37,558
Graywater Systems	9.4	2.4	3.1	14.9	$33,286
Stormwater	6.6	2.4	4.0	13.1	$52,828
Groundwater	6.8	2.3	3.8	12.8	$50,001
Recycled Water	6.6	2.3	3.7	12.6	$49,092
Energy Efficiency Retrofits^	5.7	4.1	3.9	13.6	-
Cut and sew apparel contractors*	17.8	2.2	4.5	24.5	$29,534
Grocery Stores*	13.7	1.1	3.7	18.5	$31,382
Utility Systems Construction*	7.4	2.4	4.0	13.7	$75,305
Commercial Construction*	7.7	1.9	3.9	13.6	$29,551
Housing Construction*	5.2	3.0	3.2	11.3	$81,606
Motion Picture & Video Production*	3.0	2.3	3.0	8.3	$141,254

Sources: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. California Employment Development Department & Employment Projections Program, U.S. Department of Labor, U.S. Bureau of Labor Statistics. 2010. Los Angeles County Industry-Occupation Matrix 2008/2009.

Notes: See Water Efficiency Projects Contributors List in Appendix C for individual project descriptions and budgets. Sales supported per million dollars invested are derived from five water use efficiency case studies of over 50 local projects. "Employment" is person-years of employment supported, which includes full-time and part-time jobs, all derived from industry-specific estimates.

^ Energy Efficiency Retrofits data are drawn from the national report, "A New Retrofit Industry: An analysis of the job creation potential of tax incentives for energy efficiency in commercial buildings and other components of the Better Buildings Initiative" by Lane Burt (U.S. Green Building Council), Duane Desiderio (Real Estate Roundtable), Debbie Zeidenberg (Political Economy Research Institute) and Meg Waltner (Natural Resources Defense Council), June 2011.

*Multipliers for local industries in Los Angeles County are drawn from IMPLAN System 2009 data and 2011 software; average wages are from U.S. Bureau of Labor Statistics.

wage rates paid to workers, and the shares of revenue that go to capital equipment, labor, rent, savings and profit. Overall, the local impacts of investments in water use efficiency stimulate significant numbers of jobs with average annual wages of $33,286 to $49,092.

Policy Recommendations

In order to realize the economic and employment boost that comes with local water use efficiency investments, public policy makers and stakeholders in the business and non-profit sectors can take the following actions to support future investments in water use efficiency:

1. *Funding:* Support and budget for comprehensive watershed management planning and projects, including ongoing residential and commercial water conservation campaigns in local communities, as well as support for state bond measures earmarked for local projects.
2. *Existing Businesses:* Provide targeted support to help local businesses grow and build competitive strength in water conservation, recharge, and reuse services and technologies.
3. *New Business:* Extend this support to recruiting new water sector businesses to Los Angeles by highlighting the region's large market for water conservation, recharge, and reuse services and technologies.
4. *Workforce Development:* Invest in targeted workforce training in community colleges and establish uniform certification programs for emerging water occupations. Develop apprenticeships for young adults, specialized job opening lists, and employer forums in the water use efficiency field to identify essential skills for key occupations and plan training curricula.
5. *Research:* Investigate growth needs of water sector businesses through survey outreach. Collect and disseminate information about new categories of water use efficiency investments, water sector businesses, occupations, and career ladders in the City of Los Angeles. Track the impacts of water use efficiency policies and campaigns on local water consumptions rates.
6. *Community Partnership:* Involve local community stakeholders in job outreach to link local residents with new jobs, including water conservation, environmental advocates and green jobs networks.
7. *Keep Investments Local*: Prioritize *distributed* investments in diverse water use efficiency projects over concentrated investment in a few massive projects. *Local* investments not only produce large multiplier effects where water users live and work, but also support better stewardship of this precious resource by residential and commercial water consumers. Also, local investments return taxpayer dollars to the areas where they are generated.

These policy actions will stimulate new sales and employment in the local economy, quantified in detail in the following report.

Chapter 1

Los Angeles' Water Supply and Users

Overview

Los Angeles, with its subtropical-Mediterranean climate and rainfall totaling only 12-14 inches annually, has over one and a half million acre-feet of water delivered each year by water agencies in the county.[7] It is the most populous region in the state with an average daily water use of 135 gallons per capita – about three times as much as its Mediterranean-climate counterparts in Spain, Australia, and Israel.[8] This requires local water agencies to import the majority of what is consumed at great expense, yet most of this water is used only once before it is discharged.[9] On its way through our urban landscape, water supports animal and plant life, contributes to the economy and sustains jobs, and also transports debris and pollution before it runs off via streets, pipelines and channels into local rivers, the groundwater or the sea.

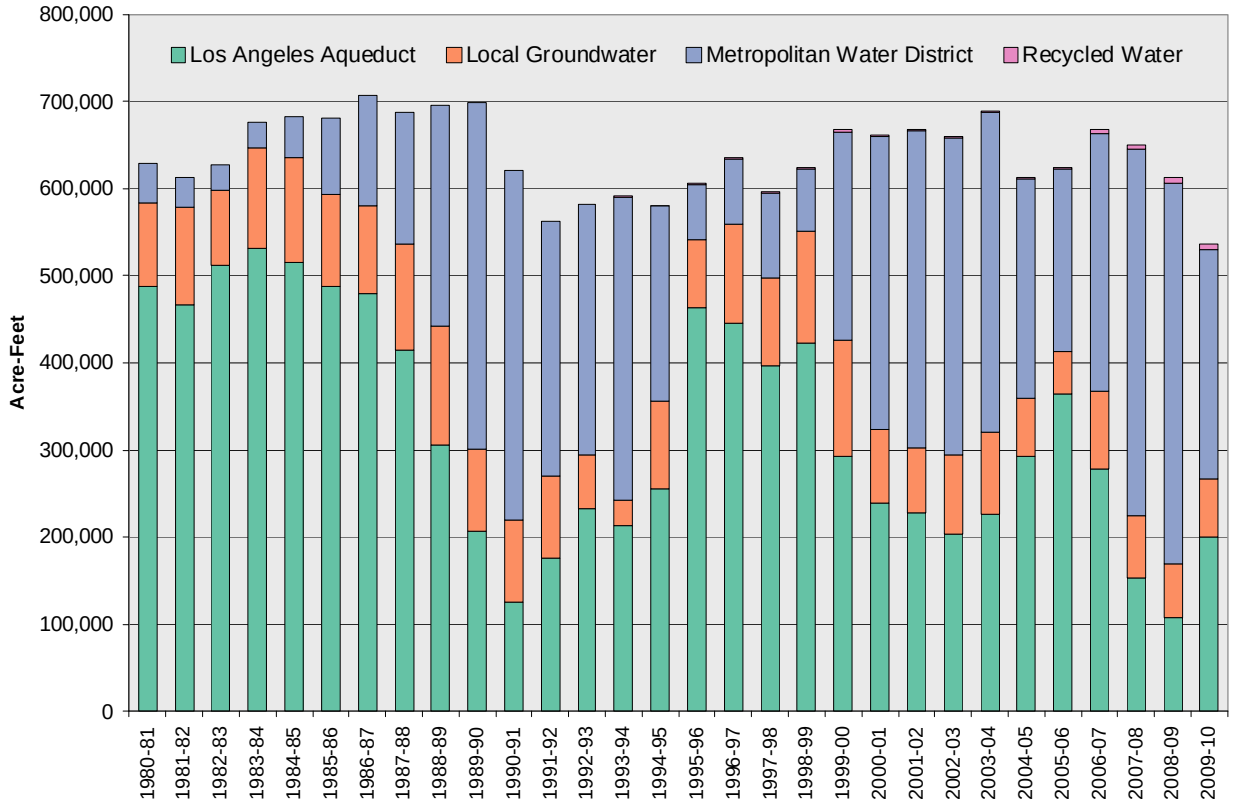
Necessity compels the Los Angeles region – along with the rest of the planet – to create and implement ways of conserving much more of this limited resource.[10] An added incentive is that investments in water use efficiency will support an increasing number of local jobs. This study estimates and quantifies the job creating impact of further investments in water use efficiency.

Droughts, Water Sources and Conservation

The 2007-09 drought drew concerned attention from water agencies serving the 35 million people of the U.S. Southwest.[11] During California's statewide drought, officially starting in 2008 and ending in March 2011, "reservoirs reached historic lows in the Colorado River Basin, ecosystems faced collapse in the San Francisco-San Joaquin Bay Delta, and water agencies were forced to institute water rationing regimes to make the water supply last longer."[12] The City of Los Angeles imports nearly 90 percent of its water, all from sources that were directly affected by the drought.[13] Imported water comes from the Los Angeles Aqueduct (35.6 percent) and the Metropolitan Water District of Southern California (52.4 percent). Local sources include groundwater (10.9 percent), and recycled water (0.8 percent) (Figure 1.1).[14] The Colorado River, which provides much of the Metropolitan Water District's supply, also supplies a population that also includes fast growing parts of Utah, Nevada and Arizona.[15] As competition for water resources rises, the price of Los Angeles' dependence upon imported water is likely to increase in the future, adding further urgency to keeping water demand within our supply means.

In response, civic leaders in Los Angeles are promoting aggressive outdoor conservation methods and innovative water reuse strategies. This is possible through implementing water efficient technologies, recharging groundwater basins with precipitation and treated water, reclaiming sewage water, and capturing urban runoff/rainwater from impervious surfaces.[16] Low impact development (LID) practices, technologies and building materials hold the potential to harvest rainwater, store it and expend it to offset the demand for imported water.[17] Recycled water is also a promising technology for water conservation.[18] With thousands of miles of surface area and "a total estimated 3.2 million acre-feet of groundwater storage capacity in the

Figure 1.1
City of Los Angeles Sources of Water Supply



Source: Water Operations Division - Water Control Group, Los Angeles Department of Water and Power, 2010. Note: Imported water sources include the Los Angeles Aqueduct and most of the water from the Metropolitan Water District, a separate agency.

Metropolitan Water District's service area, Southern California is rich in potential"[19] for water capture and storage. Research has shown that water conservation and related investments are worthwhile during non-drought as well as drought years, since local stormwater capture is among Southern California's most cost-efficient sources of water,[20] and low impact development "often results in substantial financial savings and provides a valuable water supply at low cost."[21]

To set the stage for this report's analysis of the economic and job impacts of water use efficiency investments – including analysis of several types of water use efficiency investments – this chapter first presents information on the amount, location and use of water consumed in Los Angeles. It also presents new estimates of the distribution of commercial water consumption in the county. These water consumption characteristics offer insights about how and where jobs can be created in both the public and private sectors through water use efficiency.

Water Consumption

Los Angeles County consumed 1.6 million acre-feet of water in 2008 (Table 1.1). The City of Los Angeles Department of Water and Power and its customers are the largest consumer in the county, accounting for 40 percent of consumption countywide. The Central Basin Municipal Water District[22] is the second largest consumer at 16 percent. The Upper San Gabriel Valley Municipal Water District[23] and the West Basin Municipal Water District[24] each consumes approximately 11 percent countywide water deliveries. Other municipal water districts in Los Angeles County each receive less that 10 percent of water deliveries.

Table 1.1
Water Deliveries by Water Agency Service Areas in Los Angeles County, California

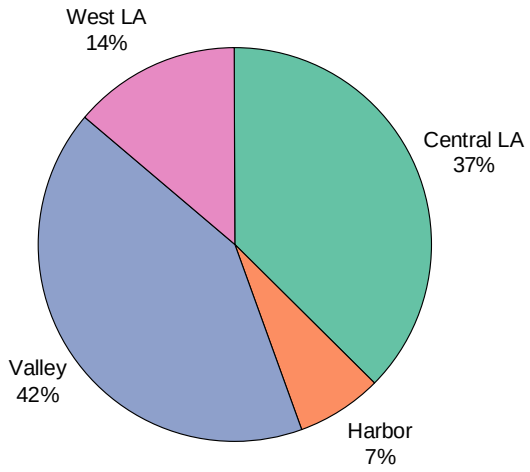
	Total Deliveries (acre-feet)		
Water Agency	**1990**	**2008**	**Change**
City of Los Angeles	685,875	648,675	-37,200
Central Basin MWD	274,979	260,873	-14,106
Upper San Gabriel Valley MWD	191,088	175,969	-15,119
West Basin MWD	203,205	171,341	-31,864
Three Valleys MWD	138,235	117,606	-20,629
City of Long Beach	80,399	53,103	-27,296
City of Pasadena	38,969	34,467	-4,502
City of Glendale	32,153	31,279	-874
City of Torrance	31,286	25,227	-6,059
City of Burbank	23,588	23,879	291
Foothill MWD	17,115	19,525	2,410
City of Santa Monica	17,061	14,054	-3,007
City of Beverly Hills	14,867	12,653	-2,214
City of Compton	11,659	8,373	-3,286
City of San Marino	6,824	5,247	-1,577
Los Angeles County Total	1,767,303	1,602,271	-165,032

Source: Mike Cohen, Pacific Institute. 2011. Municipal Deliveries of Colorado River Basin Water. Pacific Institute. Table 9, Page 19.

The City of Los Angeles Department of Water and Power, recipient of the county's largest volume of imported water deliveries from the Colorado River Basin Water, offers useful insights into the composition of urban water consumption (Figure 1.2). Serving a population of over 3.7 million residents,[25] 71 percent of its water is directly consumed by *Residential* and *Apartment House* customers. The next biggest class of water consumers in Los Angeles is *Commercial* and *Industrial*, accounting for 23 percent of use. Agricultural consumers are included in the Commercial class, while outdoor irrigation (such as watering lawns on residential and commercial properties) is captured across almost all of the listed classes (Table 1.2).

As the largest municipal utility in the United States, the Los Angeles Department of Water and Power has historically been one of

Figure 1.2
Total Water Consumption by LADWP Districts, 2009



Source: Los Angeles Department of Water and Power. 2010. *Analysis of Consumption, Water System, 12 months ending December 2009*. Note: HCF = Hundred Cubic Feet.

the City's main conduits for investing in water use efficiency. Aiming to offset its large consumption, the department's activities include conserving, recycling and reusing water, improving water infrastructure, and training its new workers in the growing field of water use efficiency.

Commercial Water Consumption

Businesses in the City of Los Angeles consumed 23 percent of the water supplied by the Department of Water and Power in 2009.[26] We estimate the distribution of businesses' water consumption by using a model of the materials and energy resources required for activities in the US economy (Carnegie Mellon's Economic Input-Output Life Cycle Assessment)[27] and a list of Los Angeles business establishments by industry type and census tract.[28]

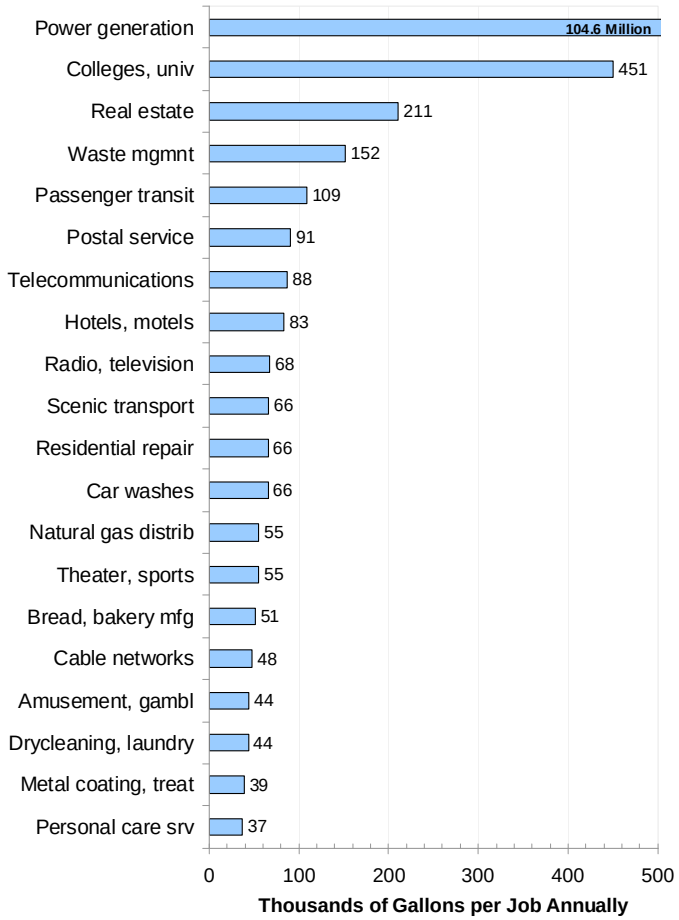
Businesses' water consumption varies significantly by industry, and Los Angeles' particular industry mix reveals interesting patterns in water use. Some of its industries are water-intensive, including electrical utilities that use water for cooling towers,[29] while others use much less water. For Los Angeles County, the businesses with the highest and lowest water consumption are shown in Figure 1.3. *Colleges and Universities*, which are campuses of institutional buildings and housing with thousands of students, faculty and staff – making them almost cities unto themselves, consume the second highest amount of water per job in the county. Other industries with high water use per job include *Real Estate* (property management), *Waste Management and Remediation*, and several industries that

Table 1.2
City of Los Angeles Water Consumption by Class

Class	Consumption (HCF)	Percent
Residential	91,094,584	39%
Apartment House	74,457,088	32%
Commercial	43,732,138	19%
Industrial	9,479,328	4%
Other City Departments	7,095,282	3%
LAUSD Schools	1,817,240	0.8%
Other Public Agencies	6,857,042	2.9%
Intradepartmental	661,834	0.3%
Irrigation & Misc	86,535	0.04%
LADWP Total	235,281,071	100%

Source: LA Department of Water and Power. 2009.

Figure 1.3
Commercial Water Consumption in LA County: Top Industry Consumers – Gallons per Job

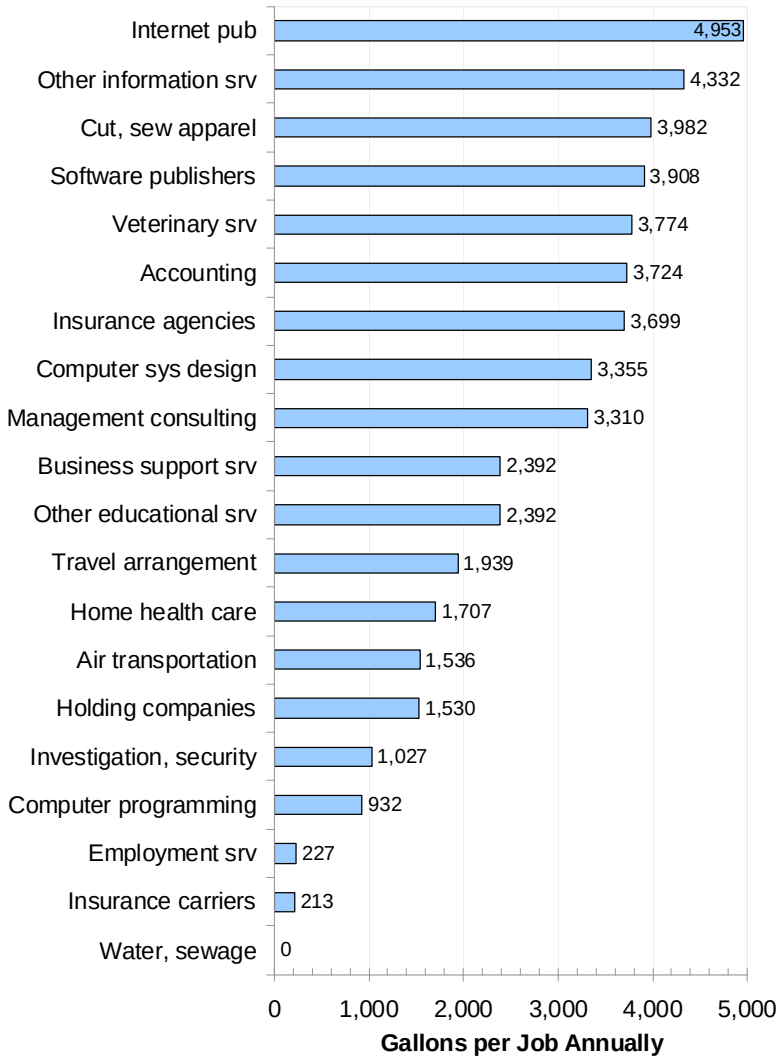


Source: Economic Roundtable; California Employment Development Department. Quarterly Census of Employment and Wages, 3rd Quarter 2009; Carnegie Mellon University Green Design Institute. Economic Input-Output Life Cycle Assessment (EIO-LCA), US 1997. Universe: Formal sector employers with 2+ employees.

maintain or service large transit or delivery fleets (*Passenger Transit*, the *Postal Service*, *Scenic Transportation*, and *Car Washes*).

Los Angeles County has several industries noteworthy for consuming low amounts of water per job (Figure 1.4). Establishments in the *Water, Sewage and Other Systems* industry sector top the list, since they are net providers of water to the region, and because they are relatively capital intensive. A group of industries associated with information technology services (*Computer Programming*, *Computer Systems Design*, *Software Publishers*, *Other Information Services* – such as *News Syndicates*, *Libraries*, and *Archives* – and *Internet Publishers*) and business management / support activities (*Holding Companies*, *Business Support Services*, *Management Consulting*, *Insurance Carriers* and *Accounting*) are also low consumers of water per job. A few industries make this list due their typically labor-intensive operations, such as Cut and Sew Apparel, or because their employees work off-site (*Employment Services*, i.e., temporary help agencies, and *Investigation and Security Services*) or in clients' homes (*Home Health Care Services*).

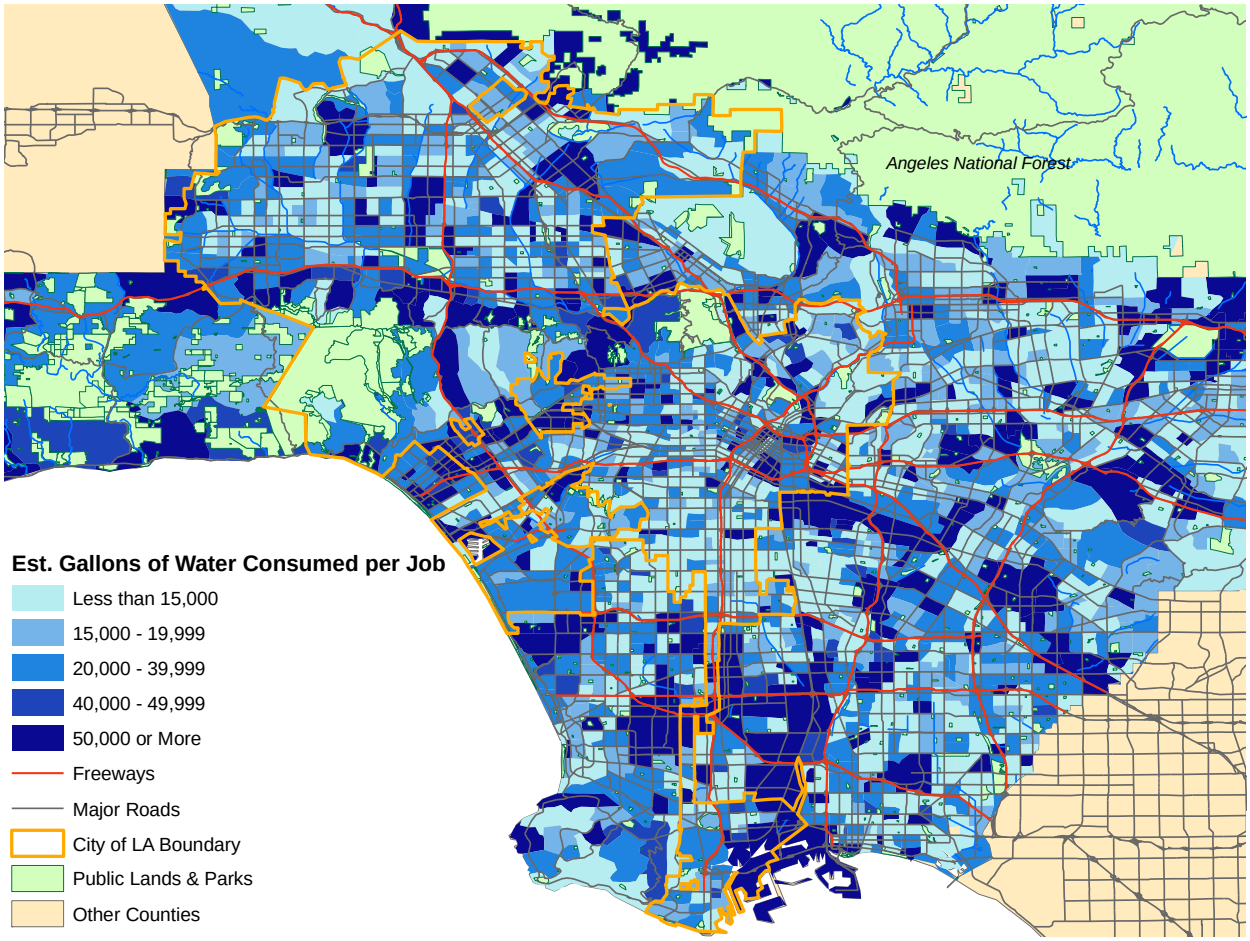
Figure 1.4
Commercial Water Consumption in LA County:
Least Industry Consumers – Gallons per Job



Source: Economic Roundtable; California Employment Development Department. Quarterly Census of Employment and Wages, 3rd Quarter 2009; Carnegie Mellon University Green Design Institute. Economic Input-Output Life Cycle Assessment (EIO-LCA), US 1997. Universe: Formal sector employers with 2+ employees.

Another dimension to commercial water consumption is its geography in Los Angeles: what areas have businesses using the most amounts of water per job? The map that answers this question is very nuanced (Figure 1.5). Establishments in one of Los Angeles' traditional manufacturing hubs – South Los Angeles along the 110 freeway and north of the 105 freeway – have lower water consumption per job than other areas. This pattern may reflect the loss of businesses and jobs in that area, or possibly their movement outside of the City of Los Angeles and into neighboring areas of Gardena, Carson and Compton. The San Fernando

Figure 1.5
Estimated Commercial Water Consumption per Job in Los Angeles City and County



Source: Economic Roundtable; California Employment Development Department. Quarterly Census of Employment and Wages, 3rd Quarter 2009; Carnegie Mellon University Green Design Institute. Economic Input-Output Life Cycle Assessment (EIO-LCA), US 1997. Universe: Formal sector employers with 2+ employees located in Los Angeles County, per Census Tract.

Valley reveals concentrations of higher water consumption not along the old manufacturing and rail corridor between Burbank and Northridge, but instead along Ventura Boulevard. Other areas with higher water consumption per job include: Granada Hills, Malibu, El Segundo, the Ports of Los Angeles and Long Beach, Lakewood/Hawaiian Gardens, Santa Fe Springs, Huntington Park/Cudahy, La Cañada Flintridge, and La Puente/Hacienda Heights.

Chapter 2

Identifying Industries that make up the Los Angeles Water Sector

Introduction

This section identifies the establishments that make up the Los Angeles economy's current water sector – maintaining water and sewage system infrastructure, related equipment sales and engineering services – and groups them into industries defined in the North American Industry Classification System (NAICS).[30] Industries in the water sector were identified by studying the industry structure of the region and also by analyzing the industry classifications of employers known to have provided goods or services for water conservation and reuse projects in the region. Goods and services that are used in the water sector include:

- Aeration and Mixing Systems
- Chemicals/Bio-Chemicals
- Clarification, Sedimentation
- Cooling Towers, Heat Exchangers
- Corrosion Control
- Customer Information Systems
- Detectors, Monitors and Recorders
- Disinfection
- Electrical and Mechanical Equip.
- Filtration Equipment
- Engineering, Consulting and Construction Services
- Environmental Services
- Graywater Irrigation Systems
- Industrial Water/Wastewater Treatment
- Lab, Sampling and Analytical
- Meters and Meter Reading Equipment
- Monitoring and Process Control Equip.
- Odor Control
- Pipes, Fittings and Related Products
- Pipe Maintenance, Repair, Installation
- Pumps, Drives and Related Products
- Pump Related Services
- Safety Equipment
- Sampling and Analyzing Equip. and Instruction
- Sludge and Bio-Solids Handling
- Sludge Processing and Application
- Stormwater Systems, Tanks and Structures
- Valves and Related Products
- Wastewater Treatment Equipment

We identify the industry classifications for Los Angeles water sector employers by finding their equivalent NAICS industry sectors, which enables us to analyze data sets with information about the overall employment, wage and occupational characteristics of these industries. The NAICS industry schema does not precisely capture the emerging water sector industries. Therefore, some of the NAICS sectors include 'false positives,' establishments that are in those NAICS industries, but not necessarily involved in Los Angeles' water sector. Nonetheless, this data is the best tool for obtaining industry and labor market information about the sector.

First Tier of the Water Sector

The *first tier* industries are made up of employers whose activities relate primarily to the region's water and wastewater infrastructures. The NAICS industries in the first tier are as follows:

- *Water Supply and Irrigation Systems (NAICS Code #221310)*
- *Sewage Treatment Facilities (221320)*
- *Water and Sewer Line and Related Structures Construction (237110)*
- *Industrial Valve Manufacturing (332911)*
- *Other Metal Valve and Pipe Fitting Manufacturing (332919)*
- *Pump and Pumping Equipment Manufacturing (333911)*

The first tier of the water sector is a mix of utility operations, specialized construction services, and manufacturers. More detailed descriptions of these NAICS sectors are contained in Data Appendix A.

Second Tier of the Water Sector:

The *second tier* of industries includes employers that support the Los Angeles water sector, supplying important goods and services to municipal water utilities as well as the water and wastewater industries. Their activities include support of pipe repairs and maintenance, corrosion control of water infrastructure, chemical treatment and removal of biosolids from contaminated water, stormwater management, operation and management of water-related facilities, automated, computer control technology, and engineering and research services.[31] A subset of the establishments in the following NAICS categories are involved in Los Angeles' water sector:

- *Land Subdivision (NAICS Code #237210)*
- *Other Heavy and Civil Engineering Construction (237990)*
- *Electrical Contractors and Other Wiring Installation Contractors (238210)*
- *Plumbing, Heating, and Air-Conditioning Contractors (238220)*
- *Other Building Equipment Contractors (238290)*
- *Industrial Gas Manufacturing (325120)*
- *All Other Miscellaneous Chemical Product and Preparation Manufacturing (325998)*
- *All Other Plastics Product Manufacturing (326199)*
- *Rubber and Plastics Hoses and Belting Manufacturing (326220)*
- *All Other Rubber Product Manufacturing (326299)*
- *Metal Tank (Heavy Gauge) Manufacturing (332420)*
- *Other Commercial and Service Industry Machinery Manufacturing (333319)*
- *Heating Equipment (except Warm Air Furnaces) Manufacturing (333414)*
- *Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing (333415)*
- *Turbine and Turbine Generator Set Units Manufacturing (333611)*
- *All Other Miscellaneous General Purpose Machinery Manufacturing (333999)*
- *Other Electronic Component Manufacturing (334419)*
- *Search, Detection, Navigation System and Instrument Manufacturing (334511)*
- *Automatic Environmental Control Manufacturing (334512)*

- *Instruments and Related Products Manufacturing for Measuring, Displaying, and Controlling Industrial Process Variables (334513)*
- *Totalizing Fluid Meter and Counting Device Manufacturing (334514)*
- *Other Measuring and Controlling Device Manufacturing (334519)*
- *Electrical Apparatus and Equipment, Wiring Supplies, and Related Equipment Wholesale (423610)*
- *Plumbing and Heating Equipment and Supplies (Hydronics) Wholesale (423720)*
- *Refrigeration Equipment and Supplies Wholesale (423740)*
- *Farm and Garden Machinery and Equipment Wholesale (423820)*
- *Industrial Machinery and Equipment Wholesale (423830)*
- *Service Establishment Equipment and Supplies Wholesale (423850)*
- *Other Chemical and Allied Products Wholesale (424690)*
- *Architects' offices, Landscape (541320)*
- *Engineering Services (541330)*
- *Testing Laboratories (541380)*
- *Environmental Consulting Services (541620)*
- *Research and Development in Biotechnology (541711)*
- *Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology) (541712)*
- *Landscaping Services (561730)*
- *Hazardous Waste Treatment and Disposal (562211)*
- *Remediation Services (562910)*
- *Environment, Conservation and Wildlife Organizations (813312)*

These industries and the occupations of workers they employ are studied in the next two chapters. A more detailed description of these NAICS industry sectors can be found in Data Appendix A.

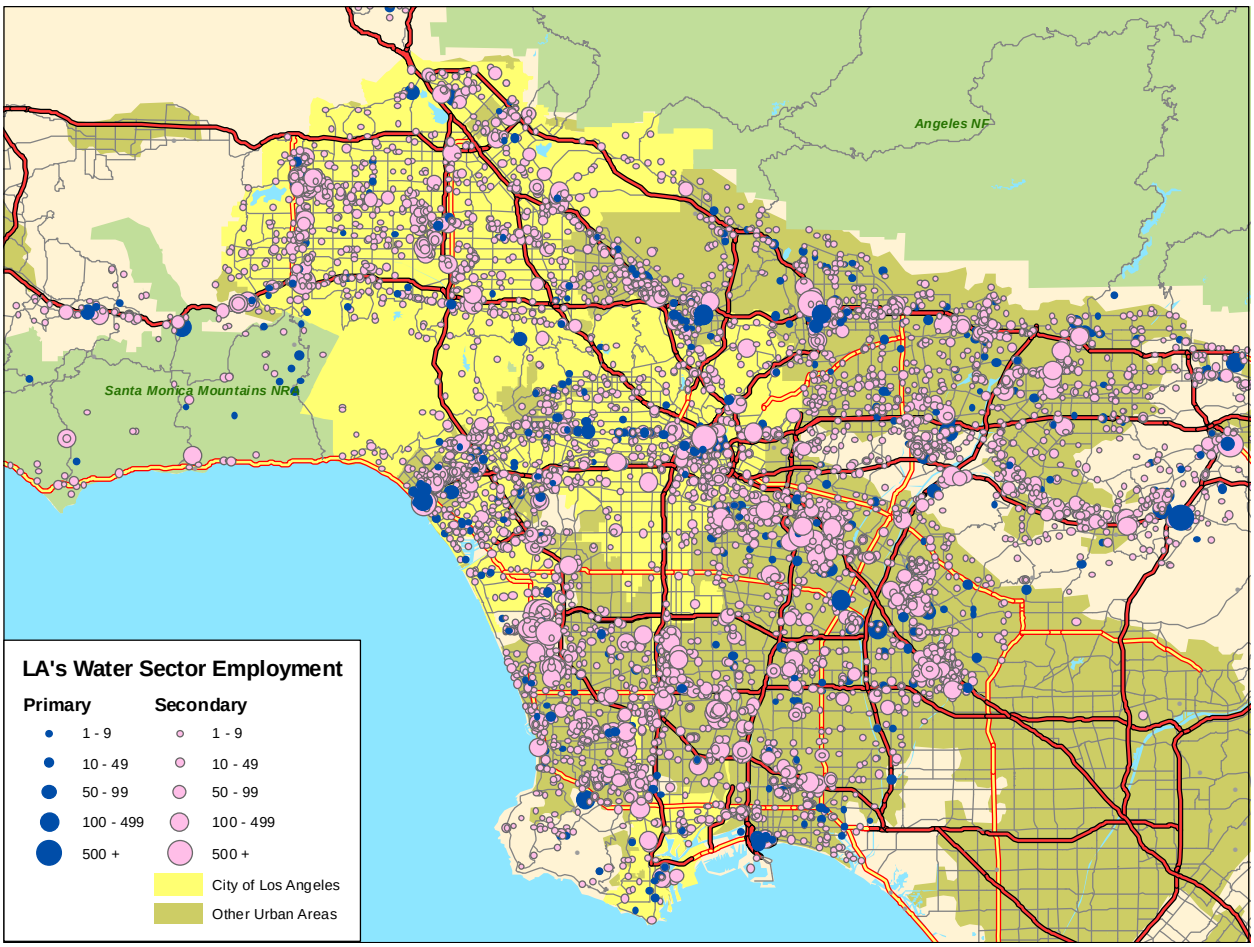
Chapter 3

Industry Analysis

Introduction: Characteristics, Growth and Decline Trends since 1996

Nationwide, the water and wastewater sector is estimated to have $127 billion in annual sales, which includes maintenance of municipal infrastructure, equipment sales, and engineering consulting services.[32] A significant number of these employers are located in Los Angeles, providing goods and services to other businesses, to consumer households, and to local government agencies. The exact number of these employers is constantly changing and difficult to determine; we estimate the size of Los Angeles' water sector by analyzing statistical data about the larger industries of which they are a part. As laid out in the previous chapter, the first and second tiers of Los Angeles County's water sector are estimated to be comprised of 17,076

Figure 3.1
Employment in Industries Capturing the Water Sector in Los Angeles County, 2009



Source: Economic Roundtable analysis; California Employment Development Department. 2011. *Quarterly Census of Employment and Wages 2009*; Los Angeles.

Table 3.1
Employment and Payroll for Industries Capturing the Water Sector in Los Angeles County, 2009

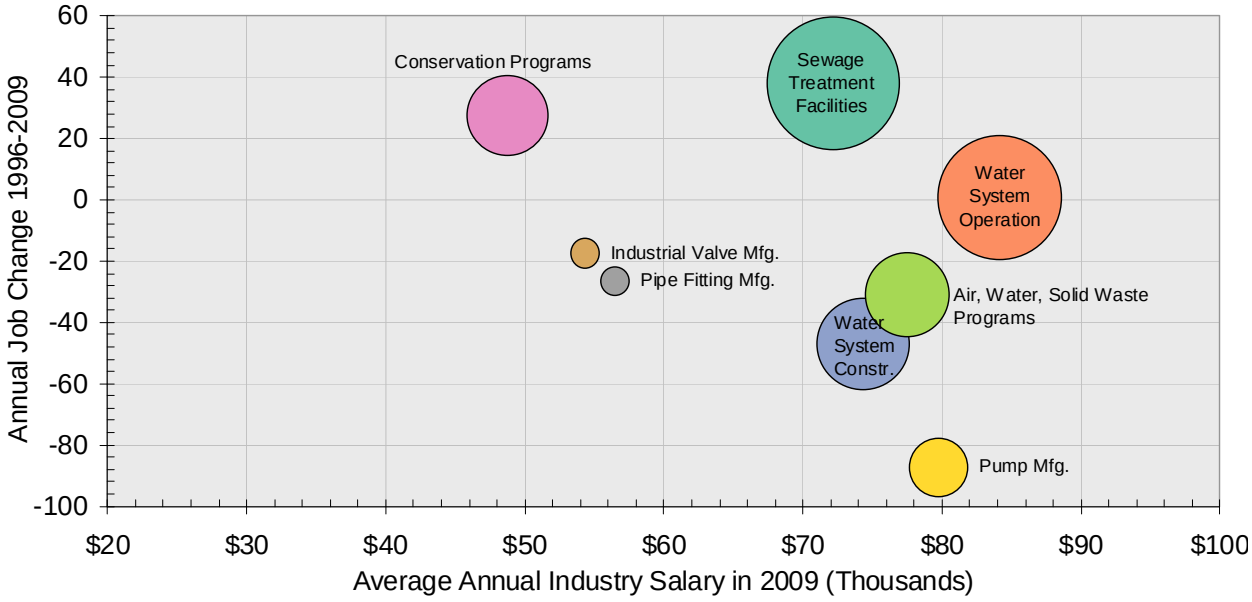
Industry Sector	Employment		Quarterly Payroll	
	Sum	Avg. per Establishment	Sum	Avg. per Establishment
Utilities	7,599	59	$151.4 M	$1,174,145
Construction	3,988	36	$88.8 M	$800,625
Manufacturing	63,560	39	$1,272.7 M	$784,663
Wholesale & Transp.	31,374	11	$534.2 M	$187,584
Retail Trade	9,588	7	$186.6 M	$142,070
Professional Services	85,094	9	$2,082.7 M	$208,170
Remediation Services	7,403	10	$78.5 M	$101,487
Other Services	2,484	9	$24.3 M	$89,276
Total	211,090	12	$4,419.6 M	$258,822

Source: Economic Roundtable analysis; California Employment Development Department. 2011. *Quarterly Census of Employment and Wages 2009*; Los Angeles. Tables based on records of 17,076 business establishments.

business establishments across the county, employing over 200,000 workers at the end of 2009. Their quarterly payroll was just under 4½ billion dollars (Figure 3.1, Table 3.1).

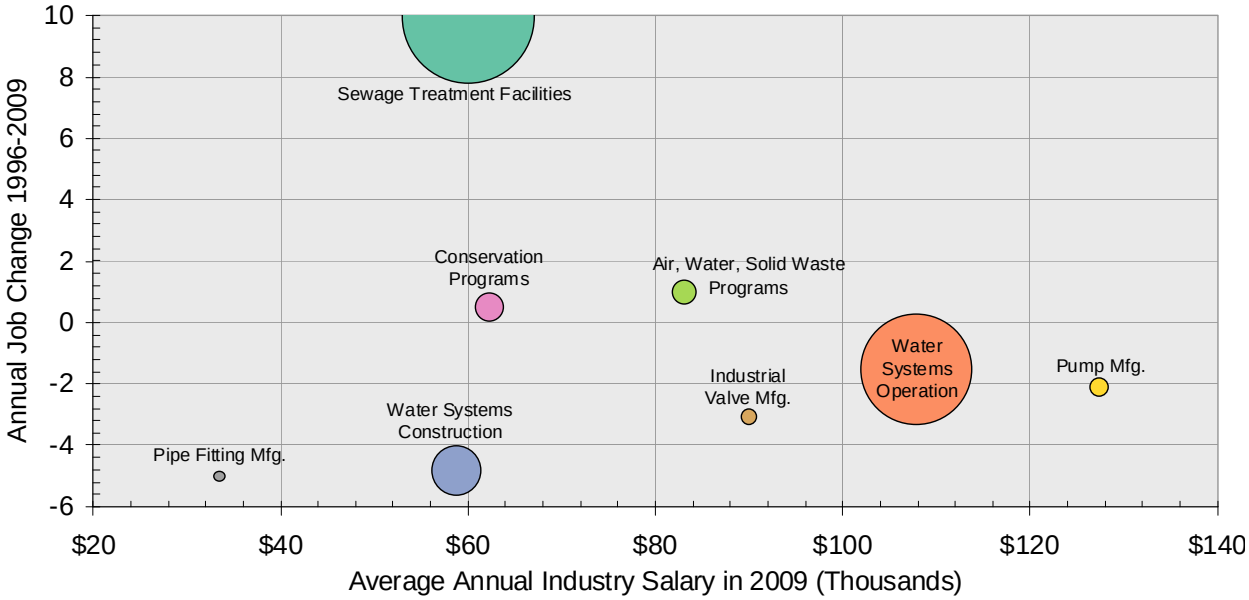
Industries in the *first tier* of Los Angeles County's water sector typically pay sustaining wages, with the annual average wage countywide ranging from $49,000 in *Conservation Programs* to $84,000 in *Water System Operations* (Figure 3.2). The largest industry is *Sewage Treatment Facilities*, with 4,080 workers countywide and 1,454 workers in the city. The

Figure 3.2
First Tier Water Industries in Los Angeles County: Employment Size, Change, and Annual Salary
(● ● ● *Current Number of Jobs Represented by Size of Circle*)



Source: Economic Roundtable analysis; California Employment Development Department. 2011. *Quarterly Census of Employment and Wages 1996-2009*; Los Angeles. Notes: All first tier industries appear in the chart. Employment size is represented by the relative size of circles in the chart.

Figure 3.3
First Tier Water Industries in the City of Los Angeles: Employment Size, Change, and Annual Salary
(● ● ● *Current Number of Jobs Represented by Size of Circle*)



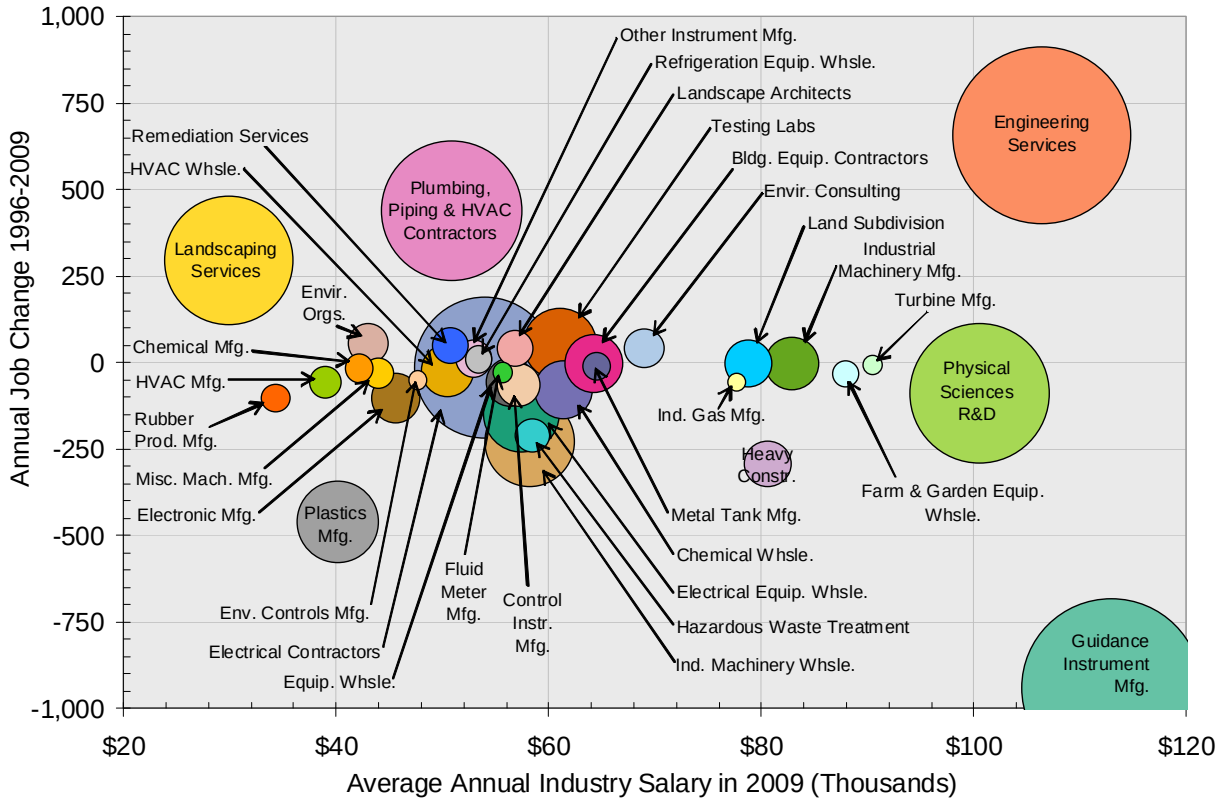
Source: Economic Roundtable analysis; California Employment Development Department. 2011. *Quarterly Census of Employment and Wages 1996-2009*; Los Angeles. Notes: All first tier industries appear in the chart. Employment size is represented by the relative size of circles in the chart.

smallest industry is *Pipe Fitting Manufacturing* with 183 workers countywide and fewer than 20 workers in the city (Figure 3.3). Since 1996, employment trends in the two largest industries, *Sewage Treatment Facilities* and *Water Systems Operations*, have diverged; the former typically added about 38 employees per year across the county, while countywide employment in the latter has been almost unchanged. The other, smaller industries in the water sector's first tier employ just over 6,160 workers countywide and 340 workers in the city, and either have had stable employment since 1996 or contracted slightly.

The industries in the *second tier* of Los Angeles' water sector present a more complex picture in terms of employment size, growth trends and wage levels (Figure 3.4 for the county and Figure 3.5 for the city). The largest industries in this set include professional services (*Engineering Services, Physical Sciences Research and Development*, and *Guidance Instrument Manufacturing*), which employs 64,258 workers countywide. In addition, a blue collar group (*Electrical Contractors, Plumbing, Piping and Heating-Ventilation-Air-Conditioning (HVAC) Contractors*, and *Landscaping Services*) employs 43,220 workers countywide. The professional services industries pay an average salary exceeding $100,000 per year, while the blue collar industries pay wages that typically are a little under $50,000 per year.

Employment trends since 1996 in the second tier industries are mixed: most are clustered around the zero line, indicating typically stable employment. Interestingly, the three largest industries that had growing employment in the past 13 years have ties to real estate development and maintenance: *Engineering Services*, *Plumbing, Piping and HVAC Contractors*, and *Landscaping Services* – all likely beneficiaries of the last housing boom.

Figure 3.4
Second Tier Water Industries in Los Angeles County: Employment Size, Change, and Annual Salary
(● ● ● Current Number of Jobs Represented by Size of Circle)

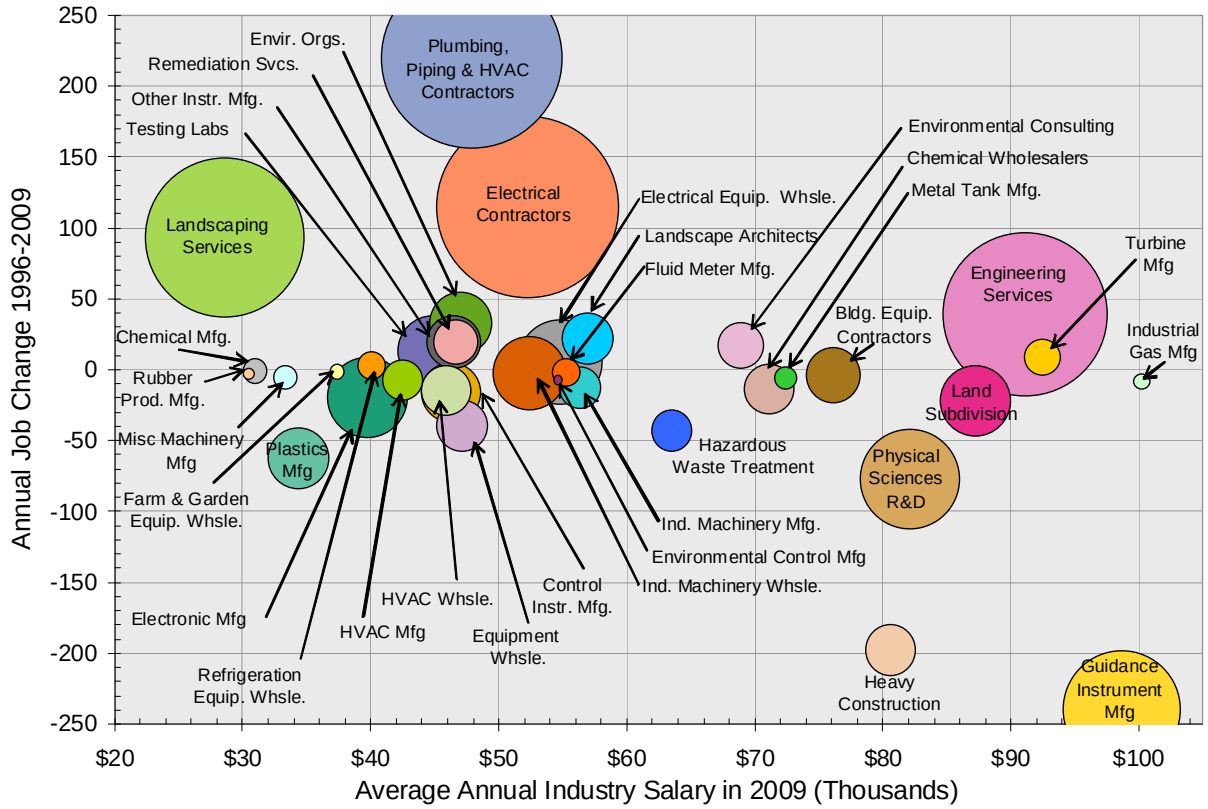


Source: Economic Roundtable analysis; California Employment Development Department. 2011. *Quarterly Census of Employment and Wages 1996-2009*; Los Angeles. Notes: Not shown is the Biotechnology Research and Development industry, with average annual wages of $251,000. Employment size is represented by the relative size of circles in the chart.

The local industries in decline are predominantly manufacturing, but also include *Heavy Construction* (heavy and engineering construction projects such as dams and channels, but excluding highway, street, bridge, and power line construction) and *Hazardous Waste Treatment* (employers operating treatment/disposal facilities for hazardous waste, and sometimes collecting and transporting hazardous waste). Increasingly, construction companies (including *Heavy Construction*) base their operations outside of Los Angeles County, even if projects are carried out within the county.

Second tier industries located within the City of Los Angeles have differing wage levels and employment shares. Fourteen of the 37 industries pay higher average annual wages in the city than in the county. Most notably, *Biotechnology Research and Development* establishments in the city pay 82 percent more than the countywide average wage, *Industrial Gas Manufacturing* pays 29 percent more, *Building Equipment Contractors* pays 18 percent more, *Chemical Wholesalers* pays 16 percent more, *Environmental Control Manufacturing* pays 15 percent more, *Metal Tank Manufacturing* pays 12 percent more, and *Land Subdivision* pays 11 percent more.

Figure 3.5
Second Tier Water Industries in the City of Los Angeles: Employment Size, Change, and Annual Salary
(● ● ● Current Number of Jobs Represented by Size of Circle)



Source: Economic Roundtable analysis; California Employment Development Department. 2011. *Quarterly Census of Employment and Wages 1996-2009*; Los Angeles. Notes: Not shown is the Biotechnology Research and Development industry, with average annual wages of $251,000. Employment size is represented by the relative size of circles in the chart.

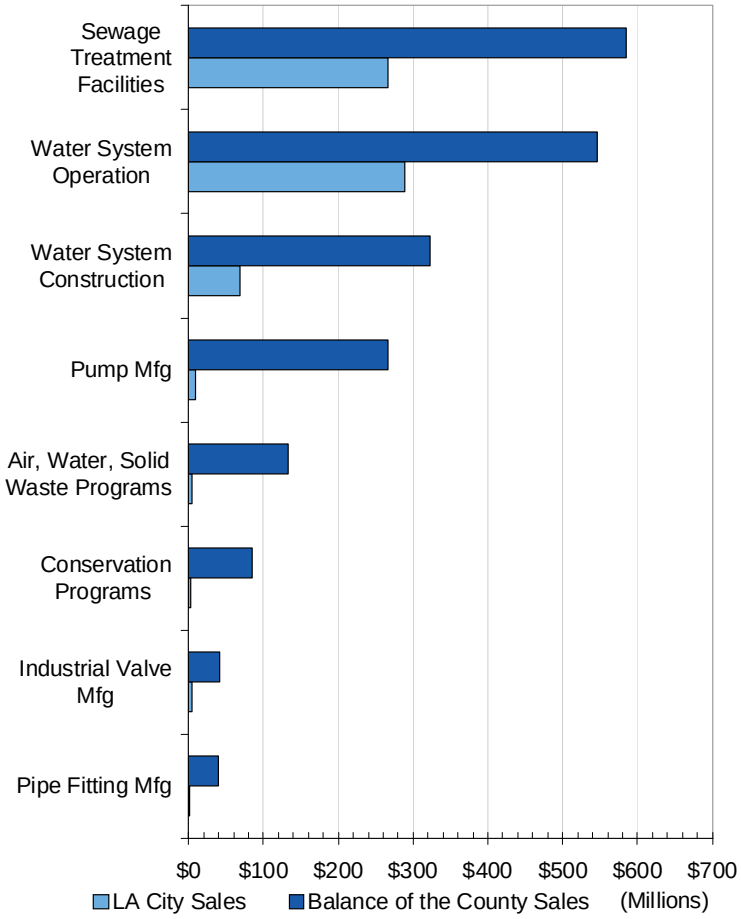
Six second tier industries account for a larger share of the labor force in the city than in the balance of the county, indicating that the city provides greater locational advantages for these employers than the county as a whole. Overall, 40 percent of countywide employment is at establishments located in the City of Los Angeles. The following second tier industries have more than 40 percent of countywide employment located in the City of Los Angeles: *Turbine Manufacturing* (73 percent), *Electronic Manufacturing* (55 percent), *Environmental Organizations* (52 percent), *Land Subdivision* (48 percent), *Other Instrument Manufacturing* (44 percent), and *Landscape Architects* (43 percent). We use 40 percent as a threshold here because that is the percentage of the county's workers employed at establishments located within the City of Los Angeles.[33]

Total Sales Generated

We estimate that industries in Los Angeles' water sector have annual direct sales (output) of $2.7 billion in the *first tier*, and $32.5 billion in the *second tier*. Water sector establishments are only a subset of these industries, but the distribution of direct sales (output) at the industry level allows insights into which businesses create the largest multiplier effects when they buy goods and services from suppliers.

Two of the first tier water sector industries stand out with the largest direct sales: *Sewage Treatment Facilities* ($266,198,565 by City of Los Angeles establishments, $850,548,463 countywide) and *Water System Operation* ($288,392,501 in the city and $834,016,739 countywide). The next largest industries by sales are *Water Systems Construction* ($68,533,481 and $391,641,416, respectively) and *Pump Manufacturing* ($9,687,307 and $276,414,766, respectively), as shown in Figure 3.6.

Figure 3.6
Estimated Sales by Industry,
Los Angeles Water Sector, First Tier Industries

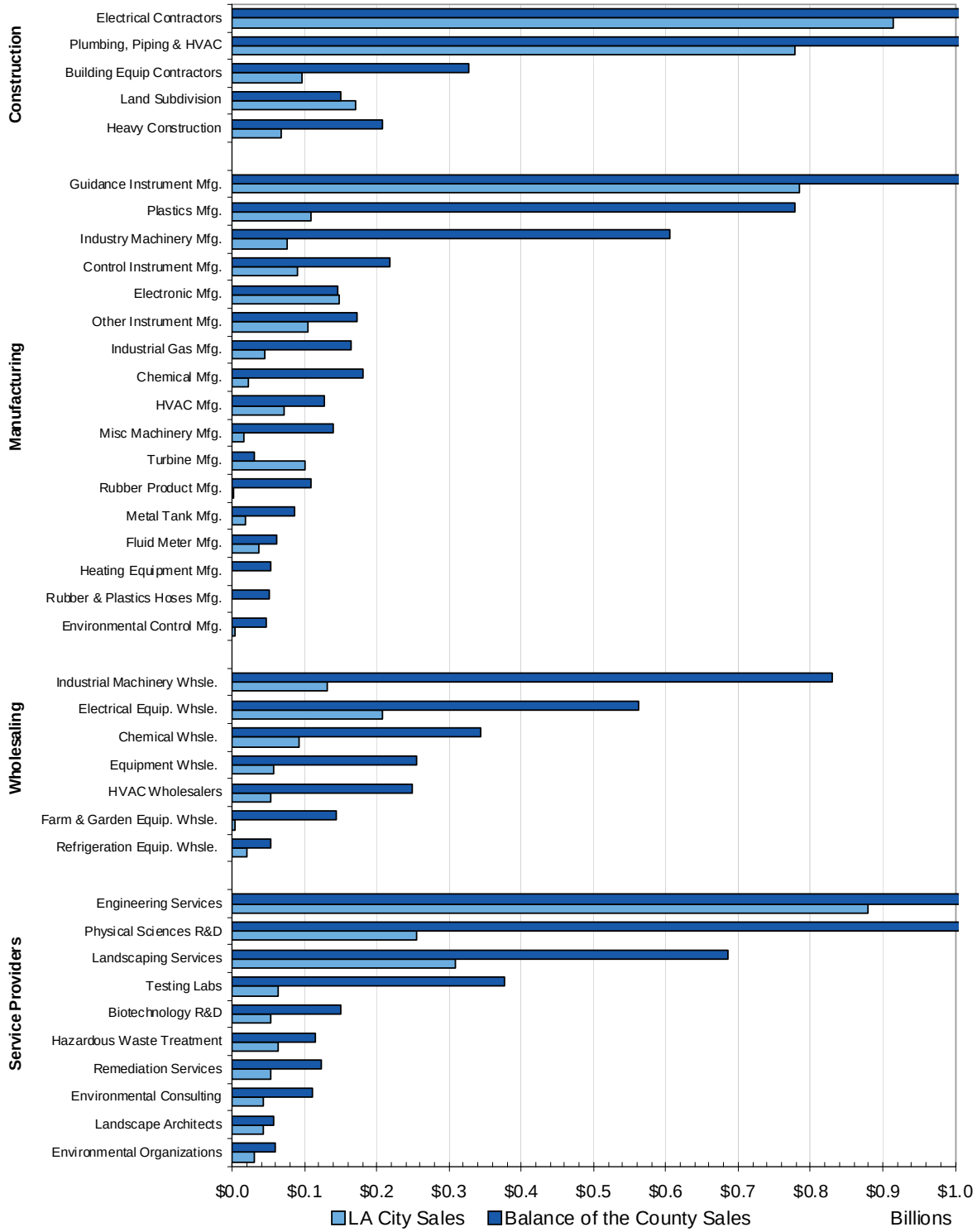


Source: Economic Roundtable analysis; California Employment Development Department. 2011. *Quarterly Census of Employment and Wages 2009*; Los Angeles; Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software.

Direct sales by first tier water sector industries pass through to supplier networks, stimulating demand for purchases of goods and services from second tier supplier businesses (Figure 3.7). Out of these Los Angeles industries, five had annual sales in excess of $1 billion countywide: *Guidance Instrument Manufacturing* ($9,235,618,132), *Engineering Services* ($4,725,643,712), *Physical Sciences Research and Development* ($2,815,897,838), *Electrical Contractors* ($2,641,989,484) and *Plumbing, Piping and HVAC Contractors* ($2,317,219,673).

Within the City of Los Angeles, the five water-related industries with the highest sales are: *Electrical Contractors* ($915,133,362), *Engineering Services* ($880,205,529), *Guidance Instrument Manufacturing* ($784,368,953), *Plumbing, Piping and HVAC Contractors* ($778,133,211), and *Landscaping Services* ($309,798,719).

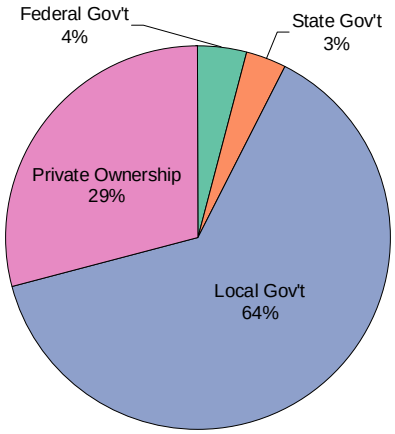
Figure 3.7
Estimated Sales by Industry, Los Angeles Water Sector, Second Tier Industries



Source: Economic Roundtable analysis; California Employment Development Department. 2011. *Quarterly Census of Employment and Wages 2009*; Los Angeles County; Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software.

Ownership Type

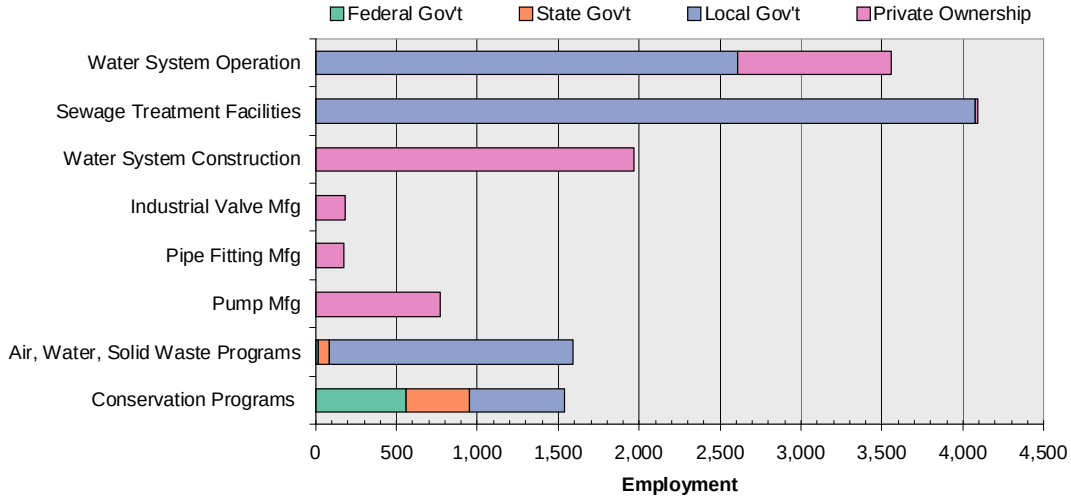
Figure 3.8
Employment by Ownership Type, 1st Tier



Los Angeles' water sector establishments can be divided into public versus private *ownership*, and public-owned establishments can be further divided into local, state or federal government ownership. This information can inform public sector growth strategies and guide public investment in water use efficiency projects.

In the first tier water sector industries, the public sector accounts for 71 percent of employment, with local government accounting for 64 percent of the total (Figure 3.8). Public agencies have significant leverage with regards to local purchasing decisions, and this is especially the case in *Sewage Treatment Facilities*, *Water System Operations*, and administration of *Air, Water, Solid Waste Programs* (Figure 3.9).

Figure 3.9
Employment by Ownership Type, Los Angeles Water Sector, First Tier Industries



The second tier of the local water sector is overwhelmingly privately-owned (Figure 3.10), with the public sector accounting for less than one percent of employment. Only two of these industries have notable shares of public ownership, *Engineering Services* and *Environmental Organizations* (Figure 3.11). These local providers of goods and services to the first tier water sector could benefit substantially from local purchasing by local government agencies, boosting private sector growth and ability to produce regional exports. Such local purchasing would impact a range of industries.

Figure 3.10
Employment by Ownership Type, 2nd Tier

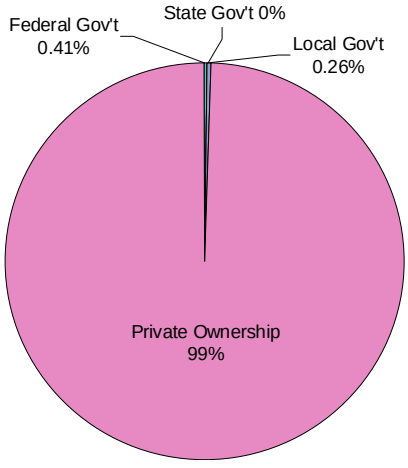
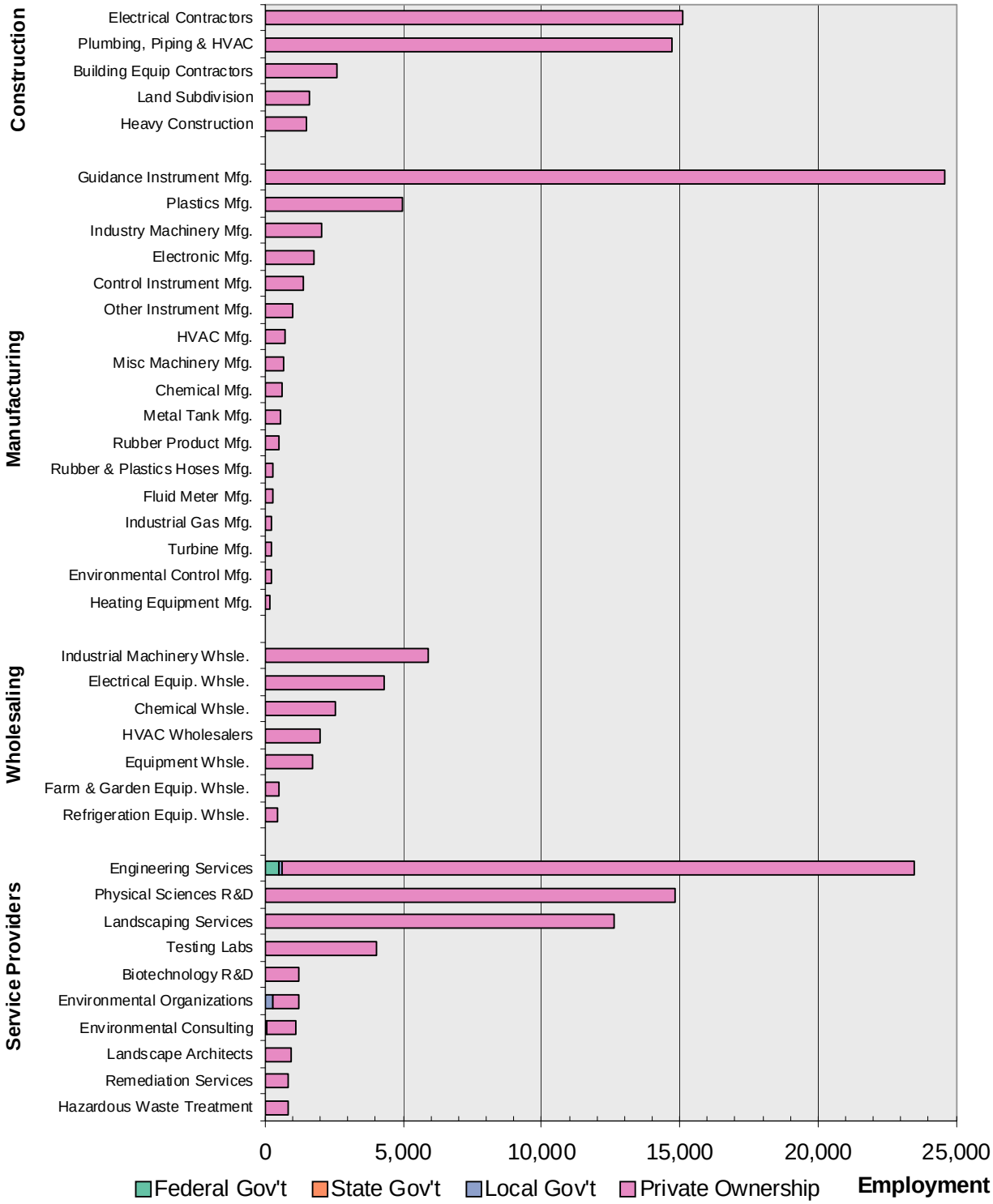


Figure 3.11
Employment by Ownership Type, Los Angeles Water Sector, Second Tier Industries



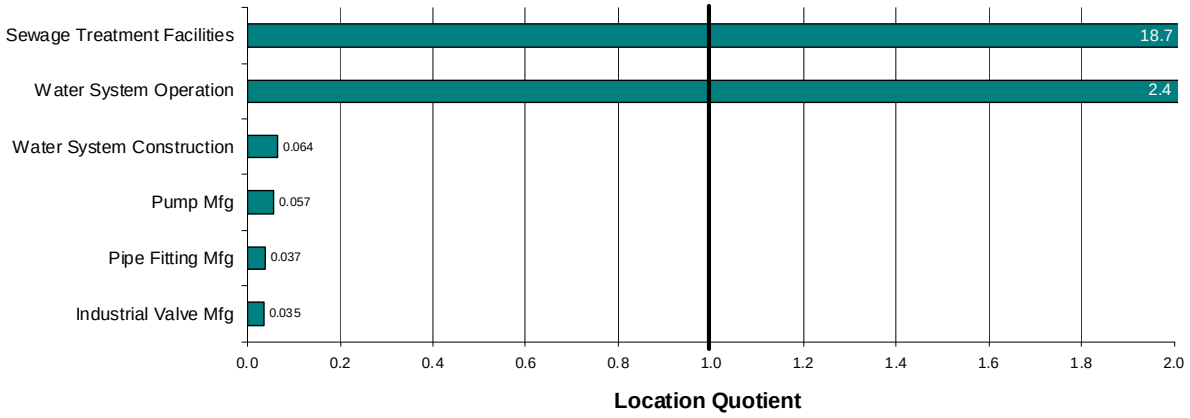
Source: Economic Roundtable analysis; California Employment Development Department. 2011. *Quarterly Census of Employment and Wages 2009*; Los Angeles County. This is the source of the preceding three figures as well.

Location Quotient

We use *location quotients* to compare Los Angeles' economy to that of the nation in regards to industry employment.[34] This measure establishes the distribution of employment among industries across the entire US as the norm, and we compare Los Angeles' employment levels to that norm, industry by industry. For example, if Los Angeles employs 2.6 percent of its' overall workforce in the *Motion Picture and Video Production* industry (NAICS 512110), while the nation only employs 0.3 percent of its overall workforce in the same industry, Los Angeles has a stronger presence in this industry, or *regional competitive advantage*. The location quotient for this example is 8.6, arrived at by dividing the percent of local employment in the *Motion Picture and Video Production* industry by the national percent.

In Los Angeles' water sector, we find that among the six industries in the first tier, the *Sewage Treatment Facilities* and *Water Supply and Irrigation Systems* industries have the strongest presence in the county (Figure 3.12). The former employs *18 times* as large a share of the labor force in the county as in the nation, while the latter has a local employment share that is over twice as large as the national share. However, *Water and Sewer Line and Related Structures Construction* industries, as well as those manufacturing *Pump and Pumping Equipment, Other Metal Valve and Pipe Fittings, and Industrial Valves*, are very weakly represented in the county.

Figure 3.12
Employment Location Quotient for the Los Angeles Water Sector, First Tier Industries



Source: Economic Roundtable analysis; U.S. Census Bureau, *County Business Patterns 2009*. U.S. Government Printing Office, Washington, DC, 2011; California Employment Development Department. 2011. *Quarterly Census of Employment and Wages 2009*; Los Angeles County.

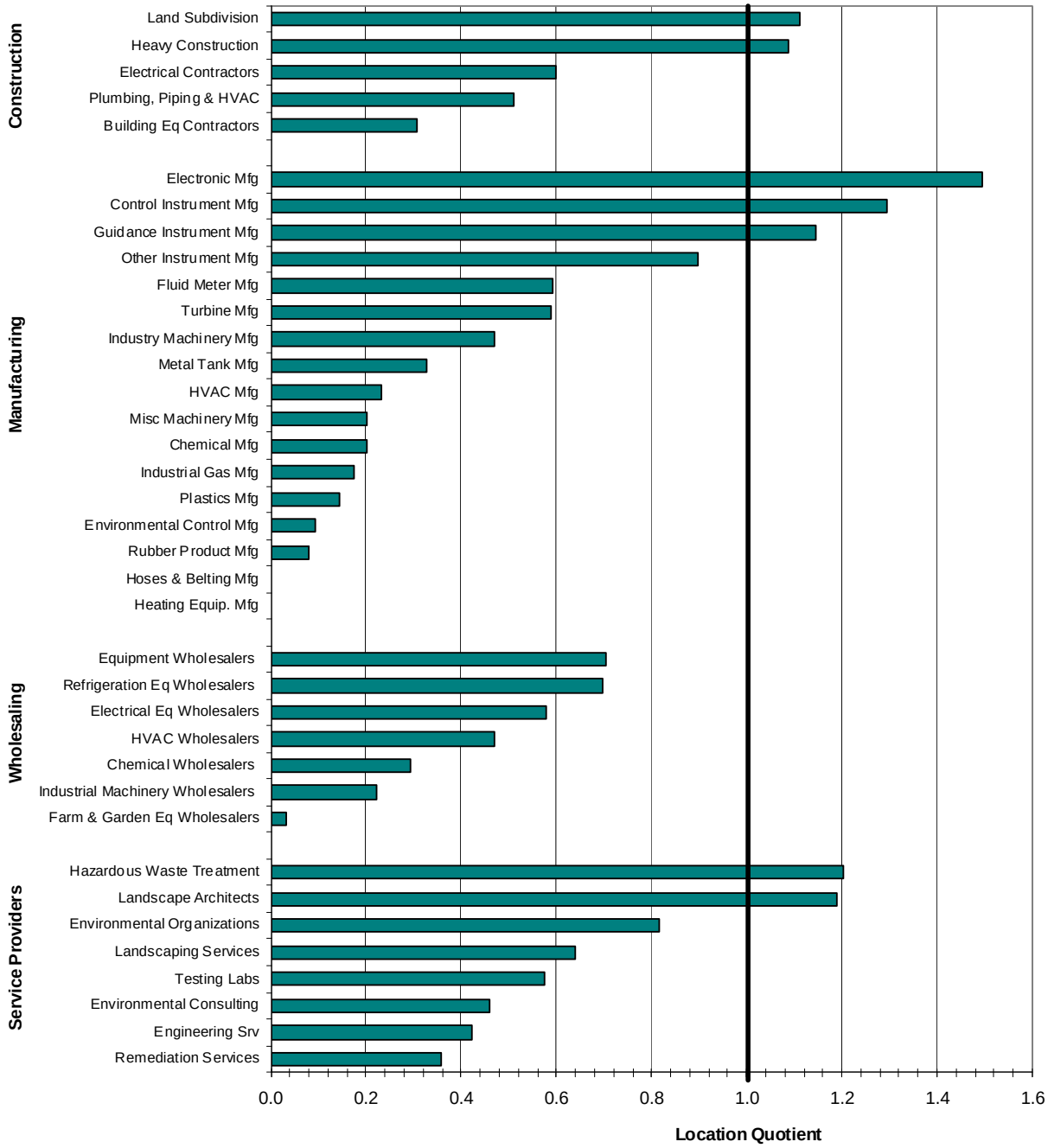
Industries in the second tier of the water sector also have mixed indicators of competitive strength as measured by the location quotient. Industries with competitive strength present opportunities for local growth (Figure 3.13). Given the large number of NAICS industry coved in the second tier of the water sector, this analysis groups them into four larger economic sectors.

The *construction* sector includes two industries with above-average employment concentration in Los Angeles, compared with the nation. Despite the severe economic downturn and significant layoffs at residential and commercial real estate construction businesses, Los Angeles nonetheless has resilience in some of the construction businesses that build water and

sewage system infrastructure.

Los Angeles' regional competitive advantage in *manufacturing* is mixed, with four industries exceeding or close to the national average: *Electronic Component Manufacturing*,

Figure 3.13
Employment Location Quotient for the Los Angeles Water Sector, Secondary Tier Industries



Source: Economic Roundtable analysis; U.S. Census Bureau, *County Business Patterns 2009*. U.S. Government Printing Office, Washington, DC, 2011; California Employment Development Department. 2011. *Quarterly Census of Employment and Wages 2009*; Los Angeles County.

Instruments and Related Products Manufacturing for Measuring, Displaying, and Controlling Industrial Process Variables, Search, Detection, Navigation System and Instrument Manufacturing, and *Other Measuring and Controlling Device Manufacturing*. These products figure prominently in automated, electronically-controlled water treatment, storage and distribution systems. However, most manufacturing industries – including some of the less sophisticated manufacturing parts supplied to the water sector, such as those based on plastics, rubber and other chemicals – are again very weakly represented in Los Angeles County. Further, employment related to *wholesale trade* in the water sector is not strongly represented in Los Angeles, compared to the national average.

Service providers to the water sector present a mix of strength, opportunity and weakness in Los Angeles, based on their location quotient. Los Angeles is strongly represented by employers in *Hazardous Waste Treatment and Disposal* services and *Landscape Architects' Offices*, and is not far off the national average in the *Environment, Conservation and Wildlife Organization* employment. Given the erosion of Los Angeles' earlier manufacturing sector, it is perhaps understandable that its overall *Engineering Services* industry is less than half of the national average, although this broad sector is an important knowledge-based component of the water sector.

While a majority of second tier industries in Los Angeles' water sector demonstrate less competitive strength in Los Angeles county than in the nation, many of the largest and most important industries are highly competitive and represent important opportunities for growth. In addition, another group of water sector industries has significant size in Los Angeles and levels of labor force concentration in Los Angeles that approach the national average, providing additional opportunities for growth. Industry leaders in the first and second tiers of the local water sector include:

- Sewage Treatment Facilities (NAICS 221320) LQ = 18.732
- Water Supply and Irrigation Systems (NAICS 221310) LQ = 2.361
- Other Electronic Component Manufacturing (NAICS 334419) LQ = 1.493
- Instruments and Related Products Manufacturing for Measuring, Displaying, and Controlling Industrial Process Variables (NAICS 334513) LQ = 1.296
- Hazardous Waste Treatment and Disposal (NAICS 562211) LQ = 1.202
- Architects' offices, Landscape (NAICS 541320) LQ = 1.191
- Search, Detection, Navigation System and Instrument Manufacturing (NAICS 334511) LQ = 1.145
- Land Subdivision (NAICS 237210) LQ = 1.112
- Other Heavy and Civil Engineering Construction (NAICS 237990) LQ = 1.087

Large industries with significant competitive strength include:

- Search, Detection, Navigation System and Instrument Manufacturing (NAICS 334511) 2,096 employees
- Sewage Treatment Facilities (NAICS 221320) 1,518 employees
- Water Supply and Irrigation Systems (NAICS 221310) 1,044 employees
- Other Electronic Component Manufacturing (NAICS 334419) 1,035 employees

Los Angeles' water sector has the potential to be a growth engine and to expand even in recessionary conditions because of the long-term necessity to create more reliable local water sources and greatly reduce our reliance on increasingly scarce and more expensive imported water.

Chapter 4

Jobs and Occupations in the Water Sector

Introduction

This section identifies key *occupations* in Los Angeles' water sector, first with information about individual job characteristics and then by clusters of related occupations representing potential career ladders for workers. Information presented about occupations includes: employment and wage estimates (hourly and annual mean, median, 10th, 25th, 75th, and 90th percentile wages), as well as associated skill levels required for employment.

Key Occupations in Los Angeles' Water Sector

Across Los Angeles County's overall economy, certain occupations are strongly involved with water use efficiency efforts. While industries in Los Angeles' water sector identified in the previous chapter directly employ a wide variety of occupations – from construction laborers, cement masons and truck drivers to architects, accountants and secretaries – in this chapter we focus on a subset of occupations in those industries with responsibilities directly tied to water use efficiency. This includes workers involved with the operation and maintenance of municipal water infrastructure, wastewater systems, water systems equipment and services, related engineering services, and residential and commercial landscaping maintenance.

- Landscaping and Groundskeeping Workers (37-3011)
- Grounds Maintenance Workers, All Other (37-3019)
- Tree Trimmers and Pruners (37-3013)
- Septic Tank Servicers and Sewer Pipe Cleaners (47-4071)
- Pesticide Handlers, Sprayers, and Applicators, Vegetation (37-3012)
- Meter Readers, Utilities (43-5041)
- Pipelayers (47-2151)
- Plumbers, Pipefitters, and Steamfitters (47-2152)
- Water and Wastewater Treatment Plant and System Operators (51-8031)
- Environmental Scientists and Specialists (19-2041)
- Geoscientists, Except Hydrologists and Geographers (19-2042)
- Conservation Scientists (19-1031)
- Environmental Engineers (17-2081)
- Hydrologists (19-2043)

These occupations employ an estimated 34,350 workers in Los Angeles County; approximately 1 percent of the county's total employed workforce, spread across multiple industries (Table 4.1). Mean wages range from $13.65 to $47.80 per hour, or $28,390 to $99,430 annually. The location quotient for these occupations, which indicates whether Los Angeles employs a larger or smaller share of them in its labor force compared to the nation as a whole, indicates that *Tree Trimmers and Pruners* (1.62) and *Environmental Engineers* (0.81) are the most strongly represented. All told, there are approximately nine jobs in these occupations

for every 1,000 jobs in the over-all economy, although most of this employment is attributable to Los Angeles' abundance of Landscaping and Groundskeeping Workers.[35]

Table 4.1
Characteristics for Individual Water Occupations in 2010:
Employment, Mean Hourly and Annual Wages

Occupation Title (SOC Code)	Total Employment, Estimated	Jobs Per 1000 Total Jobs (of any Occup.) In the LA Area	Location Quotient (Compared to US)	Mean Hourly Wage	Mean Annual Wage
Landscaping & Groundskeeping Workers (37-3011)	18,380	4.815	0.738	$13.65	$28,390
Grounds Maintenance Workers, All Other (37-3019)	**	**	**	$15.15	$31,510
Tree Trimmers & Pruners (37-3013)	1,820	0.477	1.615	$15.80	$32,870
Septic Tank Servicers & Sewer Pipe Cleaners (47-4071)	370	0.098	0.512	$17.07	$35,500
Pesticide Handlers, Sprayers, & Applicators, Vegetation (37-3012)	180	0.048	0.263	$18.94	$39,400
Meter Readers, Utilities (43-5041)	960	0.252	0.797	$22.21	$46,200
Pipelayers (47-2151)	370	0.097	0.272	$22.62	$47,060
Plumbers, Pipefitters, & Steamfitters (47-2152)	6,630	1.737	0.615	$28.26	$58,790
Water and Wastewater Treatment Plant & System Operators (51-8031)	1,770	0.463	0.543	$33.09	$68,820
Environmental Scientists & Specialists (19-2041)	1,780	0.466	0.725	$36.36	$75,630
Geoscientists, Except Hydrologists & Geographers (19-2042)	740	0.193	0.796	$38.53	$80,130
Conservation Scientists (19-1031)	70	0.018	0.121	$38.80	$80,700
Environmental Engineers (17-2081)	1,210	0.318	0.812	$40.05	$83,310
Hydrologists (19-2043)	70	0.018	0.331	$47.80	$99,430
Total	34,350	9.000			

Source: US Bureau of Labor Statistics. 2011. *May 2010 Metropolitan and Nonmetropolitan Area Occupational Employment and Wage Estimates, Los Angeles-Long Beach-Glendale, CA Metropolitan Division*. Washington, D.C. Data Last Modified: May 17, 2011. Notes: The estimated total employment is rounded to the nearest 10, and excludes the self-employed. ** = indicates that an employment estimate is not available. Sorted in ascending order by Mean Annual Wage.

The entry-level hourly wage for these 14 occupations includes two below $10 per hour, seven between $10 and $15 per hour, and five above $20 per hour (Table 4.2). The estimated median hourly wage, the wage earned by the typical worker, further illustrates the gradation of

these occupations from low-income to high-income. The hourly median wage ranges from $11.75 to $47.05 – a span of over $35 per hour. The two skilled trades occupations, *Pipelayers* and *Plumbers, Pipefitters, and Steamfitters*, are the middle-class 'bridge' in this range between lower and higher waged jobs, and are significantly unionized in Los Angeles.

Table 4.2
Characteristics for Individual Water Occupations in 2010:
Hourly Entry-Level Wage, Hourly Wage Quartiles

Occupation Title (SOC Code)	Hourly 10th Percentile Wage (Entry-Level)	Hourly 25th Percentile Wage	Hourly Median Wage (50th Percentile)	Hourly 75th Percentile Wage	Hourly 90th Percentile Wage
Landscaping & Groundskeeping Workers (37-3011)	$9.01	$10.16	$11.75	$16.03	$21.90
Grounds Maintenance Workers, All Other (37-3019)	$9.53	$10.55	$12.79	$17.33	$27.33
Tree Trimmers & Pruners (37-3013)	$10.47	$11.61	$15.04	$18.78	$22.52
Septic Tank Servicers & Sewer Pipe Cleaners (47-4071)	$12.23	$13.74	$16.43	$19.31	$23.83
Pesticide Handlers, Sprayers, and Applicators, Vegetation (37-3012)	$11.14	$15.50	$18.85	$23.22	$26.82
Meter Readers, Utilities (43-5041)	$15.26	$17.12	$20.20	$28.49	$31.36
Pipelayers (47-2151)	$13.10	$16.11	$22.01	$28.95	$33.66
Plumbers, Pipefitters, & Steamfitters (47-2152)	$14.18	$19.22	$26.74	$37.90	$44.60
Water and Wastewater Treatment Plant & System Operators (51-8031)	$22.22	$27.76	$34.08	$39.02	$43.67
Environmental Scientists & Specialists (19-2041)	$24.38	$30.04	$34.48	$42.60	$51.10
Geoscientists, Except Hydrologists & Geographers (19-2042)	$18.54	$24.47	$34.63	$47.91	$57.41
Conservation Scientists (19-1031)	$22.29	$28.95	$35.95	$45.34	$65.36
Environmental Engineers (17-2081)	$24.03	$30.66	$39.15	$48.49	$57.20
Hydrologists (19-2043)	$28.49	$35.29	$47.05	$54.96	$64.46

Source: US Bureau of Labor Statistics. 2011. *May 2010 Metropolitan and Nonmetropolitan Area Occupational Employment and Wage Estimates, Los Angeles-Long Beach-Glendale, CA Metropolitan Division*. Washington, D.C. Data Last Modified: May 17, 2011. Notes: The estimated total employment figures are rounded to the nearest 10, and exclude the self-employed. Sorted in ascending order by Mean Annual Wage. The Hourly 10th Percentile Wage is used as an estimate for the Entry-Level Wage.

The corresponding table, presenting annual rather than hourly wages, shows that Los Angeles County workers in these occupations have median annual earnings between $24,430 and $97,870 (Table 4.3).

Table 4.3
Characteristics for Individual Water Occupations in 2010:
Annual Entry-Level Wage, Average Wage Quartiles

Occupation Title (SOC Code)	Annual 10th Percentile Wage (Entry Level)	Annual 25th Percentile Wage	Annual Median Wage (50th Percentile)	Annual 75th Percentile Wage	Annual 90th Percentile Wage
Landscaping & Groundskeeping Workers (37-3011)	$18,740	$21,140	$24,430	$33,350	$45,550
Grounds Maintenance Workers, All Other (37-3019)	$19,820	$21,940	$26,610	$36,040	$56,850
Tree Trimmers & Pruners (37-3013)	$21,770	$24,140	$31,290	$39,070	$46,840
Septic Tank Servicers & Sewer Pipe Cleaners (47-4071)	$25,430	$28,580	$34,180	$40,170	$49,560
Pesticide Handlers, Sprayers, & Applicators, Vegetation (37-3012)	$23,180	$32,250	$39,200	$48,300	$55,780
Meter Readers, Utilities (43-5041)	$31,740	$35,610	$42,010	$59,270	$65,220
Pipelayers (47-2151)	$27,250	$33,500	$45,790	$60,220	$70,020
Plumbers, Pipefitters, & Steamfitters (47-2152)	$29,490	$39,970	$55,610	$78,830	$92,760
Water and Wastewater Treatment Plant & System Operators (51-8031)	$46,220	$57,740	$70,890	$81,170	$90,820
Environmental Scientists & Specialists (19-2041)	$50,710	$62,490	$71,710	$88,600	$106,290
Geoscientists, Except Hydrologists & Geographers (19-2042)	$38,560	$50,890	$72,040	$99,650	$119,420
Conservation Scientists (19-1031)	$46,360	$60,220	$74,780	$94,310	$135,960
Environmental Engineers (17-2081)	$49,990	$63,780	$81,440	$100,850	$118,980
Hydrologists (19-2043)	$59,260	$73,400	$97,870	$114,320	$134,080

Source: US Bureau of Labor Statistics. 2011. *May 2010 Metropolitan and Nonmetropolitan Area Occupational Employment and Wage Estimates, Los Angeles-Long Beach-Glendale, CA Metropolitan Division*. Washington, D.C. Data Last Modified: May 17, 2011. Notes: The estimated total employment figures are rounded to the nearest 10, and exclude the self-employed. Sorted in ascending order by Mean Annual Wage. The Annual 10th Percentile Wage is used as an estimate for the Entry-Level Wage.

Occupational Clusters and Potential Career Ladders

The second part of this chapter on Los Angeles water sector occupations presents information about four occupational clusters with potential career ladders for aspiring workers. These occupational clusters are groupings of related occupations involved in a common type of water use efficiency work, such as the construction of underground drainage systems, groundwater recharge or the installation of roof-top rainwater capture and diversion systems. The occupational clusters we present are for 1) *Building and Grounds / Forest and Conservation* workers, 2) *Construction* workers, 3) *Maintenance and Repair* workers, and 4) *Architecture and Engineering* workers.

Each of the following occupational clusters presents six or more occupation titles along with information on current employment levels, wages, and required levels of education, related work experience, and skill requirements. The occupations are sorted left-to-right by average hourly wage, representing a progression from lower to better paying jobs, and opportunities for workers to acquire additional knowledge and skills and advance to higher paying jobs. These "career ladders" typically require greater education, experience and/or skills for workers to make economic progress, although the formula for advancement up any given career ladder can demand different combinations of these worker qualifications, and additional attributes such as social skills for being an effective and collaborative team member.

The occupational clusters and potential career ladder tables include the following Los Angeles County-specific data for each occupation:

- Total employment in Los Angeles County in May 2010, rounded to the nearest 10 (estimated, excludes the self-employed).
- Entry-level hourly wage, which is estimated using the 10th percentile hourly wage.
- Average hourly wage for all workers in this occupation.
- Jobs per 1,000 – the number of jobs (employment) in the given occupation per 1,000 total jobs in the given area, Los Angeles County.
- Location quotient, which is the ratio of an occupation's share of employment in Los Angeles County to the share in the U.S. as a whole.
- Educational attainment, with is the educational profile of workers in each occupation.
- Work experience, which is the months or years of work experience that employers report is required to become proficient in the occupation.
- Skill levels, which is the level of development in each skill area that is required for the occupation.

Employment and wage data are from the Occupational Employment Survey[36], while the education, related work and skills variables come from the Occupational Information Network (O*NET) system.[37]

Building and Grounds / Forest and Conservation Workers

The occupational cluster for Building and Grounds / Forest and Conservation workers includes four service and two supervisor occupations (Table 4.4). The cluster includes workers involved ecosystem-based strategies for improved water use efficiency, wherein landscaping and native plants help reduce surface run-off and boost groundwater recharge from stormwater.

Table 4.4
Occupational Cluster: Building and Grounds / Forest and Conservation Workers in Los Angeles County

	Nursery Workers	Forest & Conservation Workers	Landscaping & Grounds-keeping Workers	Tree Trimmers & Pruners	Mgrs. of Horticultural Workers	Mgrs. of Landscaping, & Groundskeeping Workers
Occupation Code (O*NET)	45-2092.01	45-4011.00	37-3011.00	37-3013.00	45-1011.07	37-1012.00
Total Employment	1,200	170	18,380	1,820	130	1,890
Entry-Level Hourly Wage	$8.32	$8.04	$9.01	$10.47	$11.44	$12.82
Average Hourly Wage	$9.68	$9.75	$13.65	$15.80	$22.50	$24.27
Jobs per 1,000	0.315	0.045	4.815	0.477	0.035	0.496
Location Quotient	0.175	0.813	0.738	1.615	0.228	0.626
	Education (Columns add up to 100%)					
Less than a H.S. Diploma	23%	8%	52%	42%	20%	0%
High School Diploma or GED	57%	21%	26%	46%	45%	55%
Post-Secondary Certificate	1%	2%	16%	1%	1%	3%
Some College or AA Degree	6%	22%	2%	10%	16%	40%
Bachelor's (4 yr.) Degree	0%	36%	4%	0%	18%	1%
Graduate Certificate or Degree	13%	11%	0%	1%	0%	0%
	Work Experience Required for Occupational Proficiency (Columns add up to 100%)					
None	46%	9%	37%	23%	39%	4%
Up through 6 months	29%	0%	14%	26%	25%	12%
7 to 12 months	16%	8%	16%	16%	2%	2%
More than 1 year	9%	82%	33%	35%	34%	82%
	Skill Level (Scale 0-100; highest level = 100)					
Reading Comprehension	36	39	32	37	54	46
Active Listening	39	41	36	41	50	46
Writing	34	36	30	36	46	46
Speaking	34	37	36	37	50	52
Mathematics	27	29	18	21	43	36
Science	13	29	13	20	21	5
Critical Thinking	36	39	32	41	48	50
Active Learning	32	32	25	30	43	45
Instructing	36	34	27	43	45	43
Complex Problem Solving	34	37	34	39	46	46
Installation	0	0	0	0	5	4
Programming	0	13	0	0	11	7
Repairing	14	23	27	30	37	32
Quality Control Analysis	30	34	32	39	43	39
Judgment and Decision Making	37	39	36	41	50	48
Systems Analysis	25	34	27	23	45	37
Time Management	34	37	34	45	52	45

Source: U.S. Bureau of Labor Statistics. 2011. *Occupational Employment and Wages, May 2010*. Washington, D.C. O*NET, U.S. Department of Labor, Employment and Training Administration. 2011. *O*NET Version 15.0 Databases: Education, Training & Experience and Skills Tables*.

The largest occupation is *Landscaping and Groundskeeping Workers*, with an estimated 18,380 workers in Los Angeles County as of May 2010. All six occupations have entry-level wages below $13 per hour, but the average wage for the two supervising occupations (*Managers of Horticultural Workers* and *Managers of Landscaping, and Groundskeeping Workers*) is over $20 per hour. The educational attainment required for these occupations is predominantly high school level or less, aside from *Forest and Conservation Workers* (which requires at least some college training 71 percent of the time). Several occupations require six months or less of work experience, making these jobs good targets for young workers and those dislocated from other, unrelated industries by layoffs. The level of development required for several basic skills – such as reading comprehension, active listening, writing and speaking – start in the 30's for the four service occupations and then rise into the 40's and 50's for the two supervisor occupations. (Definitions of these selected O*NET skills and examples of skill levels appear in Appendix B.)

As investments in water efficient landscaping and building construction increase, this occupational cluster can be expected to expand. Increased demand for these workers may bring about an increase in the levels of education and skill development that are required, and may raise the wage floor and ceiling for these workers.

Construction Workers

The occupational cluster for Construction workers includes 16 occupations – the largest in the water sector – and covers workers involved in several types of water use efficiency projects: surface and subsurface water infrastructure and facilities, installation of graywater systems in residential and commercial buildings, and modification of streets and sidewalks for stormwater capture (Table 4.5a-b-c). This cluster captures traditional construction occupations rather than just new, "green" ones. Nonetheless, workers involved in building water use efficiency projects are installing innovative equipment, technologies and hardware that enable the region to safeguard its limited water resources, with workers likely gaining skills specific to these water use efficiency projects in the process. Given the region's recent real estate construction boom and bust, there is a great need to help general construction workers transition into new types of building projects.

With the broad array of occupations and specialties within the construction field, there are several at the lower end of the career ladder that can enable workers with limited education, experiences and skills to find work. The occupations of *Roofers' Helpers*, *Septic Tank Servicers and Sewer Pipe Cleaners*, *Solar Photovoltaic Installers*, *Electricians' Helpers*, and *Construction Laborers* add up to a significant number of jobs in Los Angeles County despite the current recession, all starting at less than $11 per hour in wages. The level of education required is typically a high school diploma or less, although these trades often require apprenticeship time. This apprentice training can be seen in the work experience required of occupations in Table 4.5b. The occupation *Segmental Pavers* captures some of the workers installing new, porous, pervious pavement surfaces that allow stormwater to seep into the ground, recharging groundwater and helping meet U.S. Environmental Protection Agency stormwater regulations.[38]

The average hourly wages for *Roofers*, *Pipelayers*, *Cement Masons and Concrete Finishers*, *Structural Iron and Steel Workers*, *Earth Drillers*, and *Carpenters* are above $20 per hour, even though their educational requirements are not much different than lesser paid construction occupations. These jobs currently employ over 18,000 workers in Los Angeles

Table 4.5a
Occupational Cluster: Construction Workers in Los Angeles County (Part 1 of 3)

	Helpers--Roofers	Septic Tank Servicers & Sewer Pipe Cleaners	Solar Photovoltaic Installers	Helpers--Electricians	Construction Laborers	Segmental Pavers
Occupation Code (O*NET)	47-3016.00	47-4071.00	47-4099.01	47-3013.00	47-2061.00	47-4091.00
Total Employment	430	370	110	1,300	20,730	150
Entry-Level Wage	$10.18	$12.23	$9.59	$11.96	$10.62	$12.90
Average Wage	$12.58	$17.07	$18.85	$19.09	$19.27	$19.89
Jobs per 1,000	0.112	0.098	0.008	0.340	5.430	0.011
Location Quotient	**	0.512	**	0.597	0.887	1.089
	Education (Columns add up to 100%)					
Less than a H.S. Diploma	33%	46%	33%	27%	25%	7%
High School Diploma or GED	43%	37%	48%	50%	37%	59%
Post-Secondary Certificate	0%	16%	7%	20%	12%	31%
Some College or AA Degree	8%	1%	4%	2%	5%	4%
Bachelor's (4 yr.) Degree	0%	0%	0%	0%	22%	0%
Graduate Certificate or Degree	16%	0%	8%	0%	0%	0%
	Work Experience Required for Occupational Proficiency (Columns add up to 100%)					
None	36%	21%	26%	33%	18%	15%
Up through 6 months	25%	9%	14%	19%	15%	3%
7 to 12 months	1%	15%	3%	18%	4%	31%
More than 1 year	38%	56%	58%	30%	63%	51%
	Skill Level (Scale 0-100; highest level = 100)					
Reading Comprehension	32	43	71	36	34	39
Active Listening	36	41	75	39	37	43
Writing	30	41	57	29	25	37
Speaking	29	32	65	37	37	39
Mathematics	25	37	50	14	7	29
Science	0	5	7	4	11	2
Critical Thinking	32	46	75	39	34	43
Active Learning	30	39	62	36	25	36
Instructing	30	39	62	27	25	37
Complex Problem Solving	37	43	80	36	36	39
Installation	14	20	19	30	16	7
Programming	5	0	5	0	0	0
Repairing	29	45	36	39	21	29
Quality Control Analysis	37	41	67	37	34	37
Judgment and Decision Making	34	39	73	32	29	37
Systems Analysis	29	36	49	9	5	30
Time Management	36	37	75	25	32	41

Source: U.S. Bureau of Labor Statistics. 2011. Occupational Employment and Wages, Los Angeles County, May 2010. Washington, D.C. O*NET, U.S. Department of Labor, Employment and Training Administration. 2011. O*NET Version 15.0 Databases: Education, Training & Experience and Skills Tables.

Table 4.5b
Occupational Cluster: Construction Workers in Los Angeles County (Part 2 of 3)

	Roofers	Pipelayers	Cement Masons & Concrete Finishers	Structural Iron & Steel Workers	Earth Drillers (Except Oil & Gas)	Carpenters
Occupation Code (O*NET)	47-2181.00	47-2151.00	47-2051.00	47-2221.00	47-5021.00	47-2031.00
Total Employment	1,580	370	2,700	1,760	870	10,810
Entry-Level Wage	$13.76	$13.10	$11.90	$9.52	$15.77	$13.25
Average Wage	$21.83	$22.62	$23.24	$24.15	$24.43	$24.50
Jobs per 1,000	0.413	0.097	0.707	0.460	0.062	2.831
Location Quotient	0.529	0.272	0.638	1.000	0.486	0.580
	Education (Columns add up to 100%)					
Less than a H.S. Diploma	34%	72%	52%	4%	28%	11%
High School Diploma or GED	52%	23%	35%	64%	46%	53%
Post-Secondary Certificate	14%	2%	13%	13%	15%	25%
Some College or AA Degree	0%	3%	0%	17%	11%	9%
Bachelor's (4 yr.) Degree	0%	0%	0%	1%	0%	0%
Graduate Certificate or Degree	0%	0%	0%	0%	0%	2%
	Work Experience Required for Occupational Proficiency (Columns add up to 100%)					
None	17%	37%	16%	0%	7%	12%
Up through 6 months	2%	38%	23%	10%	33%	9%
7 to 12 months	5%	12%	19%	17%	6%	6%
More than 1 year	77%	13%	42%	73%	54%	73%
	Skill Level (Scale 0-100; highest level = 100)					
Reading Comprehension	39	37	30	41	32	39
Active Listening	39	39	34	41	39	38
Writing	27	21	23	34	29	37
Speaking	36	37	34	34	36	38
Mathematics	25	23	43	34	18	46
Science	7	7	4	7	9	10
Critical Thinking	43	39	36	45	37	45
Active Learning	32	29	29	39	34	38
Instructing	32	27	34	37	39	39
Complex Problem Solving	43	32	37	36	41	37
Installation	5	23	11	16	14	23
Programming	0	0	0	0	0	0
Repairing	7	39	11	32	43	38
Quality Control Analysis	30	41	37	45	41	43
Judgment and Decision Making	39	37	32	37	37	40
Systems Analysis	20	23	25	30	21	33
Time Management	39	37	39	43	32	41

Source: U.S. Bureau of Labor Statistics. 2011. Occupational Employment and Wages, Los Angeles County, May 2010. Washington, D.C. O*NET, U.S. Department of Labor, Employment and Training Administration. 2011. O*NET Version 15.0 Databases: Education, Training & Experience and Skills Tables.

Table 4.5c
Occupational Cluster: Construction Workers in Los Angeles County (Part 3 of 3)

	Electricians	Pipe Fitters & Steamfitters	Plumbers	Mgrs. of Construction Trades & Extraction Workers
Occupation Code (O*NET)	47-2111.00	47-2152.01	47-2152.02	47-1011.00
Total Employment	9,120	6,630	6,630	7,660
Entry-Level Wage	$14.34	$14.18	$14.18	$20.80
Average Wage	$27.84	$28.26	$28.26	$35.04
Jobs per 1,000	2.388	1.737	1.737	2.006
Location Quotient	0.590	0.615	0.615	0.537
	Education (Columns add up to 100%)			
Less than a H.S. Diploma	0%	0%	9%	7%
High School Diploma or GED	29%	26%	52%	54%
Post-Secondary Certificate	48%	69%	33%	10%
Some College or AA Degree	24%	5%	7%	20%
Bachelor's (4 yr.) Degree	0%	0%	0%	9%
Graduate Certificate or Degree	0%	0%	0%	0%
	Work Experience Required for Occupational Proficiency (Columns add up to 100%)			
None	4%	0%	11%	17%
Up through 6 months	0%	0%	0%	0%
7 to 12 months	0%	3%	15%	7%
More than 1 year	96%	97%	74%	77%
	Skill Level (Scale 0-100; highest level = 100)			
Reading Comprehension	50	43	46	50
Active Listening	48	43	46	52
Writing	43	37	41	45
Speaking	45	41	43	52
Mathematics	50	41	36	37
Science	32	5	23	21
Critical Thinking	50	45	50	48
Active Learning	50	37	45	41
Instructing	48	45	43	46
Complex Problem Solving	46	43	45	43
Installation	48	27	32	11
Programming	5	0	0	5
Repairing	55	43	48	25
Quality Control Analysis	54	43	45	45
Judgment and Decision Making	50	41	43	46
Systems Analysis	43	39	41	41
Time Management	48	41	43	50

Source: U.S. Bureau of Labor Statistics. 2011. Occupational Employment and Wages, Los Angeles County, May 2010. Washington, D.C. O*NET, U.S. Department of Labor, Employment and Training Administration. 2011. O*NET Version 15.0 Databases: Education, Training & Experience and Skills Tables.

County, with a significant number unionized.[39] As previously mentioned, these building trades occupations require significantly more work experience to become proficient than less skilled construction occupations. Also, their required skills levels are higher, with the exception of science and programming skills. Interestingly, *Structural Iron and Steel Workers* have the highest location quotient (1.00) of any occupation in this cluster studied. This means that the estimated 1,760 workers in Los Angeles County make up the same share of the county's total employment as do workers in this occupation at the national level.

The highest paid strata of construction occupations in this cluster – the top of the jobs ladder – have average hourly wages above $25 per hour. Just over 30,000 workers are employed in Los Angeles County as *Electricians, Pipe Fitters and Steamfitters, Plumbers* and their first-line supervisors and managers. While not requiring education beyond some college or an Associate's Degree, most require at least one, and in some cases four, six or even eight years of experience. The required levels of skill development in many occupations, including *Instructing* and *Complex Problem Solving*, are in the 40's and 50's.

Maintenance and Repair Workers

The occupational cluster for Maintenance and Repair workers includes six occupations and covers workers involved in building and facility retrofitting, as well as auditing of water irrigation systems and repair of automated/mechanical water control systems (Table 4.6). Estimated employment for these occupations adds up to 12,480 jobs in Los Angeles County. The two lowest rungs of this career ladder are *Installation, Maintenance and Repair Workers' Helpers* and *Electric Motor, Power Tool, and Related Repairers*, occupations with entry-level wages starting below $10 per hour. In these and other occupations of the Maintenance and Repair cluster, a post-secondary school certification or some college is required. Work experience is also frequently required.

Aside from *Installation, Maintenance and Repair Workers' Helpers*, all of these occupations currently pay average hourly wages above $20 per hour. A more diversified set of skills is also demanded in this cluster, with higher skill levels needed for *Electrical Repairers, Commercial and Industrial Equipment.* Location quotients for *Installation, Maintenance and Repair Workers' Helpers, Electric Motor, Power Tool, and Related Repairers, Electrical Repairers, Commercial and Industrial Equipment* and *Control and Valve Installers and Repairers* are all high, indicating the Los Angeles' work force is well represented in these occupations compared to the nation as a whole.

Architecture and Engineering Workers

The occupational cluster for Architecture and Engineering workers covers six occupations involved with planning and rendering water use efficiency systems, both indoors and across the broader urban landscape (Table 4.7). These workers' contributions to meeting Los Angeles' water use efficiency goals take the form of problem-solving – designing new systems for water conservation and reuse, engineering ways to divert stormwater into Los Angeles' greatly depleted aquifer, applying new technologies to decontaminate waters affected by several decades of industrial pollution, and desalinizing waters for local use. Employing over 10,000 workers in Los Angeles County, this cluster is distinct in that it consists of "professional" occupations requiring significant amounts of higher education and related work experience, and

Table 4.6
Occupational Cluster: Maintenance and Repair Workers in Los Angeles County

	Helpers--Installation, Maintenance & Repair Workers	Electric Motor, Power Tool, & Related Repairers	Heating & Air Conditioning Mechanics & Installers	Electrical Repairers, Comm. & Industrial Equipment	Control & Valve Installers & Repairers	Electrical Power-Line Installers & Repairers
Occupation Code (O*NET)	49-9098.00	49-2092.00	49-9021.01	49-2094.00	49-9012.00	49-9051.00
Total Employment	3,930	490	3,920	1,820	1,190	1,130
Entry-Level Wage	$8.84	$9.40	$12.28	$15.75	$15.46	$16.39
Average Wage	$14.87	$20.89	$23.08	$25.84	$27.79	$34.11
Jobs per 1,000	1.030	0.127	1.026	0.476	0.313	0.297
Location Quotient	1.062	0.861	0.581	0.896	0.916	0.358
	Education (Columns add up to 100%)					
Less than a H.S. Diploma	13%	10%	1%	0%	0%	6%
High School Diploma or GED	32%	44%	16%	21%	47%	52%
Post-Secondary Certificate	45%	40%	72%	24%	40%	31%
Some College or AA Degree	10%	7%	10%	53%	10%	10%
Bachelor's (4 yr.) Degree	0%	0%	0%	1%	3%	0%
Graduate Certificate or Degree	0%	0%	1%	0%	0%	1%
	Work Experience Required for Occupational Proficiency (Columns add up to 100%)					
None	9%	19%	0%	5%	23%	17%
Up through 6 months	21%	5%	2%	1%	3%	1%
7 to 12 months	4%	10%	5%	7%	26%	0%
More than 1 year	65%	66%	93%	88%	48%	82%
	Skill Level (Scale 0-100; highest level = 100)					
Reading Comprehension	39	45	46	52	41	43
Active Listening	41	41	43	43	41	43
Writing	36	39	37	43	39	36
Speaking	39	39	43	46	37	39
Mathematics	25	37	46	46	20	18
Science	11	30	16	36	20	21
Critical Thinking	46	50	48	50	41	45
Active Learning	36	46	45	45	39	43
Instructing	36	41	39	48	30	37
Complex Problem Solving	34	46	41	50	39	48
Installation	29	37	54	50	21	20
Programming	0	16	5	30	5	0
Repairing	48	57	57	55	43	46
Quality Control Analysis	46	52	48	61	48	50
Judgment and Decision Making	39	43	43	50	43	48
Systems Analysis	23	37	37	48	29	37
Time Management	32	41	39	45	39	45

Source: U.S. Bureau of Labor Statistics. 2011. *Occupational Employment and Wages, Los Angeles County, May 2010*. Washington, D.C. O*NET, U.S. Department of Labor, Employment and Training Administration. 2011. *O*NET Version 15.0 Databases: Education, Training & Experience and Skills Tables*.

Table 4.7
Occupational Cluster: Architecture and Engineering Workers in Los Angeles County

	Environmental Engineering Technicians	Electronic Drafters *(CAD, GIS)*	Mapping Technicians	Landscape Architects	Environmental Engineers	Water/ Wastewater Engineers
Occupation Code (O*NET)	17-3025.00	17-3012.01	17-3031.02	17-1012.00	17-2081.00	17-2051.02
Total Employment	570	560	300	260	1,210	7,120
Entry-Level Wage	$16.26	$16.45	$17.99	$20.52	$24.03	$28.94
Average Wage	$25.52	$28.87	$29.35	$32.68	$40.05	$43.64
Jobs per 1,000	0.150	0.146	0.077	0.068	0.318	1.865
Location Quotient	1.033	0.664	0.182	0.518	0.812	0.951
	Education (Columns add up to 100%)					
Less than a H.S. Diploma	0%	0%	0%	0%	0%	0%
High School Diploma or GED	29%	14%	9%	0%	0%	0%
Post-Secondary Certificate	0%	21%	23%	0%	0%	0%
Some College or AA Degree	31%	39%	42%	0%	0%	0%
Bachelor's (4 yr.) Degree	32%	23%	15%	83%	90%	86%
Graduate Certificate or Degree	8%	2%	11%	17%	10%	14%
	Work Experience Required for Occupational Proficiency (Columns add up to 100%)					
None	31%	14%	18%	18%	0%	5%
Up through 6 months	0%	2%	8%	14%	0%	0%
7 to 12 months	5%	20%	12%	11%	0%	10%
More than 1 year	64%	64%	62%	57%	100%	86%
	Skill Level (Scale 0-100; highest level = 100)					
Reading Comprehension	73	55	54	57	68	71
Active Listening	57	54	45	54	63	63
Writing	59	46	52	50	61	59
Speaking	54	45	46	54	59	61
Mathematics	63	39	61	41	66	70
Science	39	30	25	48	54	57
Critical Thinking	63	50	48	55	63	64
Active Learning	59	45	46	52	61	64
Instructing	36	45	48	41	50	50
Complex Problem Solving	55	48	48	52	64	63
Installation	0	5	0	0	0	4
Programming	32	18	37	9	36	34
Repairing	25	0	0	0	4	4
Quality Control Analysis	50	7	41	36	55	54
Judgment and Decision Making	52	43	43	50	64	63
Systems Analysis	45	43	30	46	63	59
Time Management	48	43	46	48	52	55

Source: U.S. Bureau of Labor Statistics. 2011. *Occupational Employment and Wages, Los Angeles County, May 2010*. Washington, D.C. O*NET, U.S. Department of Labor, Employment and Training Administration. 2011. *O*NET Version 15.0 Databases: Education, Training & Experience and Skills Tables*.

commands higher rates of pay. These occupations hold the top wage rungs in the career ladders associated with Los Angeles' water sector, alongside management positions in construction and other fields reviewed earlier.

Entry-level wages for occupations in the Architecture and Engineering cluster start above $15 per hour. Required skill levels for this occupational cluster are high, in the typically in 40's and 50's, except for some hands-on skills such as *Installation* and *Repairing*. Los Angeles County's location quotient for three of these occupations – *Environmental Engineering Technicians, Environmental Engineers* and *Water/Wastewater Engineers* – are high, revealing regional competitive advantage in these jobs focused on environmental management and sustainability.

While even the lowest career ladder rungs in this cluster may be out of reach for many of Los Angeles' hopeful workers, including young adults who enter the labor market with limited education and related experience, they are an important part of Los Angeles' overall water use efficiency sector. Experienced workers may reach the top rungs of other water-related career ladders, yet still have the interest, motivation and resources to pursue college education, allowing them to attain the professional certification(s) needed to enter the Architecture or Engineering fields. If Los Angeles can continue to build its human capital in the emerging water use efficiency sector, it bodes well for Los Angeles' regional competitiveness, setting the stage for local businesses' involvement in water-related projects in other regions of the country and beyond.

Conclusion: Occupational Clusters

Increased employment in these occupation clusters, as well as economic progress of individual workers up these career ladders, is contingent upon Los Angeles' further investment in water use efficiency projects. Whether they are large-scale water treatment facilities, neighborhood stormwater capture projects, or water conservation campaigns aimed at the wider public, these investments are needed not only for water conservation, but for re-sparking employment amidst the ongoing downturn from the 2008 recession.

The next section of this report examines the economic and employment impacts of recent water use efficiency project in Los Angeles and the surrounding region. The occupational clusters presented in this chapter – *Building and Grounds / Forest and Conservation* workers, *Construction* workers, *Maintenance and Repair* workers, and *Architecture and Engineering* workers – are direct fits for the jobs supported in those projects. Assuming that sustained investments in water use efficiency projects can be made in Los Angeles, including initial construction and ongoing operations and maintenance, workers will have an opportunity to ascend these career ladders.

Chapter 5

Case Studies of Water Use Efficiency Projects in Los Angeles

Introduction: Analysis of Water Use Efficiency Projects Data

This chapter presents case studies for a variety of actual water-related projects in the Los Angeles area. These projects open a window for identifying the industries that participate in the water sector, as well as the range of local economic and job impacts they create. We group these water use efficiency investments into five categories of projects:

1. *Stormwater*: detention, storage, treatment, recharge, use and ecosystem restoration (24 projects)
2. *Recycled Water*: collection, detention, treatment, storage, distribution (18 projects)
3. *Groundwater Management / Remediation*: treatment equipment, de-salting plants, recharge facilities (2 projects)
4. *Water Conservation*: meter installations/ sub-metering, indoor appliance/fixture retrofits, irrigation, landscape conversions, education campaigns (11 projects)
5. *Graywater Systems*: indoor installation and retrofits, installation, filtration tank storage, treatment, outdoor drip irrigation (1 project)

The projects in each of these categories are combined into a single *composite* for each category, for which we estimate the economic and job impacts per $1 million of investment. Combining projects together offsets the variation among individual projects within each of the five categories, and offers a better predictor of the benefits that will come from future water use efficiency investments. For information on individual water use efficiency projects, please see the Water Use Efficiency Projects Contributors List in Appendix C.

Methodology for Estimating Local Economic and Job Impacts

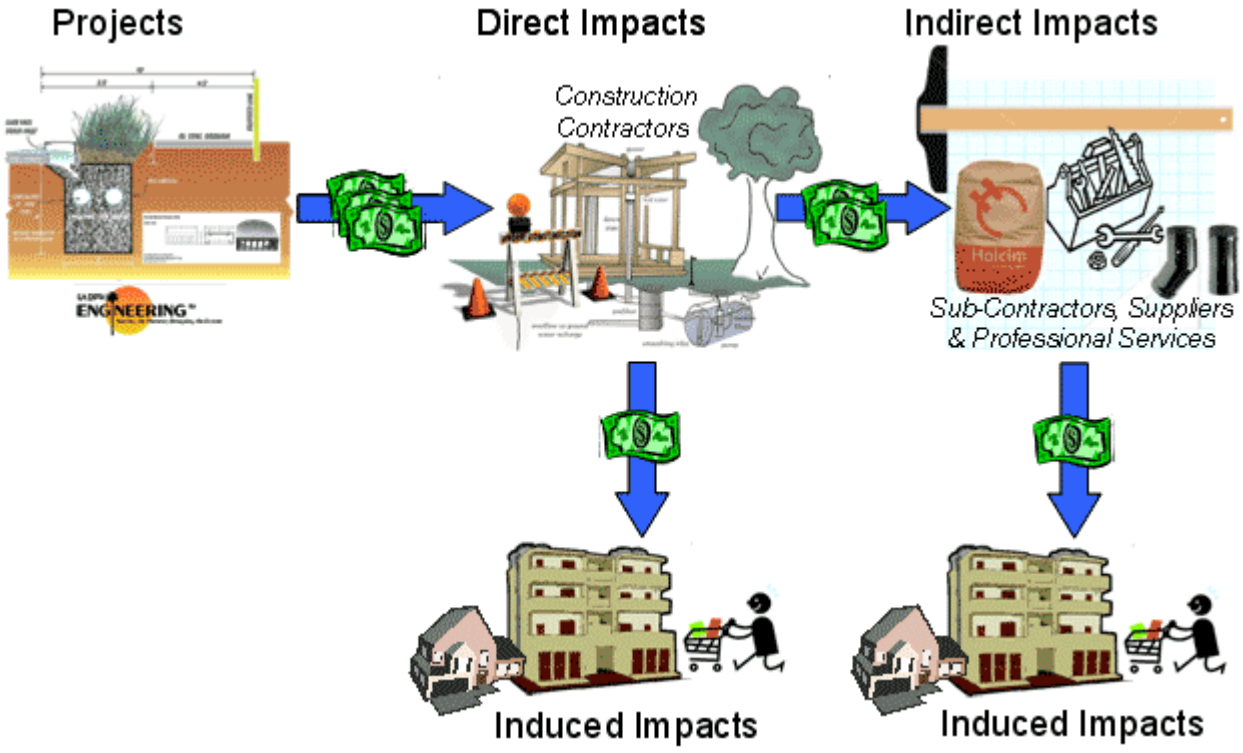
Water use efficiency projects – stormwater, recycled water, groundwater management/ remediation, water conservation and graywater – channel a significant amount of investment into the Los Angeles economy each year. And the benefits of these projects extend well beyond the private companies and public agencies directly carrying out the work of building them. The multiplier effects associated with water use efficiency projects ripple through the local economy by adding demand for goods and services. This translates into added sales and jobs for materials suppliers, professional service providers and other sub-contractors. These projects also boost the spending power of employees' households, supporting still more sales and jobs where those households spend their paychecks, as well as more tax revenue for local and state government.

Our methodology utilizes an input-output model of the Los Angeles County economy to estimate the local economic and job impacts of water use efficiency projects, carried out using IMPLAN software and regional accounts data. This model enables predictions of change in the 'local' county economy when individual sectors, such as the local construction or landscaping

industries, participate in building water use efficiency projects. The model enables estimates of economic impacts measured in dollar value of sales (*output*) and job impacts measured in the number of person-years of employment,[40] which are broken out into three different rounds multiplier effects: *direct*, *indirect*, and *induced* impacts (Figure 5.1). Here is how it works:

- Each water use efficiency project generates *direct* impacts: changes in demand for goods and services, for example, from construction companies that build elements of the water infrastructure by assembling materials, labor, equipment and tools to carry out the work. Project budgets support *direct* sales (output) and employment at those companies.
- The *indirect* impacts are the inter-industry transactions needed to satisfy the direct effect; all of the 'upstream' goods and services supplied to the companies building the project. Thus the *indirect* impacts are the portion of the project budget that passes through to 'upstream' suppliers. For example, the upstream suppliers of construction include architectural and engineering services, truck transportation services, bookkeeping and payroll services, legal services, and porous materials for underground infiltration galleries.
- Lastly, the *induced* impacts are estimates of from household spending on local goods and services using wages earned by employees working to satisfy the *direct* (construction)

Figure 5.1
Input-Output Analysis – Economic and Job Impacts of Water Use Efficiency Projects: How it Works



Source: Economic Roundtable illustration based on the IMPLAN input-output model. Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. Note: Diagram uses the Elmer Avenue Project stormwater project as an example, showing just one of its three *direct* contractors. Each project can have multiple companies *directly* involved and appearing in its budget.

and *indirect* (suppliers to construction) impacts. Household spending commonly benefits restaurants, doctors' offices, repair shops, retail and grocery stores, and landlords.

To summarize, the input to the model is the budget amounts of the water use efficiency projects, divided up and assigned to appropriate IMPLAN industry sectors for the companies carrying out the work. The outputs of the model are twofold, sales and person-years of employment, both broken out by industry sector and by the three rounds of multiplier effects: *direct*, *indirect* and *induced*.

Based upon estimates from the IMPLAN input-output model, we use a 2008-2009 industry-occupation matrix of Los Angeles County that presents employment for approximately 292 detailed industries and 696 occupations in order to identify the most frequent occupations of employment in each type of water use efficiency project. Occupational characteristics, including mean hourly and annual wage, entry-level hourly wage, and training requirements, are derived from these data.

5.1 Stormwater Projects

This section analyzes the economic and job impacts of recent stormwater projects carried out in the City of Los Angeles and surrounding communities. These investments enable communities to intercept the stormwater runoff that otherwise would accumulate on impervious surfaces and in storm drains, and instead retain and treat it for additional uses that result in greater efficiency and sustainability. Stormwater projects entail significant amounts of planning and construction work, and, in some cases, ongoing operation and maintenance.[41] These projects are sometimes components of larger parks and recreation areas, allowing them to benefit from a wider variety of funding sources.

Direct Impacts

Recent stormwater projects in the Los Angeles area represent a *direct* investment of approximately $165 million dollars (Table 5.1). The projects involved a combined 160 businesses and government agencies in their construction, or about six such entities per project. Approximately 74 percent of this overall investment ($122 million) was spent locally, on businesses located within Los Angeles County. Among the businesses that participated directly were:

- Construction companies
- Architectural, engineering, and related services companies
- Scientific research and development services companies

State and local government agencies have also been involved in planning these projects. Approximately $15.7 million of the recent stormwater project budgets were spent outside of Los Angeles County on goods and services not available locally, or else not offered competitively by local businesses. All but a tiny fraction of this *direct* non-local expenditure for

Table 5.1
Recent Stormwater Projects in the Los Angeles Area, with Budget Amount

Project Name	Budget
Andrews Park Subsurface Storage, Use and Infiltration	$6,860,601
Broadous Elementary School Project	$340,991
Bull Creek Restoration Project	$6,273,595
Elmer Avenue Project	$1,100,000
Herondo Parking Lot Detention & Beach Infiltration	$8,740,000
Imperial Highway Stormwater Best Mgmt. Practices	$2,723,403
Los Angeles Zoo Parking Lot	$13,904,243
Malibu Legacy Park	$6,942,500
Manhattan Heights Subsurface Infiltration Gallery	$7,708,339
Mar Vista Recreation Center Stormwater	$4,960,015
Marshland Enhancement (Sanitation Districts of LA Co.)	$3,421,430
Open Charter Magnet Elementary School	$487,910
Peck Park Canyon Enhancement	$6,236,396
Polliwog Park Subsurface Infiltration Gallery	$13,429,956
Riverdale Avenue Green Street Project	$621,332
SMB 5-1 Subsurface Infiltration Trenches	$1,075,550
SMB 5-2 Subsurface Infiltration Trenches	$12,760,989
SMB 5-3 Subsurface Infiltration Trenches	$2,342,000
SMB 5-4 Subsurface Infiltration Trenches	$4,126,500
South Park Subsurface Infiltration Gallery	$6,441,816
Tujunga Spreading Grounds Upgrade	$23,100,000
Westchester Stormwater BMP Project	$23,209,451
Westminster Dog Park Stormwater Best Mgmt. Practices	$1,452,755
Westside Park Rainwater Irrigation	$7,289,236
Total, All Stormwater Projects	$165,549,008

Source: See Water Use Efficiency Projects Contributors List in Appendix C.

stormwater projects was for manufactured goods (Table 5.2).

Table 5.2
Industry Sector Breakdown of Businesses Directly Involved in Recent Stormwater Projects, with Local (Los Angeles) and Total Budget Amounts

IMPLAN Sector Code	Industry Sector Description	Direct Expenditures in LA Co.	Total Direct Expenditures	Percent Local
36	Construction of other new nonresidential structures	$65,423,576	$75,313,817	87%
369	Landscape Architecture, engineering, and related services	$41,179,355	$44,612,550	92%
34	Construction of new commercial and health care structures	$6,904,589	$16,270,218	42%
432	Other state and local government enterprises	$3,187,638	$4,076,378	78%
376	Scientific research and development services	$3,112,412	$3,286,013	95%
171	Steel product manufacturing from purchased steel	$880,939	$880,939	100%
166	Cut stone and stone product manufacturing	$709,196	$3,249,153	22%
388	Services to buildings and dwellings	$361,042	$1,518,866	24%
424	Grantmaking, giving, and social advocacy organizations	$213,463	$332,336	64%
20	Extraction of oil and natural gas	$97,165	$97,165	100%
233	Fluid power process machinery manufacturing	$70,000	$70,000	100%
319	Wholesale trade businesses	$66,307	$129,651	51%
323	Retail Stores - Building material and garden supply	$29,178	$64,715	45%
187	Ornamental and architectural metal products manufacturing	$24,000	$34,396	70%
374	Management, scientific, and technical consulting services	$5,500	$5,500	100%
341	Newspaper publishers	$3,270	$3,270	100%
	(Other non-local project expenditures)	$0	$15,793,653	0%
Total		$122,267,631	$165,738,620	74%

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C. Note: Figures may not add up to totals precisely due to rounding errors.

Indirect Impacts

Local *indirect* economic impacts of recent stormwater projects tend to benefit professional services (architectural and engineering services, financial institutions, scientific and technical consulting services, and legal services) as well as project logistics businesses (petroleum refineries, realtors, telecommunications and employment services companies) with increased sales (Table 5.3). The *indirect* impacts of these supported jobs in a somewhat similar but re-ordered set of industries. These include professional services (architectural and engineering services, scientific and technical consulting services, accounting, tax preparation, bookkeeping, and payroll services, employment services, realtors, and legal services) as well as

blue collar services (wholesale trade, food services and drinking places, services to buildings and dwellings, and truck transportation) (Table 5.4).

Table 5.3
Local Indirect Economic Impacts of Recent Stormwater Projects, by Industry Sector

Rank	IMPLAN Sector Code	Industry Sector Description	Indirect Sales (Output)	Percent of Total Indirect Sales (Output)
1	369	Landscape Architecture, engineering, and related services	$7,599,737	15%
2	115	Fuel (petroleum refineries)	$4,250,466	9%
3	360	Real estate establishments (leasing land, renting structures)	$2,721,928	5%
4	351	Telecommunications	$1,952,365	4%
5	319	Wholesale trade businesses	$1,921,392	4%
6	354	Monetary authorities and depository credit intermediation activities	$1,641,893	3%
7	374	Management, scientific, and technical consulting services	$1,421,274	3%
8	367	Legal services	$1,336,146	3%
9	382	Employment services	$1,329,439	3%
10	413	Food services and drinking places	$1,233,705	2%
Total			$49,999,375	100%

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C. Note: Figures may not add up to totals precisely due to rounding errors. List shows the top ten out of 440 total industry sectors.

Table 5.4
Local Indirect Job Impacts of Recent Stormwater Projects, by Industry Sector

Rank	IMPLAN Sector Code	Industry Sector Description	Indirect Jobs Supported (Person-Years of Employment)	Percent of Total Indirect Jobs Supported (Person-Years of Employment)
1	369	Landscape Architecture, engineering, and related services	51.1	17%
2	382	Employment services	29.5	10%
3	413	Food services and drinking places	17.9	6%
4	360	Real estate establishments (leasing land, renting structures)	13.0	4%
5	374	Management, scientific, and technical consulting services	10.9	4%
6	319	Wholesale trade businesses	10.5	4%
7	368	Accounting, tax preparation, bookkeeping, and payroll services	9.0	3%
8	388	Services to buildings and dwellings	8.2	3%
9	335	Transport by truck	7.8	3%
10	367	Legal services	6.3	2%
Total			299.2	100%

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C. Note: Figures may not add up to totals precisely due to rounding errors. List shows the top ten out of 440 total industry sectors.

Induced Impacts

The additional household spending spurred by stormwater projects generated a total of

Table 5.5
Local Induced Economic Impacts of Recent Stormwater Projects, by Industry Sector

Rank	IMPLAN Sector Code	Industry Sector Description	Induced Sales (Output)	Percent of Total Induced Sales (Output)
1	361	Imputed rental activity for owner-occupied dwellings (Repair and maintenance of owner-occupied homes)	$8,221,491	12%
2	360	Real estate establishments (includes lease payments for land and rental of structures, rental housing)	$4,974,575	7%
3	394	Offices of physicians, dentists, and other health practitioners	$4,044,009	6%
4	413	Food services and drinking places	$3,668,598	5%
5	397	Private hospitals	$3,414,168	5%
6	357	Insurance carriers	$2,500,967	4%
7	354	Monetary authorities and depository credit intermediation activities	$2,478,186	3%
8	319	Wholesale trade businesses	$2,144,788	3%
9	355	Nondepository credit intermediation and related activities	$1,880,266	3%
10	115	Petroleum refineries	$1,756,952	2%
Total			$71,372,499	100%

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C. Note: Figures may not add up to totals precisely due to rounding errors. List shows the top ten out of 440 total industry sectors.

Table 5.6
Local Induced Job Impacts of Recent Stormwater Projects, by Industry Sector

Rank	IMPLAN Sector Code	Industry Sector Description	Induced Jobs Supported (Person-Years of Employment)	Percent of Total Induced Jobs Supported (Person-Years of Employment)
1	413	Food services and drinking places	53.2	11%
2	394	Offices of physicians, dentists, and other health practitioners	29.4	6%
3	360	Real estate establishments (includes lease payments for land and rental of structures)	23.8	5%
4	397	Private hospitals	20.7	4%
5	324	Retail Stores - Food and beverage	15.0	3%
6	426	Private household operations	13.8	3%
7	398	Nursing and residential care facilities	13.6	3%
8	329	Retail Stores - General merchandise	12.9	3%
9	319	Wholesale trade businesses	11.7	2%
10	356	Securities, commodity contracts, investments, and related activities	11.2	2%
Total			485.6	100%

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C. Note: Figures may not add up to totals precisely due to rounding errors. List shows the top ten out of 440 total industry sectors.

$71 million in sales. Businesses benefitting from these sales include: home improvement and hardware stores, home repair contractors, apartment owners, health care providers, restaurants, insurance companies, banks, mortgage brokers and carriers, and gas stations (Table 5.5). Of the businesses benefiting from this added household spending, restaurants saw it translate in to the highest number of jobs. Other industry sectors employing more workers due to this added local household spending include: doctors' and dentists' offices, apartment management companies, grocery stores, and nursing homes. Private housekeepers are also among the top ten (Table 5.6).

Top Occupations Impacted

Across all of the industries involved in stormwater projects – including *direct, indirect* and *induced* rounds of economic activity – the occupations they hire most frequently are shown in Table 5.7, including the percent of employment captured locally in Los Angeles County. These data on occupations are specific to those hired in industries involved in Los Angeles' stormwater projects, as opposed to occupational data on Los Angeles' overall economy.

Table 5.7
Top LA Occupations Supported by Recent Stormwater Projects, Ranked by Frequency

Rank	SOC Code - Occupation Title		Percent of Occupational Employment Captured in LA Co.	Mean Hourly Wage	Mean Annual Wage	Entry-Level Hourly Wage*
1	47-2061	Construction Laborers	82%	$18.83	$39,176	$11.95
2	47-2073	Operating Engineers and Other Construction Equipment Operators	86%	$27.67	$57,562	$21.95
3	47-1011	Managers of Construction Trades Workers	78%	$30.88	$64,236	$22.10
4	47-2151	Pipelayers	88%	$25.70	$53,448	$18.30
5	53-7051	Industrial Truck and Tractor Operators	81%	$14.71	$30,585	$11.33
6	41-0000	Sales and Related Occupations	87%	$23.15	$48,138	$15.66
7	17-0000	Landscape Architecture & Engineering Occupations	85%	$31.81	$66,157	$20.38
8	17-2051	Civil Engineers	90%	$36.03	$74,943	$25.65
9	11-1021	General and Operations Managers	74%	$58.08	$120,795	$31.76
10	47-2152	Plumbers, Pipefitters, and Steamfitters	84%	$22.67	$47,158	$14.50
11	17-3011	Architectural and Civil Drafters	91%	$25.10	$52,216	$20.11
12	17-1011	Architects, Except Landscape and Naval	92%	$34.18	$71,100	$26.13
13	17-1099	All Other Architects, Surveyors, and Cartographers	92%	$23.60	$49,106	$17.38
14	43-9061	Office Clerks, General	78%	$12.52	$26,046	$9.08
15	11-9021	Construction Managers	73%	$40.26	$83,744	$28.49
16	43-3031	Bookkeeping, Accounting, and Auditing Clerks	76%	$16.59	$34,510	$11.74
17	43-6011	Executive Secretaries and Administrative Assistants	80%	$19.03	$39,579	$14.44
18	47-5021	Earth Drillers, Except Oil and Gas	88%	$22.92	$47,667	$18.26
19	53-3032	Truck Drivers, Heavy and Tractor-Trailer	70%	$17.16	$35,694	$13.60
20	47-2031	Carpenters	44%	$22.61	$47,023	$15.64
Total, all occupations			73%	$20.90	$43,480	$10.80

Source: Economic Roundtable analysis; California Employment Development Department & Employment Projections Program, U.S. Department of Labor, U.S. Bureau of Labor Statistics. 2010. Los Angeles County Industry-Occupation Matrix 2008/2009. SOC stands for Standard Occupation Classification. *The mean of the first third of the wage distribution is the proxy for entry-level wage.

Approximately 73 percent of workers involved in Los Angeles' stormwater projects were employed by businesses located within the county, and many of the most frequently hired occupations employed a higher percentage of county residents. Many of the top occupations are in skilled trades or professional services, paying good wages. Some lower-skilled occupations, such as construction laborers, have a low mean annual wage despite decent mean hourly and entry-level wages, which is attributable to workers being employed intermittently instead of full-time and year-round.

Impacts per $1 Million Spent

Every million dollars invested in stormwater projects in Los Angeles stimulated an estimated $1.99 million in total local sales (output). The added sales activity consists of $408,934 of local indirect sales and $583,740 of local induced sales per one million dollars of local direct sales made in this type of water use efficiency project (Table 5.8). These figures are specific to the portions of stormwater project budgets directed to businesses located in Los Angeles County. Our estimate of impacts for the entire project budget – which was split between businesses located within Los Angeles County and those located outside – is that this stimulated a total of $1.95 million in total local sales (output). The multiplier effect for the Los Angeles County portion of the budget is slightly higher, likely due to the non-local portion of the budget being highly skewed towards manufactured goods.[42]

Measured in jobs, the impacts per million dollars invested in Los Angeles stormwater projects translated into an estimated 13.1 person-years of employment. This is based upon an

Table 5.8
Multiplier Effects of Recent Stormwater Projects, Local and Overall Sales Supported

Budget Portion Invested in…	Description	Direct Sales (Output)	Indirect Sales (Output)	Induced Sales (Output)	Total Sales (Output)
Los Angeles County	Per $1 Million Direct	$1,000,000	$408,934	$583,740	$1,992,674
	Entire Project Budgets	$122,267,630	$49,999,374	$71,372,499	$243,639,504
All Locations	Per $1 Million Direct	$1,000,000	$401,824	$549,981	$1,951,805
	Entire Project Budgets	$165,738,620	$66,597,779	$91,153,106	$323,489,505

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C for stormwater project budgets.

estimated 6.6 person-years of employment *directly* supported by the construction of the stormwater project, plus another 2.4 person-years of employment supported by *indirect* sales ("upstream" goods and services used in the projects), and 4.0 person-years of *induced* employment stimulated by household spending of workers directly and indirectly employed in the stormwater projects (Table 5.9). Again, the employment multiplier effects for the portion of stormwater budgets invested in Los Angeles County are slightly stronger than the entire project budget, which supports 12.5 person-years of employment

Table 5.9
Multiplier Effects of Recent Stormwater Projects: Local and Overall Jobs Supported

Budget Portion Invested in…	Description	Direct Employment	Indirect Employment	Induced Employment	Total Employment
Los Angeles County	Per $1 Million Direct	6.6	2.4	4.0	13.1
	Entire Project Budgets ($122M)	811.0	299.2	485.6	1,595.9
All Locations	Per $1 Million Direct	6.5	2.3	3.7	12.5
	Entire Project Budgets ($166M)	1,070.0	385.4	620.1	2,075.5

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C for stormwater project budgets.

Geography of Impacts

Approximately 95 percent of stormwater projects investments went to business and agencies located inside California, with the remaining 5 percent spent either in other states or internationally (Table 5.10).

Table 5.10
Geography of Stormwater Project Investments

	Total	Los Angeles County	California, Other Counties	US, Outside California	Outside the US
Dollar Amount	$165,549,008	$122,612,477	$34,470,551	$8,415,979	$50,000
Percent	100%	74.06%	20.82%	5.08%	0.03%

Source: Stormwater project budgets, drawn from the Water Use Efficiency Projects Contributors List in Appendix C.

Impacts of Ongoing Operations and Maintenance

Four stormwater projects studied in this report included budget data on their ongoing operations and maintenance, allowing separate estimates of their economic and job impacts beyond initial construction of the project.[43] Similar to the methodology used in the preceding section, the operations and maintenance budgets of these projects are blended together in order to provide a richer picture of possible future projects' operations and maintenance budgets. In distinction from the earlier analysis focused on 'first year' project construction costs, the following estimates are of subsequent years of operation and maintenance, and are annualized. Portions of project budget described as "initial" operations and maintenance are considered to have been spent during the 'first year' of projects immediately after construction, and are not included in the following analysis. Lastly, only local economic and job impacts are presented, since it is assumed that all operations and maintenance will be performed by local establishments.

Stormwater projects allocated an ongoing budget of $7.9 million for operations and maintenance, carried out by establishments in the *Construction of Water and Sewer Line and Related Structures*, *Landscaping Services*, *Engineering Services*, and *Administration of Conservation Programs* industries. Every $1 million invested in this aspect of stormwater projects stimulated $426,970 in added local indirect sales and $562,089 in added local induced sales (Table 5.11). The job impacts per million dollars invested in operations and maintenance

Table 5.11
Multiplier Effects of One Year of Operations and Maintenance in Stormwater Projects:
Local Sales Supported

Description	Direct Sales (Output)	Indirect Sales (Output)	Induced Sales (Output)	Total Output (Sales)
Per $1 Million Direct	$1,000,000	$426,970	$562,089	$1,989,059
Entire O & M Budgets ($7.9M)	$7,868,907	$3,359,788	$4,423,026	$15,651,721

Table 5.12
Multiplier Effects of One Year of Operations and Maintenance in Stormwater Projects:
Local Jobs Supported

Description	Direct Employment	Indirect Employment	Induced Employment	Total Employment
Per $1 Million Direct	7.4	2.4	4.0	13.8
Entire O & M Budgets ($7.9M)	58.6	18.8	31.2	108.6

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C for stormwater project budgets.

are slightly higher than for the initial construction of stormwater projects, amounting to an estimated 13.8 person-years of employment. This is based upon an estimated 7.4 person-years of employment *directly* supported by the ongoing operations and maintenance of stormwater projects, 2.4 person-years of employment supported by *indirect* sales ("upstream" goods and services), and 4.0 person-years of *induced* employment stimulated by household spending of workers involved directly and indirectly in the ongoing operation of stormwater projects after the first year (Table 5.12).

Case Study: Generation Water - Rain Gardens

One example of a stormwater project is the installation of rain gardens, which are planted portions of a property that allow rainwater from roofs, driveways, walkways, and paved surfaces to be absorbed into the ground. This reduces rain runoff, since urban stormwater that is not absorbed into the ground often flows into storm drains, which leads to erosion, water pollution, flooding, and also prevents groundwater supplies from being recharged. Rooftop rain gardens are one service offered by Generation Water and its young adult trainees in Los Angeles.

Generation Water's roof-fed rain gardens – typically installed on residential properties with a yard – adapt existing rain gutters in order to divert rainwater into the ground, and then plant a drought-tolerant garden where the diverted water enters the soil. These rain gardens each cost $600 to install, with $200 spent on plants and other materials, and the balance covering labor costs. Installation of a rain garden is typically carried out in one day by a team of five young adult workers.

$200	Materials (mostly plants)
$400	Labor (5 people, 1 day)
$600	Total

Based upon this project profile, we estimate the economic impacts of Generation Water's version of rain gardens, using the IMPLAN Input-Output for Los Angeles:

Table 5.13
Proxy of Generation Water Rain Garden Projects using NAICS Industries and IMPLAN Sectors

NAICS Code	NAICS Title	IMPLAN Code	Industry Sector	Percent Weight	Budget for $600
111421	Nursery and Tree Production	6	Greenhouse, nursery, and floriculture production	33%	$200
238170	Siding Contractors	40	Maint. & repair construction of residential structures	33%	$200
561730	Landscaping Contractors	388	Services to buildings and dwellings	33%	$200
			Totals	100%	$600

Source: Marcus Castain, Generation Water, 2011.

Our estimate blends together two industry profiles characterizing the 60 percent of labor costs for installing the rain gardens (Table 5.13). Half of the labor is characterized as the Siding Contractors industry, which includes establishments installing and modifying rain gutters and downspouts. The other half of labor costs is characterized as the Landscaping Contractors industry, excavating portions of properties and planting the rain gardens. Materials are represented by the Nursery and Tree Production industry, which makes up the balance of the project budget.

The employment impacts of Generation Water installing a single rain garden are known – five workers for one day, with the added benefits of providing training opportunities in a newly emerging water use efficiency field for young adults in Los Angeles. The economic benefits to Los Angeles of one rain garden installation include are $221 in local indirect sales stimulated among the suppliers of goods and services for the project, as well as $320 in induced sales in the community, based on the household spending of workers directly and indirectly involved (Table 5.14).

Table 5.14
Economic Multiplier Factors and Dollar Amounts for one Generation Water Rain Garden

IMPLAN Code	Percent	$600 Budget	Direct Output Factor	Indirect Output Factor	Induced Output Factor	Total Output Factor	Direct Sales	Indirect Sales	Induced Sales	Total Sales
6	33%	$200	1.000000	0.276922	0.570773	1.847695	$200	$55	$114	$370
40	33%	$200	1.000000	0.309128	0.531686	1.840814	$200	$62	$106	$368
388	33%	$200	1.000000	0.518069	0.496551	2.014621	$200	$104	$99	$403
	100%	$600				Totals	$600	$221	$320	$1,141

Source: Marcus Castain, Generation Water, 2011; Economic Roundtable analysis; Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software.

The economic multiplier factors for this stormwater case study can be scaled up to estimate the impacts of a larger number rain garden installations.

5.2 Recycled Water Projects

This section analyzes the economic and job impacts of recycled water projects recently carried out in the City of Los Angeles and the surrounding Southern California region.[44] These investments, also called reclaimed water[45] projects, treat wastewater in order to remove impurities and solids so that it can then be used again – in irrigation and landscaping conveyed through secondary "purple pipe" plumbing systems, or else directed into groundwater. Recycled water projects can require very large budgets, thus creating significant multiplier effects.

Table 5.15
Recent Recycled Water Projects in the Los Angeles and Surrounding Region, with Budget Amount

Project Name	Budget
Anza Avenue Lateral, Phase I	$562,765
Anza Recycled Water Lateral, Phase II	$609,141
Ashwood Lateral, City of Inglewood	$119,646
California State University Dominguez Hills Lateral Extension	$280,198
Corporate Campus El Segundo Lateral	$97,692
Fullerton Road reclaimed Pipeline	$4,956,233
Groundwater Recharge System (GWRS) Phase 1, Orange Co. Water District	$501,553,783
Groundwater Replenishment Project	$293,000,000
Harbor Refineries Recycled Water Project (1)	$45,700,000
Harbor Refineries Recycled Water Project (2)	$27,700,000
Harbor Refineries Recycled Water Project (3)	$40,000,000
Hyperion Secondary Effluent Pump Station	$35,277
Mariposa Lateral	$207,147
Michelson Upgrade Project	$119,495,352
Rowland Water District: Arenth Reclaimed Water Pipeline	$5,047,717
Title 22 Distribution System	$44,436
Torrance Booster Pump Station	$76,683
Whittier Narrows Water Reclamation Plant UltraViolet Disinfection System Facilities	$11,522,886
Total, All Recycled Water Projects	$1,051,008,954

Source: See Water Use Efficiency Projects Contributors List in Appendix C.

Direct Impacts

Eighteen recent recycled water projects in the region represent a *direct* investment of approximately $1.051 billion dollars (Table 5.15), split up among 61 participating private businesses and public agencies. Examining these direct project participants by budget amounts and industry sector (Table 5.16), we find that the following carried out most of the work:

- Construction companies
- Architectural, engineering, and related services companies
- Water, sewage and other treatment and delivery systems companies

Table 5.16
Industry Sector Breakdown of Businesses Directly Involved in Recent Recycled Water Projects, with Local (Los Angeles and Orange County) and Total Budget Amounts

IMPLAN Sector Code	Industry Sector Description	Direct Expenditures in LA Co.	Total Direct Expenditures	Percent Local
36	Construction of other new nonresidential structures	$894,134,422	$900,727,020	99%
369	Landscape Architecture, engineering, and related services	$85,493,151	$85,773,578	100%
33	Water, sewage and other treatment and delivery systems	$33,869,134	$33,869,134	109%
432	Other state and local government enterprises	$20,944,057	$20,944,057	100%
28	Drilling oil and gas wells	$5,000,000	$5,000,000	100%
375	Environmental and other technical consulting services	$2,930,000	$2,930,000	100%
374	Management, scientific, and technical consulting services	$44,500	$44,500	100%
377	Advertising and related services	$31,911	$31,911	100%
386	Business support services	$14,000	$14,000	100%
319	Wholesale trade businesses	$7,450	$12,041	62%
	(Non-local project expenditures)	$0	$1,611,055	0%
Total		$1,042,468,626	$1,050,957,297	99%

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C. Note: Figures may not add up to totals precisely due to rounding errors. This list presents all dollars invested on Recycled Water projects. Note: Because one of the major recycled water projects is located in Orange County, "Local" covers both Los Angeles and Orange Counties in this case study.

State and local government agencies again play a role in planning these water use efficiency projects, accounting for two percent of the aggregated budget.

Geography of Impacts

Approximately $1.6 million of the recycled water project budgets were spent outside of Los Angeles and Orange Counties, mostly on specialized electronics components for an ultraviolet water disinfection system. This amounted to less than one percent of the combined budget for recycled water projects. A detailed description of the geographic distribution of recycled water project budgets appears in Table 5.17.

Table 5.17
Geography of Recycled Water Project Investments

	Total	Los Angeles & Orange Counties	California, Other Counties	US, Outside California	Outside the US
Dollar Amount	$1,051,008,954	$1,042,500,584	$6,590,372	$324,168	$1,593,830
Percent	100%	99%	0.63%	0.03%	0.15%

Source: Recycled water project budgets, drawn from the Water Use Efficiency Projects Contributors List in Appendix C.

Indirect Impacts

Local *indirect* economic impacts of recent recycled water projects supported added sales in professional services sectors (architectural and engineering services, real estate establishments, legal services, banking and accounting services) and project logistics businesses (petroleum refineries, wholesalers, telecommunications, equipment leasing services, and truck transport companies, shown in Table 5.18. When we measure the *indirect* impacts in terms of number of

jobs supported, a slightly different list emerges. Top indirect employment beneficiaries of recycled water projects includes professional services (architectural, engineering, employment, real estate, accounting, tax preparation, bookkeeping, payroll, and legal services) as well as some blue collar services (wholesale trade, food services and drinking places, truck transportation, auto repair, and services to buildings and dwellings), as shown in Table 5.19.

Table 5.18
Local Indirect Economic Impacts of Recent Recycled Water Projects, by Industry Sector

Rank	IMPLAN Sector Code	Industry Sector Description	Indirect Sales (Output)	Percent of Total Indirect Sales (Output)
1	369	Landscape Architecture, engineering, and related services	$78,757,523	18%
2	115	Fuel (petroleum refineries)	$48,141,168	11%
3	319	Wholesale trade businesses	$19,708,399	5%
4	360	Real estate establishments (leasing land, renting structures)	$17,344,260	4%
5	351	Telecommunications	$14,594,336	3%
6	365	Comm. and industrial machinery and equipment rental and leasing	$13,713,878	3%
7	367	Legal services	$12,403,480	3%
8	354	Monetary authorities and depository credit intermediation activities	$11,991,649	3%
9	335	Transport by truck	$11,702,390	3%
10	368	Accounting, tax preparation, bookkeeping, and payroll services	$8,754,426	2%
Total			$429,026,141	100%

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C. Note: Figures may not add up to totals precisely due to rounding errors. List shows the top ten out of 440 total industry sectors.

Table 5.19
Local Indirect Job Impacts of Recent Recycled Water Projects, by Industry Sector

Rank	IMPLAN Sector Code	Industry Sector Description	Indirect Jobs Supported (Person-Years of Employment)	Percent of Total Indirect Jobs Supported (Person-Years of Employment)
1	369	Landscape Architecture, engineering, and related services	529.8	22%
2	382	Employment services	160.7	7%
3	319	Wholesale trade businesses	107.7	5%
4	413	Food services and drinking places	84.8	4%
5	335	Transport by truck	84.8	4%
6	360	Real estate establishments (leasing land, renting structures)	82.9	3%
7	368	Accounting, tax preparation, bookkeeping, and payroll services	77.0	3%
8	414	Automotive repair and maintenance, except car washes	68.2	3%
9	367	Legal services	58.8	2%
10	388	Services to buildings and dwellings	54.5	2%
Total			2,376.8	100%

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C. Note: Figures may not add up to totals precisely due to rounding errors. List shows the top ten out of 440 total industry sectors.

Induced Impacts

The additional household spending spurred by stormwater projects generated over $567

Table 5.20
Local Induced Economic Impacts of Recent Recycled Water Projects, by Industry Sector

Rank	IMPLAN Sector Code	Industry Sector Description	Induced Sales (Output)	Percent of Total Induced Sales (Output)
1	361	Imputed rental activity for owner-occupied dwellings (Repair and maintenance of owner-occupied homes)	$65,372,791	12%
2	360	Real estate establishments (includes lease payments for land and rental of structures, rental housing)	$39,590,939	7%
3	394	Offices of physicians, dentists, and other health practitioners	$32,174,384	6%
4	413	Food services and drinking places	$29,183,377	5%
5	397	Private hospitals	$27,163,851	5%
6	357	Insurance carriers	$19,889,283	4%
7	354	Monetary authorities and depository credit intermediation activities	$19,717,577	3%
8	319	Wholesale trade businesses	$17,068,282	3%
9	355	Nondepository credit intermediation and related activities	$14,955,374	3%
10	115	Petroleum refineries	$13,979,118	2%
Total			$567,736,427	100%

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C. Note: Figures may not add up to totals precisely due to rounding errors. List shows the top ten out of 440 total industry sectors.

Table 5.21
Local Induced Job Impacts of Recent Recycled Water Projects, by Industry Sector

Rank	IMPLAN Sector Code	Industry Sector Description	Induced Jobs Supported (Person-Years of Employment)	Percent of Total Induced Jobs Supported (Person-Years of Employment)
1	413	Food services and drinking places	422.9	11%
2	394	Offices of physicians, dentists, and other health practitioners	233.6	6%
3	360	Real estate establishments	189.3	5%
4	397	Private hospitals	164.8	4%
5	324	Retail Stores - Food and beverage	119.2	3%
6	426	Private household operations	109.5	3%
7	398	Nursing and residential care facilities	108.5	3%
8	329	Retail Stores - General merchandise	102.7	3%
9	319	Wholesale trade businesses	93.2	2%
10	356	Securities, commodity contracts, investments, and related activities	89.3	2%
Total			3,862.9	100%

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C. Note: Figures may not add up to totals precisely due to rounding errors. List shows the top ten out of 440 total industry sectors.

million in sales. Businesses benefitting the most from these consumer sales include: home improvement and hardware stores, home repair contractors, apartment owners, health care providers, restaurants, insurance companies, banks, wholesalers, mortgage brokers and carriers, and gas stations (Table 5.20). In terms of person-years of employment induced by the added household spending resulting from recycled water projects, restaurants again were at the top of the list. Other industry sectors employing more workers due to this added local household spending include: doctors' and dentists' offices, apartment management companies, grocery stores, housekeepers, and nursing homes (Table 5.21).

Top Occupations Impacted

The occupations hired most frequently across all of the industries involved in recycled water projects – including *direct*, *indirect* and *induced* rounds of economic activity – are shown in Table 5.22.[46] Most of the occupations hired as part of this type of water use efficiency project are tied to construction, and only a small fraction of this employment was outside of Los Angeles

Table 5.22
Top LA/OC Occupations Supported by Recent Recycled Water Projects, Ranked by Frequency

Rank	SOC Code - Occupation Title		Percent of Occupational Employment Captured in LA Co.	Mean Hourly Wage	Mean Annual Wage	Entry-Level Hourly Wage*
1	47-2061	Construction Laborers	99%	$19.68	$40,937	$12.27
2	47-2073	Operating Engineers and Other Construction Equipment Operators	99%	$28.56	$59,401	$22.03
3	41-0000	Sales and Related Occupations	99%	$33.83	$70,359	$15.05
4	47-1011	Managers of Construction Trades Workers	99%	$31.89	$66,338	$24.14
5	47-2151	Pipelayers	99%	$25.70	$53,448	$18.30
6	53-7051	Industrial Truck and Tractor Operators	99%	$16.11	$33,514	$13.38
7	17-0000	Landscape Architecture & Engineering Occupations	99%	$46.14	$95,984	$25.58
8	47-2152	Plumbers, Pipefitters, and Steamfitters	99%	$22.05	$45,858	$16.87
9	11-1021	General and Operations Managers	99%	$59.42	$123,589	$30.31
10	47-5021	Earth Drillers, Except Oil and Gas	99%	$22.92	$47,667	$18.26
11	53-3032	Truck Drivers, Heavy and Tractor-Trailer	99%	$17.34	$36,076	$12.90
12	11-9021	Construction Managers	99%	$43.62	$90,725	$31.26
13	43-3031	Bookkeeping, Accounting, and Auditing Clerks	99%	$15.72	$32,694	$11.57
14	13-1051	Cost Estimators	99%	$29.53	$61,419	$21.28
15	47-5081	Helpers--Extraction Workers	99%	$14.52	$30,189	$12.74
16	43-9061	Office Clerks, General	99%	$13.12	$27,294	$9.51
17	51-4121	Welders, Cutters, Solderers, and Brazers	99%	$18.39	$38,247	$14.34
18	43-1011	First-Line Supervisors/Managers of Office and Administrative Support Workers	99%	$23.01	$47,856	$17.23
19	43-6011	Executive Secretaries and Administrative Assistants	99%	$19.98	$41,567	$15.33
20	43-6014	Secretaries, Except Legal, Medical, and Executive	99%	$14.95	$31,090	$12.38
Total, all occupations			99%	$22.98	$47,800	$11.75

Source: Economic Roundtable analysis; California Employment Development Department & Employment Projections Program, U.S. Department of Labor, U.S. Bureau of Labor Statistics. 2010. Los Angeles County Industry-Occupation Matrix 2008/2009. SOC stands for Standard Occupation Classification. *The mean of the first third of the wage distribution is the proxy for entry-level wage.

and Orange Counties. The top occupations are a mix of skilled construction trades, general service occupations, and professional services, paying good wages. Some lower-skilled occupations, such as construction laborers, have a low mean annual wage despite decent mean hourly and entry-level wages, which is attributable to workers not being employed intermittently rather than full-time and year-round.

Impacts per $1 Million Spent

Every million dollars invested in recycled water projects in Los Angeles stimulated an estimated $1.96 million in total local sales (output). The added sales consist of $411,548 in local indirect sales and $544,608 in local induced sales for every million dollars of local direct sales made in this type of water use efficiency project (Table 5.23). These figures are specific to the portions of recycled water project budgets directed to businesses located in Los Angeles and Orange Counties. Our estimate of impacts for all recycled water project budgets – which adds a small amount of additional budget that went to companies located outside of Los Angeles and Orange Counties – is that these projects stimulated $1.95 million in total local sales (output).

Table 5.23
Multiplier Effects of Recent Recycled Water Projects, Local and Overall Sales Supported

Budget Portion Invested in…	Description	Direct Sales (Output)	Indirect Sales (Output)	Induced Sales (Output)	Total Sales (Output)
Los Angeles & Orange Counties	Per $1 Million Direct	$1,000,000	$411,548	$544,608	$1,956,156
	Entire Project Budgets	$1,042,468,626	$429,026,141	$567,736,427	$2,039,231,194
All Locations	Per $1 Million Direct	$1,000,000	$410,371	$543,049	$1,953,420
	Entire Project Budgets	$1,050,957,297	$431,282,594	$570,721,346	$2,052,961,237

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C for recycled water project budgets. In this case study only, "local" includes Orange and Los Angeles Counties of California.

Measured in jobs, the impacts per million dollars invested in Los Angeles recycled water projects translated into an estimated 12.6 person-years of employment. This is based on an estimated 6.6 person-years of employment *directly* supported by the construction of the recycled water project, plus another 2.3 person-years of employment supported by *indirect* sales ("upstream" goods and services used in the projects), and 3.7 person-years of *induced* employment stimulated by household spending of workers involved directly and indirectly in the recycled water projects (Table 5.24). The recycled water projects in Los Angeles and Orange Counties studied here had a very small portion of their direct work carried out by companies outside of the local economy, and thus the multiplier effects for employment are almost identical for the total budget, which supported 12.5 person-years of employment per million dollar invested.

Table 5.24
Multiplier Effects of Recent Recycled Water Projects: Local and Overall Jobs Supported

Budget Portion Invested in…	Description	Direct Employment	Indirect Employment	Induced Employment	Total Employment
Los Angeles & Orange Counties	Per $1 Million Direct	6.6	2.3	3.7	12.6
	Entire Project Budgets ($1.04B)	6,843.5	2,376.8	3,862.9	13,083.2
All Locations	Per $1 Million Direct	6.6	2.3	3.7	12.5
	Entire Project Budgets ($1.05B)	6,896.3	2,388.1	3,883.2	13,167.6

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C for recycled water project budgets. In this case study only, "local" includes Orange and Los Angeles Counties of California.

Impacts of Ongoing Operations and Maintenance

Two recycled water projects studied in this report included budget data on their ongoing operations and maintenance, allowing the following separate estimates of their economic and job impacts beyond initial construction of the project.[47] The first project is the *Groundwater Recharge System, Phase 1*, carried out by the Orange County Water District to maximize waste water recycling through indirect potable reuse, yielding 72,000 acre-feet per year of recycled water. This plant's operations and maintenance are carried out by 61 employees, classified under the Water Supply and Irrigation Systems industry sector (NAICS 221310). The second project is the Michelson Upgrade Project, also located in Orange County, a decentralized wastewater treatment plant for recycling water used for irrigation. This facility's operations and maintenance are performed by 7 employees, also classified under the Water Supply and Irrigation Systems industry sector (NAICS 221310).

Recycled water projects allocated an ongoing budget of $2.8 million for operations and maintenance. Per million dollars invested, the added sales activity stimulated in the local economy[48] was $388,256 in local indirect sales and $476,123 in local induced sales (Table 5.25). The job impacts for every $1 million invested in operations and maintenance are significantly lower than for the initial construction of recycled water projects, amounting to an estimated 9.8 person-years of employment. This is based upon an estimated 3.8 person-years of employment *directly* supported by the ongoing operations and maintenance of recycled water facilities, 2.6 person-years of employment supported by *indirect* sales ("upstream" goods and services), and 3.4 person-years of *induced* employment stimulated by household spending of workers involved directly and indirectly in the facilities' ongoing operation after the first year (Table 5.26).

The employment impacts for recycled water facilities estimated through input-output analysis are significantly lower that the real-world employment reported due to two factors. First, the real-world operations and maintenance budgets reported for these two facilities cover only direct salaries, averaging $42,193 annually. The real cost of employing workers at these facilities includes materials and supplies, taxes, and overhead expenses such as insurance and employee benefits, and is much higher than the reported cost. This latter cost per person-year of employment is the amount estimated in the input-output model. Second, the estimate created

Table 5.25
Multiplier Effects of One Year of Operations and Maintenance in Recycled Water Projects:
Local Sales Supported

Description	Direct Sales (Output)	Indirect Sales (Output)	Induced Sales (Output)	Total Output (Sales)
Per $1 Million Direct	$1,000,000	$388,256	$476,123	$1,864,379
Entire O & M Budgets ($2.9M)	$2,869,135	$1,113,959	$1,366,062	$5,349,156

Table 5.26
Multiplier Effects of One Year of Operations and Maintenance in Recycled Water Projects:
Local Jobs Supported

Description	Direct Employment	Indirect Employment	Induced Employment	Total Employment
Per $1 Million Direct	3.8	2.6	3.4	9.8
Entire O & M Budgets ($7.9M)	10.9	7.6	9.6	28.1

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C for recycled water project budgets.

using input-output analysis is based upon overall data for the *Water, Sewage and Other Systems* industry sector in Los Angeles County, and is not specific to newly emerging recycled water facilities. Despite this difference, the economic impacts analysis presented here offers a conservative and useful guide for predicting impacts from future investments in recycled water projects.

5.3 Groundwater Management / Remediation Projects

This section analyzes the economic and job impacts of recent groundwater management / remediation projects carried out in Los Angeles County. These investments were made to recharge and decontaminate Los Angeles' depleted groundwater supply – which has been drawn down for decades,[49] as well as to treat groundwater that is affected by soil salinization. Indeed, the depletion and pollution of local groundwater is often identified as one of the greatest problems of water resources management. In Los Angeles, we are started to make investments in groundwater management and remediation, but there are far fewer of these types of water use efficiency projects available to study than stormwater and recycled water projects (Table 5.27).

Table 5.27
Groundwater Management / Remediation Projects in the Los Angeles County, with Budget Amount

Project Name	Budget
Impaired Groundwater Treatment (De-Salting) Project	$35,300,000
Tujunga Wellfield Liquid Phase Granular Activated Carbon (GAC) Project	$12,000,000
Total, All Groundwater Management / Remediation Projects	$47,300,000

Source: See Water Use Efficiency Projects Contributors List in Appendix C.

Direct Impacts

The two examples of groundwater management / remediation in Los Angeles represent a *direct* investment of $47.3 million dollars, with each involving one engineering services company and one lead construction company (Table 5.28). These large scale, capital intensive projects are initially planned and funded by state and local government agencies, although the funds expended for the public sector work is only accounted for in the *Tujunga Wellfield Liquid Phase Granular Activated Carbon (GAC) Project*, carried out by the Metropolitan Water District of Southern California. There was no data available on specialized filtration equipment of water treatment services for these projects, so these cannot be accounted for in direct expenditures.

Table 5.28
Industry Sector Breakdown of Businesses Directly Involved in Recent Groundwater Management / Remediation Projects, with Local (Los Angeles County) and Total Budget Amounts

IMPLAN Sector Code	Industry Sector Description	Direct Expenditures in LA Co.	Total Direct Expenditures	Percent Local
36	Construction of other new nonresidential structures	$40,100,001	$40,100,001	100%
369	Landscape Architecture, engineering, and related services	$7,200,000	$7,200,000	100%
Total		$47,300,000	$47,300,000	100%

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C. Note: Figures may not add up to totals precisely due to rounding errors.

Indirect Impacts

Local *indirect* economic impacts of the two groundwater management / remediation projects stimulated added sales of approximately $19.3 million in professional services and construction logistics businesses (Table 5.29). The *indirect* job impacts create a slightly

Table 5.29
Local Indirect Economic Impacts of Recent Groundwater Management / Remediation Projects, by Industry Sector

Rank	IMPLAN Sector Code	Industry Sector Description	Indirect Sales (Output)	Percent of Total Indirect Sales (Output)
1	369	Landscape Architecture, engineering, and related services	$3,505,554	18%
2	115	Fuel (petroleum refineries)	$2,115,255	11%
3	319	Wholesale trade businesses	$873,041	5%
4	360	Real estate establishments (leasing land, renting structures)	$781,708	4%
5	351	Telecommunications	$685,878	4%
6	365	Comm. and industrial machinery and equipment rental and leasing	$614,558	3%
7	367	Legal services	$542,578	3%
8	354	Monetary authorities and depository credit intermediation activities	$514,829	3%
9	335	Transport by truck	$509,231	3%
10	382	Employment services	$373,257	2%
Total			$19,277,092	100%

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C. Note: Figures may not add up to totals precisely due to rounding errors. List shows the top ten out of 440 total industry sectors.

Table 5.30
Local Indirect Job Impacts of Recent Groundwater Management / Remediation Projects, by Industry Sector

Rank	IMPLAN Sector Code	Industry Sector Description	Indirect Jobs Supported (Person-Years of Employment)	Percent of Total Indirect Jobs Supported (Person-Years of Employment)
1	369	Landscape Architecture, engineering, and related services	23.6	22%
2	382	Employment services	8.3	8%
3	319	Wholesale trade businesses	4.8	4%
4	413	Food services and drinking places	4.6	4%
5	360	Real estate establishments (leasing land, renting structures)	3.7	3%
6	335	Transport by truck	3.7	3%
7	368	Accounting, tax preparation, bookkeeping, and payroll services	3.1	3%
8	414	Automotive repair and maintenance, except car washes	3.1	3%
9	374	Management, scientific, and technical consulting services	2.7	2%
10	367	Legal services	2.6	2%
Total			108.5	100%

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C. Note: Figures may not add up to totals precisely due to rounding errors. List shows the top ten out of 440 total industry sectors.

different list (Table 5.30). Top indirect employment beneficiaries of groundwater management / remediation projects include professional services, but also wholesale trade, restaurants, real estate and truck transportation.

Table 5.31
Local Induced Economic Impacts of Recent Groundwater Management / Remediation Projects, by Industry Sector

Rank	IMPLAN Sector Code	Industry Sector Description	Induced Sales (Output)	Percent of Total Induced Sales (Output)
1	361	Imputed rental activity for owner-occupied dwellings (Repair and maintenance of owner-occupied homes)	$3,043,414	12%
2	360	Real estate establishments (includes lease payments for land and rental of structures, rental housing)	$1,839,761	7%
3	394	Offices of physicians, dentists, and other health practitioners	$1,496,110	6%
4	413	Food services and drinking places	$1,357,426	5%
5	397	Private hospitals	$1,263,071	5%
6	357	Insurance carriers	$925,660	4%
7	354	Monetary authorities and depository credit intermediation activities	$916,776	3%
8	319	Wholesale trade businesses	$793,278	3%
9	355	Nondepository credit intermediation and related activities	$695,816	3%
10	115	Petroleum refineries	$649,964	2%
Total			$26,409,915	100%

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C. Note: Figures may not add up to totals precisely due to rounding errors. List shows the top ten out of 440 total industry sectors.

Table 5.32
Local Induced Job Impacts of Recent Groundwater Management / Remediation Projects, by Industry Sector

Rank	IMPLAN Sector Code	Industry Sector Description	Induced Jobs Supported (Person-Years of Employment)	Percent of Total Induced Jobs Supported (Person-Years of Employment)
1	413	Food services and drinking places	19.7	11%
2	394	Offices of physicians, dentists, and other health practitioners	10.9	6%
3	360	Real estate establishments (includes lease payments for land and rental of structures, rental housing)	8.8	5%
4	397	Private hospitals	7.7	4%
5	324	Retail Stores - Food and beverage	5.5	3%
6	426	Private household operations	5.1	3%
7	398	Nursing and residential care facilities	5.0	3%
8	329	Retail Stores - General merchandise	4.8	3%
9	319	Wholesale trade businesses	4.3	2%
10	356	Securities, commodity contracts, investments, and related activities	4.2	2%
Total			179.7	100%

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C. Note: Figures may not add up to totals precisely due to rounding errors. List shows the top ten out of 440 total industry sectors.

Induced Impacts

The additional household spending spurred by groundwater management / remediation projects stimulated over $26 million in sales. Businesses benefitting the most from these consumer sales include: home improvement and hardware stores, home repair contractors, apartment owners, health care providers, restaurants, insurance companies, banks, wholesalers, mortgage brokers and carriers, and gas stations (Table 5.31). In terms of person-years of employment induced by the added household spending resulting from these two groundwater projects, restaurants are the top of the list, along with doctors' and dentists' offices, apartment owners, grocery stores, housekeepers, and nursing homes (Table 5.32).

Top Occupations Impacted

The occupations hired most frequently across all of the industries involved in groundwater management / remediation projects – including through *direct*, *indirect* and *induced*

Table 5.33
Top Los Angeles Occupations Supported by Recent Groundwater Management / Remediation Projects, Ranked by Frequency

Rank	SOC Code - Occupation Title		Percent of Occupational Employment Captured in LA Co.	Mean Hourly Wage	Mean Annual Wage	Entry-Level Hourly Wage*
1	47-2061	Construction Laborers	100%	$19.67	$40,904	$11.66
2	47-2073	Operating Engineers and Other Construction Equipment Operators	100%	$31.14	$64,776	$25.80
3	47-1011	Managers of Construction Trades Workers	100%	$31.96	$66,474	$23.88
4	47-2151	Pipelayers	100%	$25.61	$53,261	$17.06
5	17-0000	Landscape Architecture & Engineering Occupations	100%	$46.14	$95,984	$25.58
6	41-0000	Sales and Related Occupations	100%	$19.62	$40,810	$16.62
7	53-7051	Industrial Truck and Tractor Operators	100%	$22.45	$46,710	$19.11
8	47-2152	Plumbers, Pipefitters, and Steamfitters	100%	$21.37	$44,447	$15.96
9	47-5021	Earth Drillers, Except Oil and Gas	100%	$22.92	$47,667	$18.26
10	11-1021	General and Operations Managers	100%	$65.24	$135,688	$30.11
11	53-3032	Truck Drivers, Heavy and Tractor-Trailer	100%	$19.16	$39,855	$11.69
12	11-9021	Construction Managers	100%	$42.71	$88,824	$29.55
13	43-3031	Bookkeeping, Accounting, and Auditing Clerks	100%	$18.96	$39,428	$12.61
14	13-1051	Cost Estimators	100%	$34.12	$70,958	$26.76
15	47-5081	Helpers--Extraction Workers	100%	$14.52	$30,189	$12.74
16	17-2051	Civil Engineers	100%	$32.87	$68,378	$22.92
17	43-9061	Office Clerks, General	100%	$12.79	$26,597	$8.26
18	51-4121	Welders, Cutters, Solderers, and Brazers	100%	$21.29	$44,287	$16.81
19	17-3011	Architectural and Civil Drafters	100%	$23.52	$48,927	$17.84
20	43-6011	Executive Secretaries and Administrative Assistants	100%	$19.67	$40,904	$11.66
Total, all occupations			100%	$26.48	$55,076	$13.49

Source: Economic Roundtable analysis; California Employment Development Department & Employment Projections Program, U.S. Department of Labor, U.S. Bureau of Labor Statistics. 2010. Los Angeles County Industry-Occupation Matrix 2008/2009. SOC stands for Standard Occupation Classification. *The mean of the first third of the wage distribution is the proxy for entry-level wage.

rounds of economic activity – are shown in Table 5.33.[50] Most of the occupations hired as part of this type of water use efficiency project are associated with either architectural, engineering, and related services or construction services, all of which were captured inside Los Angeles County.[51] Other occupations in the top 20 list include: salespersons, bookkeeping, accounting, and auditing clerks, cost estimators, and secretaries. All but one occupation (Office Clerks, General) have an entry-level wage well above the state's legal minimum.

Impacts per $1 Million Spent on Groundwater Management / Remediation Projects

Every million dollars invested in groundwater management / remediation projects in Los Angeles stimulated an estimated $1.97 million in total local sales (output). The added sales consist of $407,550 in local indirect sales and $558,349 in local induced sales for every million dollars of local direct sales made in this type of water use efficiency project (Table 5.34). These figures are specific to the portions of stormwater project budgets directed to businesses located in Los Angeles County, and are inclusive of the total project budget amounts.

Table 5.34
Multiplier Effects of Recent Groundwater Management / Remediation Projects, Sales Supported

Budget Portion Invested in…	Description	Direct Sales (Output)	Indirect Sales (Output)	Induced Sales (Output)	Total Sales (Output)
Los Angeles Co./ All Locations	Per $1 Million Direct	$1,000,000	$407,550	$558,349	$1,965,899
	Entire Project Budgets	$47,300,000	$19,277,092	$26,409,915	$92,987,008

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in the Appendix C for individual project budgets. "Los Angeles Co." and "All Locations" figures are identical due to 100% of the work being done in LA.

Measured in jobs, the impacts per million dollars invested in Los Angeles groundwater management / remediation projects translated into an estimated 12.8 person-years of employment. This is based on an estimated 6.8 person-years of employment *directly* supported by the construction of the groundwater management / remediation project, plus another 2.3 person-years of employment supported by *indirect* sales ("upstream" goods and services used in the projects), and 3.8 person-years of *induced* employment stimulated by household spending of workers involved directly and indirectly in these projects (Table 5.35).

Table 5.35
Multiplier Effects of Recent Groundwater Management / Remediation Projects: Jobs Supported

Budget Portion Invested in…	Description	Direct Employment	Indirect Employment	Induced Employment	Total Employment
Los Angeles County/ All Locations	Per $1 Million Direct	6.8	2.3	3.8	12.8
	Entire Project Budgets ($122M)	319.5	108.5	179.7	607.7

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in the Appendix C for individual project budgets.

Impacts of Ongoing Operations and Maintenance

One of the two groundwater management / remediation projects included budget data for ongoing operations and maintenance: the *Tujunga Wellfield Liquid Phase Granular Activated Carbon (GAC) Project Two*, located in the San Fernando Valley Groundwater Basin.[52] Based on this single project, we estimate the following economic and job impacts for the ongoing, non-construction activities.[53]

This groundwater management / remediation project allocates an ongoing budget of $9.7 million for operations and maintenance, carried out by establishments in the *Construction Management, Water and Sewage Treatment Plant* and *Engineering Services* industries. For every million dollars invested, the added sales activity stimulated in the local economy was $422,834 in local indirect sales and $579,805 in local induced sales (Table 5.36).

The job impacts for every one million dollars invested in operations and maintenance for this groundwater management / remediation project is slightly higher than for the initial construction of projects of this type, amounting to into an estimated 13.9 person-years of employment. This is based upon an estimated 7.3 person-years of employment *directly* supported by the ongoing operations and maintenance of the project, 2.5 person-years of employment supported by *indirect* sales ("upstream" goods and services), and 4.1 person-years of *induced* employment stimulated by household spending of workers involved directly and indirectly in the project's ongoing operation (Table 5.37).

Table 5.36
Multiplier Effects of One Year of Operations and Maintenance in Groundwater Management / Remediation Projects: Local Sales Supported

Description	Direct Sales (Output)	Indirect Sales (Output)	Induced Sales (Output)	Total Output (Sales)
Per $1 Million Direct	$1,000,000	$422,834	$579,805	$2,002,640
Entire O & M Budgets ($9.7M)	$9,666,667	$4,087,397	$5,604,785	$19,358,849

Table 5.37
Multiplier Effects of One Year of Operations and Maintenance in Groundwater Management / Remediation Projects: Local Jobs Supported

Description	Direct Employment	Indirect Employment	Induced Employment	Total Employment
Per $1 Million Direct	7.3	2.5	4.1	13.9
Entire O & M Budgets ($7.9M)	70.9	23.8	39.5	134.3

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C for groundwater management / remediation projects budgets.

Given the unique conditions and remediation approaches for contaminated water sites within Los Angeles County, future groundwater management / remediation projects will likely have significant variation in their operations and maintenance costs. This estimate should be revisited as more data become available for these types of water use efficiency projects.

5.4 Water Conservation Projects

The water use efficiency case studies in this section consist of 11 conservation projects, analyzed to understand their economic and job impacts in Los Angeles County. These investments aim to reduce Los Angeles' usage of water, and seek to increase wastewater recycling. This type of project can take a variety of forms with modest budgets, ranging from public awareness campaigns and plumbing retrofit programs to green landscaping and gardens (Table 5.38). Keeping with the methodology in preceding sections, these 11 projects are first analyzed as a single composite case study. Afterwards, we present a case study of water conservation projects offered by *Generation Water* project, an innovative water-use auditing and retrofitting service that promotes training and employment opportunities for young adults in the newly emerging water use efficiency field.

Table 5.38
Recent Los Angeles Water Conservation Projects, with Budget Amount

Project Name	**Budget**
Complete Restroom Retrofit Monitoring Program (ICP Program)	$70,000
Complete Restroom Retrofit Project	$473,619
Food Facilities Audit, Incentive and Training Program (Enhanced Conservation Program)	$55,000
Green Garden Program	$607,100
High-Efficiency Toilet Distributions	$301,500
Local Water Conservation Plans for Water Purveyors	$223,000
MWD Conservation Proposal- Landscape Audits/Water Budgets/Equipment Incentives	$43,750
Ocean Friendly Landscape Project	$1,835,843
Re-circulate & Save Program (CII Incentive Program)	$404,437
Residential Indoor Plumbing Retrofit Kits	$269,000
Water & Energy Efficiency Multi-Family Program (Enhanced Conservation Program)	$836,500
Total, All Water Conservation Projects	$5,119,749

Source: See Water Use Efficiency Projects Contributors List in Appendix C.

Direct Impacts

Los Angeles' eleven recent water conservation projects represent a *direct* investment of approximately $5.1 million dollars – smaller than the three project categories analyzed in the preceding sections, and split among 16 participating private businesses and public agencies. Examining these direct project participants by industry sector and budget amounts (Table 5.39), we find that the following industries carried out most of the local work:

- Environmental and other technical consulting services
- Grantmaking, giving, and social advocacy organizations
- Wholesale trade businesses
- Architectural, engineering, and related services
- Civic, social, professional, and similar organizations

Table 5.39
Industry Sector Breakdown of Businesses Directly Involved in Recent Water Conservation Projects, with Los Angeles and Total Budget Amounts

IMPLAN Sector Code	Industry Sector Description	Direct Expenditures in LA Co.	Total Direct Expenditures	Percent Local
375	Environmental and other technical consulting services	$150,000	$1,281,600	12%
424	Grantmaking, giving, and social advocacy organizations	$123,303	$123,303	100%
319	Wholesale trade businesses	$70,875	$70,875	100%
369	Architectural, engineering, and related services	$43,750	$448,187	10%
425	Civic, social, professional, and similar organizations	$40,473	$217,473	19%
203	Farm machinery and equipment manufacturing	$0	$1,577,067	0%
33	Water, sewage and other treatment and delivery systems	$0	$836,500	0%
199	Plumbing fixture fitting and trim manufacturing	$0	$98,619	0%
406	Museums, historical sites, zoos, and parks	$0	$92,000	0%
Total		$428,401	$4,745,624	9%

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C. Note: Figures may not add up to totals precisely due to rounding errors.

Environmental consultants, providers of manufactured goods and utility services are foremost among the non-local beneficiaries of conservation projects. Approximately $4.4 million of the water conservation project budgets was spent outside of Los Angeles County, mostly on the aforementioned goods and services. This amounted to almost 85 percent of the combined budget for water conservation projects. A detailed description of the geographic distribution of recycled water project budgets appears in Table 5.40.

Table 5.40
Geography of Water Conservation Project Investments

	Total	Los Angeles & Orange Counties	California, Other Counties	US, Outside California	Outside the US
Dollar Amount	$5,119,749	$732,526	$4,210,223	$177,000	$0
Percent	100%	14.3%	82.2%	3.5%	0.0%

Source: Water conservation project budgets, drawn from the Water Use Efficiency Projects Contributors List in Appendix C.

Indirect Impacts

Local *indirect* economic impacts of recent water conservation projects supported added sales in professional services (leasers of land, renters of structures, management, scientific, and technical consulting services, architectural, engineering, and related services, banking and accounting services), and some support services (employment services, food services, accounting, tax preparation, bookkeeping, and payroll services) benefitted as well (Table 5.41). When the

indirect impacts are measure in terms of jobs supported, the list is similar but slightly re-ordered. Top indirect employment beneficiaries of water conservation programs include: employment and real estate services, management, scientific, and technical consulting services, restaurants, and architectural, engineering, and related services (Table 5.42).

Table 5.41
Local Indirect Economic Impacts of Recent Water Conservation Projects, by Industry Sector

Rank	IMPLAN Sector Code	Industry Sector Description	Indirect Sales (Output)	Percent of Total Indirect Sales (Output)
1	360	Real estate establishments (leasing land, renting structures)	$20,832	11%
2	374	Management, scientific, and technical consulting services	$10,636	6%
3	351	Telecommunications	$10,526	6%
4	369	Landscape Architecture, engineering, and related services	$8,873	5%
5	354	Monetary authorities and depository credit intermediation activities	$8,005	4%
6	382	Employment services	$7,425	4%
7	355	Nondepository credit intermediation and related activities	$6,038	3%
8	357	Insurance carriers	$5,518	3%
9	413	Food services and drinking places	$5,345	3%
10	368	Accounting, tax preparation, bookkeeping, and payroll services	$5,247	3%
Total			$184,086	100%

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C. Note: Figures may not add up to totals precisely due to rounding errors. List shows the top ten out of 440 total industry sectors.

Table 5.42
Local Indirect Job Impacts of Recent Water Conservation Projects, by Industry Sector

Rank	IMPLAN Sector Code	Industry Sector Description	Indirect Jobs Supported (Person-Years of Employment)	Percent of Total Indirect Jobs Supported (Person-Years of Employment)
1	382	Employment services	0.2	13%
2	360	Real estate establishments (leasing land, renting structures)	0.1	8%
3	374	Management, scientific, and technical consulting services	0.1	6%
4	413	Food services and drinking places	0.1	6%
5	369	Landscape Architecture, engineering, and related services	0.1	5%
6	356	Securities, commodity contracts, investments, and related activities	0.0	4%
7	368	Accounting, tax preparation, bookkeeping, and payroll services	0.0	4%
8	393	Other private educational services	0.0	3%
9	339	Couriers and messengers	0.0	3%
10	388	Services to buildings and dwellings	0.0	3%
Total			1.3	100%

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C. Note: Figures may not add up to totals precisely due to rounding errors. List shows the top ten out of 440 total industry sectors.

Induced Impacts

The additional household spending spurred by water conservation projects generated

Table 5.43
Local Induced Economic Impacts of Recent Water Conservation Projects, by Industry Sector

Rank	IMPLAN Sector Code	Industry Sector Description	Induced Sales (Output)	Percent of Total Induced Sales (Output)
1	361	Imputed rental activity for owner-occupied dwellings (Repair and maintenance of owner-occupied homes)	$32,544	11%
2	360	Real estate establishments (includes lease payments for land and rental of structures, rental housing)	$20,087	7%
3	394	Offices of physicians, dentists, and other health practitioners	$16,214	6%
4	413	Food services and drinking places	$14,662	5%
5	397	Private hospitals	$13,694	5%
6	354	Monetary authorities and depository credit intermediation activities	$9,947	3%
7	357	Insurance carriers	$9,933	3%
8	319	Wholesale trade businesses	$8,646	3%
9	355	Nondepository credit intermediation and related activities	$7,493	3%
10	115	Fuel (petroleum refineries)	$7,052	2%
Total			$284,969	100%

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C. Note: Figures may not add up to totals precisely due to rounding errors. List shows the top ten out of 440 total industry sectors.

Table 5.44
Local Induced Job Impacts of Recent Water Conservation Projects, by Industry Sector

Rank	IMPLAN Sector Code	Industry Sector Description	Induced Jobs Supported (Person-Years of Employment)	Percent of Total Induced Jobs Supported (Person-Years of Employment)
1	413	Food services and drinking places	0.2	11%
2	394	Offices of physicians, dentists, and other health practitioners	0.1	6%
3	360	Real estate establishments (includes lease payments for land and rental of structures, rental housing)	0.1	5%
4	397	Private hospitals	0.1	4%
5	324	Retail Stores - Food and beverage	0.1	3%
6	398	Nursing and residential care facilities	0.1	3%
7	426	Private household operations	0.1	3%
8	329	Retail Stores - General merchandise	0.1	3%
9	319	Wholesale trade businesses	0.0	2%
10	356	Securities, commodity contracts, investments, and related activities	0.0	2%
Total			1.9	100%

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C. Note: Figures may not add up to totals precisely due to rounding errors. List shows the top ten out of 440 total industry sectors.

almost $285 thousand in sales. Businesses benefitting the most from these consumer sales include the usual suspects: home improvement and hardware stores, home repair contractors, apartment owners, health care providers, restaurants, insurance companies, banks, wholesalers, mortgage brokers and carriers, and gas stations (Table 5.43). Industry sectors employing more workers due to the added local household spending that results from water conversation program investments include: restaurants, doctors' and dentists' offices, apartment management companies, grocery stores, nursing homes, and housekeepers (Table 5.44).

Top Occupations Impacted

The occupations hired most frequently across all of the industries involved in water conservation projects – including *direct*, *indirect* and *induced* rounds of economic activity – are shown in Table 5.45.[54] Most of the occupations hired as part of this type of water use efficiency project are tied to office-based services and horticulture, as well as to environmental outreach

Table 5.45
Top LA Occupations Supported by Recent Water Conservation Projects, Ranked by Frequency

Rank	SOC Code - Occupation Title		Percent of Occupational Employment Captured in LA Co.	Mean Hourly Wage	Mean Annual Wage	Entry-Level Hourly Wage*
1	41-4012	Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific	68%	$20.34	$42,300	$14.07
2	43-9061	Office Clerks, General	36%	$12.21	$25,408	$9.15
3	43-5081	Stock Clerks and Order Fillers	82%	$12.70	$26,406	$9.64
4	43-3031	Bookkeeping, Accounting, and Auditing Clerks	30%	$16.33	$33,953	$11.14
5	53-7062	Laborers and Freight, Stock, and Material Movers, Hand	70%	$10.67	$22,203	$8.09
6	43-6011	Executive Secretaries and Administrative Assistants	23%	$19.84	$41,264	$14.84
7	11-1021	General and Operations Managers	17%	$49.52	$103,006	$29.32
8	43-5071	Shipping, Receiving, and Traffic Clerks	58%	$12.25	$25,485	$9.14
9	43-1011	Managers of Office and Admin. Support Workers	37%	$22.72	$47,265	$17.23
10	39-9032	Recreation Workers	100%	$9.12	$18,956	$7.51
11	45-2092	Farmworkers and Laborers, Crop, Nursery, and Greenhouse	100%	$8.02	$16,672	$7.12
12	13-1199	Business Operations Specialists, All Other	18%	$33.10	$68,853	$24.71
13	13-1111	Management Analysts	12%	$48.88	$101,664	$23.95
14	43-6014	Secretaries, Except Legal, Medical, and Executive	25%	$13.73	$28,566	$11.03
15	21-9099	All Other Counselors, Social and Religious Workers	100%	$15.24	$31,689	$9.74
16	53-3033	Truck Drivers, Light or Delivery Services	49%	$11.18	$23,248	$8.74
17	11-9151	Social and Community Service Managers	90%	$27.90	$58,042	$18.14
18	43-4171	Receptionists and Information Clerks	47%	$12.54	$26,073	$9.77
19	27-3031	Public Relations Specialists	57%	$24.11	$50,147	$14.91
20	37-2011	Janitors and Cleaners, Except Maids and Housekeeping Cleaners	48%	$9.79	$20,357	$7.55
Total, all occupations			28%	$20.94	$43,557	$10.88

Source: Economic Roundtable analysis; California Employment Development Department & Employment Projections Program, U.S. Department of Labor, U.S. Bureau of Labor Statistics. 2010. Los Angeles County Industry-Occupation Matrix 2008/2009. SOC stands for Standard Occupation Classification. *The mean of the first third of the wage distribution is the proxy for entry-level wage.

and advocacy, with approximately 28 percent of these jobs being captured in Los Angeles County. Notably, 10 of the top 20 occupations linked to water conservation programs have entry level wages under $10 per hour, and four occupations have mean annual wages at or below the HHS poverty guidelines for a family of four.[55] Some of these lower wages may be attributable to occupations where full-time hours are not the norm, and the relatively low number of skilled trades jobs currently tied to this type of water use efficiency work.

Impacts per $1 Million Spent

Every million dollars invested in Los Angeles' water conservation projects and programs stimulated an estimated $2.09 million in total local sales (output). The added sales consist of $429,705 in local indirect sales and $665,193 in local induced sales for every million dollars of local direct sales made in this type of water use efficiency project (Table 5.46). These figures are specific to portions of water conservation project budgets directed to businesses located in Los Angeles. Our estimate of impacts for all water conservation project budgets – which adds a small amount of additional budget that went to companies outside of Los Angeles County – is that a million dollars stimulates a total of $1.88 million in total local sales (output).

Table 5.46
Multiplier Effects of Recent Water Conservation Projects, Local and Overall Sales Supported

Budget Portion Invested in…	Description	Direct Sales (Output)	Indirect Sales (Output)	Induced Sales (Output)	Total Sales (Output)
Los Angeles County	Per $1 Million Direct	$1,000,000	$429,705	$665,193	$2,094,898
	Entire Project Budgets	$428,401	$184,086	$284,969	$897,456
All Locations	Per $1 Million Direct	$1,000,000	$407,077	$480,308	$1,887,385
	Entire Project Budgets	$4,745,624	$1,931,835	$2,279,362	$8,956,821

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C for individual project descriptions and budgets.

Measured in jobs, the impact per million dollars invested in Los Angeles water conservation projects is an estimated 16.6 person-years of employment – the highest of any of the water use efficiency types studied. This is based upon an estimated 9.1 person-years of employment *directly* supported by the implementation of the water conservation programs, plus another 3.0 person-years of employment supported by *indirect* sales ("upstream" goods and services used in the projects), and 4.5 person-years of *induced* employment stimulated by household spending of workers involved directly and indirectly in water conservation projects (Table 5.47). Los Angeles' water conservation projects had a high proportion of direct work carried out by companies located elsewhere, which only supported 11.8 person-years of employment per million dollar invested. Thus, LA's water conservation projects stimulated a greater volume of non-local employment, even though the portions of those programs carried out in Los Angeles supported more person-years of employment per $1 million invested.

Table 5.47
Multiplier Effects of Recent Recycled Water Projects: Local and Overall Jobs Supported

Budget Portion Invested in…	Description	Direct Employment	Indirect Employment	Induced Employment	Total Employment
Los Angeles County	Per $1 Million Direct	9.1	3.0	4.5	16.6
	Entire Project Budgets ($.428M)	3.9	1.3	1.9	7.1
All Locations	Per $1 Million Direct	6.0	2.6	3.3	11.8
	Entire Project Budgets ($4.7M)	28.4	12.2	15.5	56.1

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C for individual project descriptions and budgets.

Impacts of Ongoing Operations and Maintenance

For this study, we did not obtain information about ongoing operations and maintenance aspects of water conservations projects. Since many projects in this category build public awareness campaigns that can require ongoing outreach to communities of interest, utilizing the same environmental consulting services and social advocacy organizations, the multiplier effects factors show in Tables 5.46 and 5.47 are suitable for estimating the impacts of such programs beyond their first year. Additionally, the following section on water use efficiency audits and irrigation system surveys provides estimates of other types of maintenance performed on existing water systems, where water conservation is one of the main goals.

Case Study: Generation Water – Audits and Retrofits

Generation Water, previously known as the Infrastructure Academy, is a Los Angeles-area non-profit that promotes water use efficiency and workforce development through its training and employment program for young adults. This social enterprise offers water use efficiency surveys of existing school campus as well as park properties and buildings in order to identify leaking or otherwise broken irrigation systems. Generation Water can then offer a second service, "retrofitting" that fixes and upgrades irrigation system equipment. Generation Water employs and trains young adults age 18-24 for these and other water use efficiency programs, and in the process helps school districts, municipalities and home owners achieve greater water use efficiency, and helps the Los Angeles region meet its water conservation goals.

The following analysis focuses exclusively on Generation Water's water conservation programs, presenting a per-service-unit estimate. This methodological approach is needed because of the small scale at which Generation Water's program has been rolled out thus far, and because this specific program represents a major expansion opportunity in the emerging field of water use efficiency for young adults entering the local labor market. As in previous sections, we analyze the economic impacts of Generation Water's water conservation programs using the IMPLAN input-output model for Los Angeles County, blending together the industry sectors that best match Generation Water's service offerings.

Water Efficiency Audits and Irrigation System Surveys

Generation Water and its young trainees offer initial evaluation services to school districts and municipal parks to help them reduce their water consumption, focused on identifying and repairing leaking ground irrigation systems. Their 'water use efficiency audit' and 'irrigation system survey' services have been offered since 2009, conducted at over 160 local schools and one city park thus far. These services include "analysis of the water bills of school districts, mapping out irrigation equipment and landscaping using Geographic Information Systems (GIS), building an electronic database of existing irrigation equipment and landscaping, and making recommendations on how to reduce water usage."[56]

The audits and surveys offered by Generation Water vary in cost based upon the type of school campuses; elementary, middle and high school campuses typically have different parcel sizes and amounts of unpaved, outdoor surfaces, and thus are charged different rates for irrigation system surveys (Table 5.48). In their rate schedule, parks are comparable to Middle Schools. This auditing and survey work is carried out by a team of young adult workers, including a field manager (skilled in electronics and irrigation systems, $18/hr.), a data supervisor ($14/hr.), a GIS specialist ($9.50/hr.), plus five general team members ($8-$9.50/hr.) who conduct a field inventory of the existing irrigation system and inspects its sprinkler heads for leaks.

Table 5.48
Three Types of Water Use Efficiency Audits and Irrigation System Surveys for School Campuses, *Generation Water*

Type	Cost	Time
Elementary School	$1,500	1 day
Middle School	$2,500	2 days
High School	$3,000	2.5 days
Parks	$2,500	2 days

Sources: Marcus Castain, Generation Water, 2011.

Based upon this project profile, we estimate the economic impacts of Generation Water's water use efficiency audits and irrigation system surveys using NAICS Industries and IMPLAN Sectors shown in Table 5.49.

Table 5.49
Proxy of Generation Water's Efficiency Audits and Irrigation System Surveys Projects using NAICS Industries and IMPLAN Sectors

NAICS Code	NAICS Title	IMPLAN Code	Industry Sector	Percent Weight
238220	Plumbing, HVAC Contractors	39	Maint. & Repair of Non-Res. Bldgs.	30%
541320	Landscape Arch. Services	369	Arch., Eng., & Related Services	5%
541350	Building Inspection Services	369	Arch., Eng., & Related Services	5%
561730	Landscaping Contractors	388	Services To Bldgs. & Dwellings	40%
813312	Environment, Conservation Orgs	424	Social Advocacy Organizations	20%
			Total	100%

Source: Marcus Castain, Generation Water, 2011; Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software.

Our estimate blends together the profiles of five industries that represent the activities carried out in performing water efficiency audits and irrigation system surveys (Table 5.49). Forty-five percent of the labor time is characterized as *Landscaping Contractors* and *Landscape Architecture Services*, capturing the work of digging into the landscapes of school campuses and

Table 5.50
Economic Multiplier Factors per Dollar of Generation Water Audits and Surveys

IMPLAN Code	Percent Weight	Direct Output Factor	Indirect Output Factor	Induced Output Factor	Total Output Factor	Direct Sales	Indirect Sales	Induced Sales	Total Sales
39	30%	1.0000	0.362484	0.568542	1.931026	$0.3000	$0.1087	$0.1706	$0.5793
369	5%	1.0000	0.408569	0.701848	2.110417	$0.0500	$0.0204	$0.0351	$0.1055
369	5%	1.0000	0.408569	0.701848	2.110417	$0.0500	$0.0204	$0.0351	$0.1055
388	40%	1.0000	0.518069	0.496551	2.014621	$0.4000	$0.2072	$0.1986	$0.8058
424	20%	1.0000	0.518069	0.496551	2.014621	$0.2000	$0.1036	$0.0993	$0.4029
	100%					$1.0000	$0.4604	$0.5387	$1.9991

Source: Marcus Castain, Generation Water, 2011; Economic Roundtable analysis; Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software.

parks to access the irrigation systems. Another 35 percent of the labor time is characterized as the *Plumbing, HVAC Contractors* and *Building Inspection Services*, concerned with the evaluation of irrigation systems. The remaining 20 percent of the labor time expended in these audits and surveys is characterized as *Environmental and Conservation Organizations,* wherein Generation Water's young adult trainees are advocating for greater water conservation with school and parks staff.

The economic benefits of these Generation Water services to Los Angeles were calculated using IMPLAN multiplier factors (Table 5.50). Applying these factors to the per-unit-fee for schools and municipal parks, the economic impacts of Generation Water irrigation surveys and water use efficiency audits are substantial (Table 5.51). The smallest service category, grade schools, stimulates $691 in indirect sales for each audit/survey, while stimulating $808 in induced sales. The largest service category, high schools, stimulates $1,151 in indirect sales for each audit/survey, while stimulating $1,347in induced sales per $3,000 unit of sale.

Table 5.51
Economic Impacts of Generation Water Audits and Surveys

NAICS Code	Per Unit Fee	Direct Sales	Indirect Sales	Induced Sales	Total Sales
Grade School	$1,500	$1,500	$691	$808	$2,999
Middle School	$2,500	$2,500	$1,151	$1,347	$4,998
High school	$3,000	$3,000	$1,381	$1,616	$5,997
City Park	$2,500	$2,500	$1,151	$1,347	$4,998

Source: Marcus Castain, Generation Water, 2011; Economic Roundtable analysis; Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software.

The number of Generation Water trainees and apprentices involved in irrigation survey and water use efficiency audit teams was described briefly above. Generation Water's mission to build a pipeline of diverse, well-qualified young workers for the emerging green economy is being carried out in two ways:

- By providing young people with training and on the job work experience as they embark on a career in water, sustainability, the skilled trades, or a STEM-related field (Science, Technology, Engineering, and Mathematics).

- By completing sustainability projects that reduce water and/or energy consumption while minimizing negative environmental impacts.

Table 5.52
Water Efficiency Audit and Irrigation System Survey Teams for Generation Water Projects

Typical Audit & Survey Team:	Workers	Hourly Wage	Daily Wages
Field Manager	1	$18.00	$144.00
Data Supervisor	1	$14.00	$112.00
GIS Analyst	1	$9.50	$76.00
Field Team Members	5	$8.00	$320.00
Total	8		$652.00

Sources: Generation Water; Economic Roundtable analysis.

Since apprenticeship-like work with on-the-job training is a mainstay for this young adults employment program, its employment impacts are estimated using Generation Water's own employment per project ratios, rather than using input-output estimates of this sectors overall workforce. The teams that carry out their audits and surveys typically include eight workers for a period of a day or more, with daily wages paid amounting to $652 (Table 5.52). The number of days needed to carry out the audits and surveys varies: elementary school campuses require one full day, middle schools and parks take two days, while two and half days are allocated for high school campuses.

Depending upon the number of audit/survey projects conducted at schools and city parks in Los Angeles County, it could support up to 53,048 person-days of employment, or 145.3 person-years of employment (Table 5.53). This would amount to $34.6 million in wages earned, in addition to the on-the-job training and experienced gained by young adult participants. As mentioned before, audits and surveys would not be carried out on all 4,113 school campuses and city parks within the county, but this gives a picture of the potential scale of a fully implemented Generation Water program.

Table 5.53
Employment Potential for Water Efficiency Audit and Irrigation System Survey Teams: Generation Water

	Elementary School	Middle School or Park	High School	Total
Number of Sites	2,092	1,027	994	4,113
Project Days Duration	1	2	2.5	
Persons per Project	8	8	8	
Possible Person Days	16,736	16,432	19,880	53,048
Daily Wages	$652.00	$652.00	$652.00	
Total Possible Wages	$10,911,872	$10,713,664	$12,961,760	$34,587,296

Sources: Generation Water; Economic Roundtable analysis.

Irrigation System Retrofit Services

Generation Water offers a follow-on service for schools and municipal parks after its young adult workers identify water leaks and system inefficiencies, called retrofits.[57] This service includes the installation of weather based irrigation, repair of broken irrigation infrastructure, replacing sprinkler nozzles with new, more water efficient parts, and overall equipment upgrades. Although the amount of labor and materials needed to carry out these retrofits varies, Generation Water shared the following breakdown of costs for this service:

$1,000	Material costs
$500	Labor (5 people, 1 day)
$1,500	Total

Based upon this project profile, we estimate the economic impacts of Generation Water's version of rain gardens, using the IMPLAN Input-Output for Los Angeles.

This estimate blends together the profiles of nine industries that capture the range of activities involved in carrying out irrigation system retrofits (Table 5.54). Two-thirds of the cost of these services is for materials and parts, captured in the *Pipe and Pipe Fitting Manufacturing*, *Irrigation Equipment Manufacturing*, *Irrigation Equipment Wholesalers*, and *Building. Material and Garden Equipment Supply Retailers*. The balance of the budgets pays for labor time of the Generation water team, whose skills are represented by a mix of the following industries: *Plumbing and HVAC Contractors*, *Landscape Architectural Services*, *Building Inspection Services*, *Landscaping Contractors*, and *Environment and Conservation Organizations*.

Table 5.54
Proxy of Generation Water Rain Garden Projects using NAICS Industries and IMPLAN Sectors

NAICS Code	NAICS Title	IMPLAN Code	Industry Sector	Percent	$1500 Budget
238220	Plumbing, HVAC Contractors	39	Maint. & Repair of Non-Res. Bldgs.	12%	$180
332996	Pipe & Pipe Fitting Mfg.	201	Pipe And Pipe Fitting Mfg.	17%	$250
333111	Irrigation Equip. Mfg	204	Lawn And Garden Equip. Mfg.	17%	$250
423820	Irrigation Equip. Wholesalers	319	Wholesale Trade	17%	$250
444	Bldg. Material & Garden Equip. Stores	323	Bldg. Material & Garden Stores	17%	$250
541320	Landscape Architectural Services	369	Arch., Eng., & Related Services	2%	$30
541350	Bldg. Inspection Services	369	Arch., Eng., & Related Services	2%	$30
561730	Landscaping Contractors	388	Services To Bldgs. & Dwellings	12%	$180
813312	Environment, Conservation Orgs.	424	Social Advocacy Organizations	5.3%	$80
			Total	100%	$1,500

Source: Marcus Castain, Generation Water, 2011; Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software.

While the job impacts of one irrigation system retrofit are unique to Generation Water's training and apprenticeship for young adults, a single $1,500 installation stimulates $533 in local *indirect* sales among the local suppliers of goods and services, as well as $645 in *induced* sales in the local community based on the household spending of workers directly and indirectly

Table 5.55
Economic Multiplier Factors and Dollar Amounts for one Generation Water Irrigation System Retrofit

IMPLAN Code	Percent	$1500 Budget	Direct Output Factor	Indirect Output Factor	Induced Output Factor	Total Output Factor	Direct Sales	Indirect Sales	Induced Sales	Total Sales
39	12%	$180	1.000000	0.362484	0.568542	1.931026	$180	$65	$102	$348
201	17%	$250	1.000000	0.330485	0.265566	1.596051	$250	$83	$66	$399
204	17%	$250	1.000000	0.374039	0.203554	1.577593	$250	$94	$51	$394
319	17%	$250	1.000000	0.362546	0.474466	1.837012	$250	$91	$119	$459
323	17%	$250	1.000000	0.168648	0.542641	1.711289	$250	$42	$136	$428
369	2%	$30	1.000000	0.408569	0.701848	2.110417	$30	$12	$21	$63
369	2%	$30	1.000000	0.408569	0.701848	2.110417	$30	$12	$21	$63
388	12%	$180	1.000000	0.518069	0.496551	2.014621	$180	$93	$89	$363
424	5.3%	$80	1.000000	0.518069	0.496551	2.014621	$80	$41	$40	$161
	100%	$1,500				**Total**	$1,500	$533	$645	$2,678

Source: Marcus Castain, Generation Water, 2011; Economic Roundtable analysis; Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software.

involved (Table 5.55). The economic multiplier factors for this water conservation case study can be scaled up to estimate the impacts of a larger number of potential water efficiency audits, irrigation system surveys and retrofits in Los Angeles County.

Future Opportunity for Generation Water

The ultimate goal for this program is to carry out audits and surveys on school campuses and parks across Los Angeles. With this in mind, we present the number of school campuses in Los Angeles County – including public, private and site-based charter schools – to help consider the scale of economic and job impacts that Generation Water's programs might reach (Table 5.56). This complete count of school campuses in Los Angeles County includes some that may not request or need water use efficiency audits and irrigation system surveys, since not all campuses have irrigation systems; only those with permeable school grounds and irrigation systems could potentially utilize water use efficiency audits and irrigation system survey and retrofits. Thus, this count is intended to show the *potential* number of school campuses in Los Angeles County where their water use efficiency services could be carried out.

Table 5.56
Number of Schools Campuses,
by School Type, per School and Total Possible

Type of Audit:	Elementary School	Middle School	High School	All Campus Types	Percent
Unit Cost for Service:	$1,500	$2,500	$3,000		
LAUSD School District	469	91	112	672	19%
Other Public Schools in LA Co.	1363	308	417	2,088	59%
Private School Campuses in LA Co.	258	11	399	668	19%
Charter Schools in LA County	2	49	66	117	3%
Total Number of Campuses:	2,092	459	994	3,545	100%

Source: Economic Roundtable analysis; California Department of Education.

Generation Water also conducts water efficiency audits and irrigation system surveys of municipal parks. This service is just beginning, with one park-based project completed thus far. There are a total of 178 municipal parks in the City of Los Angeles and another 390 in the balance of Los Angeles County, where Generation Water's audits and surveys could be carried out, assuming that they all have existing irrigation systems in some portion of their grounds (Table 5.57). The actual number of parks that could potentially benefit from these services is a subset of this total.

Table 5.57
Number of City Parks
in Los Angeles County

Type of Audit:	Parks
Unit Cost for Service:	$2,500
City of Los Angeles Parks	178
LA County Parks, outside of LA City	390

Sources: Economic Roundtable analysis; GreenInfo Network's California Protected Areas Database (CPAD, a GIS inventory of all protected park and open space lands in California); Generation Water.

5.6 Graywater Systems Installation Projects

Graywater is defined as any used household water, except for the portion that is used in toilets, kitchen sinks or dishwashers, that is then reused for other purposes such as landscape irrigation.[58] Graywater systems provide several benefits such as effectively increasing the water supply, efficiently irrigating landscapes, reducing wastewater and urban run-off pollution, as well as decreasing energy demand and carbon emissions.[59] All of these benefits have financial values, and some have job implications.

Until California legalized the use of it for landscape irrigation,[60] graywater had been treated as "waste" and typically discharged from residential properties by way of municipal sewage systems or septic tanks. Added together, sink, shower, and laundry water comprise over half of typical residential consumption. However, the limited supply of water relative to our growing demand for it requires that we reclaim some of the water we use once, and put it to secondary uses. A graywater system thus captures and filters this water for additional uses instead of disposing of it through municipal sewage systems.

Installation of Graywater Systems in Residential Dwelling Units

Graywater systems require that water from the showers, tubs, bathroom sinks, and laundry machines be kept separate from toilet, kitchen sink and dishwasher water. Inside the home, this requires creating a smaller, secondary graywater main pipe of the same quality of construction[61] as the traditional sewage pipe. That secondary graywater main pipe and associated feeder pipes only add costs above those of a conventional plumbing system if the former requires a significantly longer and more difficult installation of its main graywater pipe, since each household appliance producing graywater already has its own drain, p-trap, and vent connection if plumbed conventionally. The only other extra costs are for connecting the graywater filter system to that pipe outside the home and overflowing it to the sewer as required for a fail-safe design.[62] (Please see Appendix D for more details on graywater systems installation.)

Similar to traditional indoor plumbing, the installation of graywater systems today is often carried out by regular plumbing contractors.[63] The California Plumbing Code's guidelines on graywater systems require plumbers to learn skills above and beyond traditional plumbing, but the code also provides specific guidelines for the plumber to follow where the code deviates from normal plumbing requirements. Licensed plumbers can learn fairly quickly how to install graywater systems, especially as new "green" plumber training courses are offered.[64]Outside the home, landscaping companies typically handle the work of installing a drip irrigation system to feed lawns, gardens and plants, connecting it to the graywater filter system. This work involves digging trenches for the drip irrigation lines, cutting and assembling drip irrigation line tubing, connecting the lines to the graywater filter system from inside the building, testing the rate of flow as well as looking for leaks, and installing timers and flow meter controllers. The outdoor portion of graywater systems can also include a method of discharging water overflow – the amount above and beyond needed for watering the landscape. Diverted overflow water is channeled to a leeching field, which requires more trench digging, laying perforated HDPE pipes across submerged gravel beds.

Economic Impacts of Installing Graywater Systems in Residential Dwelling Units

This section presents a model of impacts of installing graywater systems in 5,439 new residential properties in Los Angeles county – the number built countywide in an average year,[65] illustrating their distinct economic and job impacts. Real data on the labor costs for installing graywater systems is very rare, and proved difficult to obtain for this study, even when vigorously pursued. This is partly due to graywater systems being installed alongside traditional plumbing drainage systems, either in a new home or as a retrofit of an existing plumbing system. As such, the graywater portions of construction budgets usually are not separated out from overall project plumbing costs, leaving us to instead estimate the economic and job impacts by relying upon experts in the graywater field.[66]

The following data is based upon local company *ReWater*'s experience installing the interior portions of graywater systems in new[67] Southern California single-family and multi-family homes, in which there was little variation in floor plans and blueprints. The per-unit cost for installing a residential graywater system in these new housing developments was:

5BR plus Single Family Home (6,000 Sq. Ft.)	$2,000
4BR-3BA Single Family Home (2,800 Sq. Ft.)	$750
3BR-3BA Single Family Home (2,100 Sq. Ft.)	$540
Average	$1,097

The costs of installing the exterior drip irrigation system is almost the same that the interior plumbing, approximately $1,100 per property. This aspect of the cost model is provided by Frank Pasker, LEED-AP Project Manager at DBB Architects of Los Angeles:

Outdoor piping	$500
Gravel beds & filter fabric material	$200
Design ($2,000)	$200
Percolation test ($2,000)	$200
Total	$1,100

The *Design* and *Percolation Test* portions of this estimate are adjusted downwards to compensate for the number of multi-family housing projects, where graywater systems are installed in multiple housing units sharing a single exterior landscape.

Direct Impacts

We apply the average cost per housing unit for installing a graywater system ($1,097 for interior plumbing, plus $1,100 for exterior landscaping) to the average number of new residential properties built in Los Angeles City and County from 1997 to 2010 (Table 5.58).[68] In this hypothetical case study, the installation of graywater systems in all new housing units built in a year in Los Angeles County would represent a *direct* investment of approximately $11.95 million dollars.

All of the installation work for the interior piping and filter installation would be carried out by the *Plumbing, Heating, and Air-Conditioning Contractors* industry (NAICS 238220),[69] which includes the local plumbing contractors carrying out installation projects designed by graywater-focused companies such as *ReWater*, along with traditional plumbing and Plumbing, Piping and HVAC contractors.[70] The exterior work would be carried out by *Landscape Services*

industry (NAICS 561730), in which we include the design and soil testing work. This cost model assumes that all of the work installing these systems would be carried out on new homes built in Los Angeles County, and that this work would be carried out by companies based in the county.[71]

Table 5.58
Cost Model for New Housing Properties Constructed Annually in Los Angeles with Total Added Cost if All New Units Had Graywater Systems Installed

	Estimated New Residential Properties Built	Interior Plumbing Costs for All Households ($1,907)	Exterior Landscaping Costs for All Households ($1,100)	Total Cost
City of Los Angeles	1,807	$1,982,279	$1,987,700	$3,969,979
Balance of LA County	3,632	$3,984,758	$3,995,656	$7,980,414
Los Angeles County Total	5,439	$5,967,037	$5,983,356	$11,950,393

Source: Economic Roundtable analysis, City of Los Angeles Department of Building and Safety permit data 1997-2010; Los Angeles County Assessor's Office, 2009 Secured Basic File Abstract (DS04).

Indirect Impacts

Local *indirect* economic impacts of this hypothetical investment in graywater installations in Los Angeles' new homes would add sales in a variety of sectors (gas stations, telecommunications, real estate, architectural, engineering, and related services, and wholesalers) add up to almost $5.5 million of added local sales (Table 5.59). When the *indirect* impacts are measure in terms of jobs supported, the list is similar, adding up to 29.1 person-years of employment supported (Table 5.60).

Table 5.59
Local Indirect Economic Impacts of Graywater System Installations in All New Homes in LA County, by Industry Sector

Rank	IMPLAN Sector Code	Industry Sector Description	Indirect Sales (Output)	Percent of Total Indirect Sales (Output)
1	115	Fuel (Petroleum refineries)	$1,242,476	23%
2	351	Telecommunications	$290,541	5%
3	360	Real estate establishments (includes lease payments for land and rental of structures, rental housing)	$273,817	5%
4	369	Landscape Architecture, engineering, and related services	$240,556	4%
5	319	Wholesale trade businesses	$214,551	4%
6	335	Transport by truck	$154,251	3%
7	367	Legal services	$148,608	3%
8	20	Extraction of oil and natural gas	$120,045	2%
9	354	Monetary authorities and depository credit intermediation activities	$114,915	2%
10	357	Insurance carriers	$111,529	2%
Total			$5,462,137	100%

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C. Note: Figures may not add up to totals precisely due to rounding errors. List shows the top ten out of 440 total industry sectors.

Table 5.60
Local Indirect Job Impacts of Graywater System Installations in All New Homes in LA County, by Industry Sector

Rank	IMPLAN Sector Code	Industry Sector Description	Indirect Jobs Supported (Person-Years of Employment)	Percent of Total Indirect Jobs Supported (Person-Years of Employment)
1	382	Employment services	2.4	8%
2	369	Landscape Architecture, engineering, and related services	1.6	6%
3	360	Real estate establishments (includes lease payments for land and rental of structures, rental housing)	1.3	5%
4	319	Wholesale trade businesses	1.2	4%
5	329	Retail Stores - General merchandise	1.2	4%
6	335	Transport by truck	1.1	4%
7	324	Retail Stores - Food and beverage	1.0	3%
8	413	Food services and drinking places	0.9	3%
9	374	Management, scientific, and technical consulting services	0.8	3%
10	368	Accounting, tax preparation, bookkeeping, and payroll services	0.8	3%
Total			29.1	100%

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C. Note: Figures may not add up to totals precisely due to rounding errors. List shows the top ten out of 440 total industry sectors.

Induced Impacts

The additional household spending spurred by graywater projects could generate almost

Table 5.61
Local Induced Economic Impacts of Graywater System Installations in All New Homes in LA County, by Industry Sector

Rank	IMPLAN Sector Code	Industry Sector Description	Induced Sales (Output)	Percent of Total Induced Sales (Output)
1	361	Imputed rental activity for owner-occupied dwellings (Repair and maintenance of owner-occupied homes)	$621,275	11%
2	360	Real estate establishments (includes lease payments for land and rental of structures, rental housing)	$380,899	7%
3	394	Offices of physicians, dentists, and other health practitioners	$308,187	6%
4	413	Food services and drinking places	$278,991	5%
5	397	Private hospitals	$260,260	5%
6	357	Insurance carriers	$189,403	3%
7	354	Monetary authorities and depository credit intermediation activities	$188,994	3%
8	319	Wholesale trade businesses	$164,037	3%
9	355	Nondepository credit intermediation and related activities	$142,716	3%
10	115	Fuel (Petroleum refineries)	$133,991	2%
Total			$5,424,212	100%

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C. Note: Figures may not add up to totals precisely due to rounding errors. List shows the top ten out of 440 total industry sectors.

Table 5.62
Local Induced Job Impacts of Graywater System Installations in All New Homes in LA County, by Industry Sector

Rank	IMPLAN Sector Code	Industry Sector Description	Induced Jobs Supported (Person-Years of Employment)	Percent of Total Induced Jobs Supported (Person-Years of Employment)
1	413	Food services and drinking places	4.0	11%
2	394	Offices of physicians, dentists, and other health practitioners	2.2	6%
3	360	Real estate establishments	1.8	5%
4	397	Private hospitals	1.6	4%
5	324	Retail Stores - Food and beverage	1.1	3%
6	398	Nursing and residential care facilities	1.0	3%
7	426	Private household operations	1.0	3%
8	329	Retail Stores - General merchandise	1.0	3%
9	319	Wholesale trade businesses	0.9	2%
10	356	Securities, commodity contracts, investments, and related activities	0.9	2%
Total			36.9	100%

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. See Water Use Efficiency Projects Contributors List in Appendix C. Note: Figures may not add up to totals precisely due to rounding errors. List shows the top ten out of 440 total industry sectors.

$5.4 million in local sales. Businesses benefitting the most from these consumer sales include home improvement and hardware stores, home repair contractors, apartment owners, health care providers, restaurants, insurance companies, banks, wholesalers, mortgage brokers and carriers, and gas stations (Table 5.61). Industry sectors employing more workers due to the added local household spending that would result from widespread installation of graywater systems include: restaurants, doctors' and dentists' offices, apartment management companies, grocery stores, nursing homes, and housekeepers (Table 5.62).

Top Occupations Impacted

The occupations hired most frequently across all of the industries involved in graywater projects – including *direct*, *indirect* and *induced* rounds of economic activity – are shown in Table 5.63. Overwhelmingly, these occupations are in the plumbing contracting and landscaping services industries, including skilled trades, manual laborers, management, office and logistics

Table 5.63
Top LA Occupations Supported by Graywater System Installations in LA County

Rank	SOC Code - Occupation Title		Percent of Occupational Employment Captured in LA Co.	Mean Hourly Wage	Mean Annual Wage	Entry-Level Hourly Wage*
1	37-3011	Landscaping and Groundskeeping Workers	33%	$9.10	$18,943	$7.60
2	47-2152	Plumbers, Pipefitters, and Steamfitters	33%	$21.43	$44,567	$12.08
3	37-1012	First-Line Supervisors/Managers of Landscaping, Lawn Service, and Groundskeeping Workers	33%	$17.43	$36,273	$11.52
4	37-3013	Tree Trimmers and Pruners	33%	$11.95	$24,850	$10.25
5	11-1021	General and Operations Managers	33%	$49.57	$103,091	$29.43
6	43-9061	Office Clerks, General	33%	$10.85	$22,553	$7.41
7	17-0000	Landscape Architecture & Engineering Occupations	33%	$20.97	$43,614	$15.11
8	43-3031	Bookkeeping, Accounting, and Auditing Clerks	33%	$15.60	$32,439	$10.11
9	47-3015	Helpers--Pipelayers, Plumbers, and Pipefitters	33%	$12.39	$25,771	$8.85
10	49-9042	Maintenance and Repair Workers, General	33%	$17.18	$35,721	$10.94
11	11-1011	Chief Executives	33%	$74.46	$154,857	$44.46
12	37-3012	Pesticide Handlers, Sprayers, and Applicators, Vegetation	33%	$11.24	$23,373	$9.71
13	37-9099	All Other Building and Grounds Cleaning and Maintenance Workers	33%	$7.70	$16,020	$6.96
14	43-4171	Receptionists and Information Clerks	33%	$12.73	$26,479	$9.45
15	47-2051	Cement Masons and Concrete Finishers	33%	$21.30	$44,303	$12.77
16	13-2011	Accountants and Auditors	33%	$26.52	$55,162	$20.24
17	49-9098	Helpers--Installation, Maintenance, and Repair Workers	33%	$13.59	$28,266	$8.98
18	47-4011	Construction and Building Inspectors	33%	$11.62	$24,182	$9.98
19	53-7062	Laborers and Freight, Stock, and Material Movers, Hand	33%	$12.09	$25,155	$9.69
20	17-2051	Civil Engineers	33%	$36.75	$76,438	$24.82
Total, all occupations			33%	$16.00	$33,286	$10.10

Source: Economic Roundtable analysis; California Employment Development Department & Employment Projections Program, U.S. Department of Labor, U.S. Bureau of Labor Statistics. 2010. Los Angeles County Industry-Occupation Matrix 2008/2009. SOC stands for Standard Occupation Classification. *The mean of the first third of the wage distribution is the proxy for entry-level wage.

support. Given the assumptions of our cost model for our installing graywater systems, all of this employment is located in Los Angeles County, but in reality this depends upon which companies are hired to do the work.[72] The wage rates shown in Table 5.63 are specifically for listed occupations in Los Angeles' *Plumbing, Heating, and Air-Conditioning Contractors* and Landscaping Services industry sectors. The wages paid in actual companies carrying out graywater system installations, a subset of those two industry sectors, should resemble the industries as a whole because the same establishments and workers that carry out other plumbing and landscaping projects also install graywater systems.

It is encouraging to note that half of the top 20 occupations listed have average hourly wages above $15 per hour, likely reflecting the presence of unionized jobs among the skilled trades shown. If the landscaping services establishments installing the outdoor portion of graywater systems were more dependent on skilled labor, there could be more occupations above this threshold. The California 'graywater code' requires certain standards be met in order to obtain a permit for the drip irrigation portion of graywater systems, and could be a means for raising the training, certification and, ultimately, wage levels of otherwise low-wage landscaping workers. State law and municipal building permit requirements could thus determine the quality of work performed in graywater system installations.[73]

Impacts per $1 Million Spent

Every million dollars spent installing graywater systems in Los Angeles' new homes, with work carried out by local companies, would stimulate an estimated $1.9 million in total local sales (output). The added sales activity consists of $457,068 in local indirect sales and $453,894 in local induced sales per every million of local direct sales made in this type of water use efficiency project (Table 5.64).

Table 5.64
Multiplier Effects of Graywater System Installations, Local and Overall Sales Supported

Budget Portion Invested in…	Description	Direct Sales (Output)	Indirect Sales (Output)	Induced Sales (Output)	Total Sales (Output)
Los Angeles County & City of Los Angeles	Per $1 Million Direct	$1,000,000	$457,068	$453,894	$1,910,962
	Total Model Investment	$11,950,393	$5,462,137	$5,424,212	$22,836,743

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. Multiplier effects shown apply to both the City of Los Angeles and Los Angeles County.

Measured in number of jobs supported, the impact per million dollars invested in Los Angeles graywater projects is an estimated 14.9 person-years of employment. This is based on an estimated 9.4 person-years of employment *directly* supported by the installation of graywater systems, plus another 2.4 person-years of employment supported by *indirect* sales ("upstream" materials and services used in the projects), and 3.1 person-years of *induced* employment stimulated by household spending of workers involved directly and indirectly in graywater projects (Table 5.65). The number of jobs supported per $1 million spent is among the highest of water use efficiency projects in this report, which is partly attributable to the lower wages paid to workers in the *Landscape Services* industry. If the training level and wages of these workers are raised, the *number* of person-years of employment shown in Table 5.65 would decline

slightly, but the *quality* of those jobs would be improved. As with the other water use efficiency investments, these economic and job impacts are specific to installing graywater systems themselves, and do not account for the broader economic benefits associated with landscape irrigation water savings and wastewater reduction.

Table 5.65
Multiplier Effects of Graywater System Installations: Local and Overall Jobs Supported

Budget Portion Invested in…	Description	Direct Employment	Indirect Employment	Induced Employment	Total Employment
Los Angeles County & City of Los Angeles	Per $1 Million Direct	9.4	2.4	3.1	14.9
	Tot. Model Investment ($11.9M)	112.2	29.1	36.9	178.2

Source: Economic Roundtable analysis, Minnesota IMPLAN Group, Inc., IMPLAN System 2009 data and 2011 software. Multiplier effects shown apply to both the City of Los Angeles and Los Angeles County.

Impacts of Ongoing Operations and Maintenance

The ongoing operations and maintenance of graywater systems installations is limited to subsequent plumbing and drip irrigation repair work needed to offset wear and tear on these systems over time. As such, the economic and job impacts of subsequent graywater system repair should utilize the model presented in this section, which produces estimates based on additional sales in Los Angeles' *Plumbing, Heating, and Air-Conditioning Contractors* industry sector (NAICS 238220). There may be further local impacts that could be modeled, such as added local demand for materials used to replace specialized graywater system piping, water filtration processes and storage systems within buildings, as well as cleaning clogged drip-irrigation distribution pipes outside of buildings. The variety and scale of these graywater systems maintenance activities can be modeled more accurately as more data become available.

5.6 Location of Water Use Efficiency Investments Construction and Impacts

Los Angeles, California and the nation have important choices to make in seeking to attain improved water use efficiency, and one of these is the amount of funding for pursuing *distributed, local* versus *statewide* water use efficiency projects. The water use efficiency investments studied in this report are all *local*, meaning that they help conserve, reduce, reuse or conserve water after is has been distributed for consumption, or afterwards when it is discharged. Investments in these *local* water use efficiency projects not only produce large multiplier effects in local economies where water users live and work, but also support better stewardship of this precious resource within communities of residential and commercial water consumers. Investments in statewide water systems, including dams and conveyance systems, also generate economic and job impacts, focused on discrete geographic areas that are distant from most water consumers. Before addressing this policy choice, it is important to understand in greater detail where local investments are made *within* Los Angeles, since there is debate among water advocates about which local investments are best.

The Geography of Local Water Use Efficiency Investments in Los Angeles

Where do the five types of water use efficiency projects described in this report get built in urban regions such as Los Angeles? Where are the economic and jobs impacts felt? Part of the answer involves pinpointing the typical locations of projects in *urban watersheds*, which extend from the points where water enters the region ("upper watershed") to where water ultimately exits ("lower watershed") (Figure 5.2). Water enters the urban watersheds of Los Angeles in the form of rainfall, landing on rooftops, lawns and paved surfaces. It also gets delivered to consumers by local water agencies via hundreds of miles of webbed pipeline and storage areas. Much of this water subsequently gets used once and then discharged, travelling down the urban watersheds on the surface (streets, channels) and/or below ground (sewer pipes, groundwater) in increasing concentrations before exiting into the sea. Evapotranspiration is another route for water to exit urban watersheds.

One debate about water use efficiency investments concerns the best place in urban watersheds to build them, both in terms of cost-effectiveness and environmental impacts. Investments in the upper watershed – such as graywater systems in buildings, water conservation campaigns aimed at consumers, rain gardens fed from rooftops and other

Figure 5.2
Sites of Water Use Efficiency Investments throughout the Urban Watershed

Source: Concepts from Mark Hanna, GeoSyntec.

forms of stormwater capture result in filtering, storing, and/or reuse water, or else directing it downwards to recharge the groundwater. Because these projects are located at the point where rainwater first falls and where potable water is first delivered and consumed, they require repeated small-scale investments in lower cost infrastructure and technology.

Alternatively, building a smaller number of larger water infrastructure projects in the middle or lower watershed to treat, store and reuse water manages larger volumes aggregated from the thousands of storm drains that feed the Los Angeles River, or collected in the river itself just before discharge into the harbor. Economies of scale are realized in these projects categories, including stormwater water filtering and spreading grounds, sewage water recycling plants, and storm drain retrofits designed to stop trash from flowing further down the watershed. One concern about water use efficiency investments built in the lower watershed is that debris and pollution is transported long distances through communities situated in the middle watershed before it removed from the water, affecting public health and environmental quality.[74] Also, large-scale water use efficiency investments require commensurately large tracts of land for facility construction, which includes space for water settling pools, tanks for removing dissolved and suspended biological matter from the water, and physical or chemical disinfection processes. Space requirements for water storage or recharging the groundwater after treatment can also be significant, all needing location along major waterways or at the mouths of rivers. Land availability for these uses can thus impose prohibitive additional costs on project budgets.

The debate is ongoing about which categories of local water use efficiency investments are best, but for the purposes of this report, we see advantages in pursuing a diversified portfolio of projects. Investments in greater water efficiency in the upper urban watersheds requires raising the consciousness of water consumers, which is a necessary part of our collective reckoning with Los Angeles' limited sources of water. Middle and lower watershed investments also make sense given the economies of scale needed to deploy some emerging water treatment technologies, plus the need for ongoing, on-site operation and maintenance in these facilities. Based on different situations and logistics, the five categories of water use efficiency projects each deliver very tangible economic and job impacts to Los Angeles.

Impacts of Local versus Statewide Investments

The local impacts of water use efficiency projects are documented throughout this report, and they help demonstrate how Los Angeles is an ideal setting for optimizing economic and job growth by investing in water use efficiency:

1. Los Angeles offers a natural climate, expansive built environment and large population that will benefit substantially from increased investment in local water use efficiency.

2. Los Angeles is home to the largest wholesale water agency in the world (Metropolitan Water District of Southern California) and the largest municipal water agency in the nation (Los Angeles Department of Water and Power), two major policy-making institutions that can provide sustained and consistent information, outreach, and investment.

3. The Los Angeles economy is experiencing a more severe recession than the nation as a whole, with an unemployment rate surpassing 12 percent compared to the national

rate hovering around 9 percent. If previous recessions are any guide,[75] Los Angeles will take longer to emerge from this recession than other urban areas, suggesting that public investment is needed for job stimulus.

4. Local investments in water use efficiency projects also return tax payer dollars to the areas where they are generated

Statewide water projects, such as building a conveyance tunnel under the Sacramento-San Joaquin River Delta to move water to Central and Southern California at a cost of $12.5 billion, allocate the investments and environmental burden for a statewide need to a single region of the state. Job multipliers and environmental dislocation would be concentrated in that region. In contrast, the decentralized local investments associated with water use efficiency have a far lighter environmental footprint, link any impacts to the point of consumption, and distribute economic benefits throughout the state. For these reasons, Los Angeles policy makers should allocate ongoing public investment in *local* water use efficiency projects.

Chapter 6

Policy Recommendations

Recommendations

Investments in water use efficiency produce two kinds of benefits. First, they reduce this region's water consumption and dependence on large, statewide water diversion projects that have adverse environmental impacts. Second, these projects create large numbers of jobs that pay sustaining wages and generate broad expansion in local business activity. The following policy recommendations are made with economic and environmental goals in mind:

1 Support and budget for comprehensive watershed management planning and projects. Projects analyzed in this report clearly demonstrate significant job creation potential in both construction/installation work and ongoing operations and maintenance. Los Angeles should capitalize on the win-win-win potential of watershed management planning and projects that bring environmental benefits, employment growth and increased sales to local businesses in the supply chains.

   a. Encourage banks to set up water infrastructure lending pools to support water use efficiency projects.

   b. Foster private sector investment in local water infrastructure, augmenting traditional rate-payer and bond-based funding sources.

   c. Offer rebate programs for water use efficiency investments, such as installations of graywater systems in residential and commercial properties.

2 Existing local businesses and non-profit organizations need targeted support to grow and build competitive strength in offering groundwater, stormwater and water conservation services and technologies. This can be provided through:

   a. Public sector contracts in exchange for preferred hiring

   b. Equity-backed loans or grants for established businesses

   c. Assistance with regulatory issues

   d. Loans, grants and technical assistance for new start ups

   e. Target local companies for public agency purchasing

   f. Partnering with local non-profits to build community leadership capacity in all categories of water use efficiency

   g. Targeted job training, both classroom and on-the-job, to meet the need of these employers for qualified workers

3 Recruit new water sector businesses to locate in Los Angeles using the region's large market for water conservation, recharge, and reuse services and products as an inducement.

4 Undertake further initiatives through local water agencies (such as the Los Angeles Department of Water and Power) to promote residential and commercial water conservation:

   a. Undertake increased outreach and public awareness campaigns to meet crucial regional goals for public water demand reduction and conservation.

   b. Collaborate with municipal housing agencies and redevelopment authorities to install graywater systems in publicly subsidized and covenant-protected, affordability-restricted residential properties

   c. Provide student internships in water conservation through the local school districts and community colleges.

5 Advocate further local and state bond funding, similar to Proposition O (2004), focused on:

   a. Stormwater and urban runoff capture and recharge

   b. Groundwater remediation, storage and conjunctive use

   c. Recycled water

6 Create and periodically update information about water sector businesses in Los Angeles, utilizing public departments' pre-qualified supplier and consultant lists. Identify areas of expertise among these businesses, such as *Stormwater*, *Recycled Water*, *Groundwater Management / Remediation*, *Water Conservation*, and *Graywater*.

   a. Investigate growth needs of water sector businesses

   b. Require water agencies to track consumption rates along with the impacts of education campaigns, technology adoption, billing rate adjustments and other efficiency policies on those consumptions rates.

7 Periodically update wage and employment information on water sector occupations. The Occupational Information Network (O*NET) list of occupations is gradually being expanded to include "green" jobs, and new data on water sector work should become available in the future.

8 Organize employer forums to identify essential skills for key occupations and plan training curricula.

9 Provide customized employer training with uniform certification for businesses in the water use efficiency field, including:

   a. On-the-job training

   b. Customized classroom training provided by local community colleges

10 Provide occupation-based training for essential skills and competencies:

   a. Upgrade skills training capacity in local community colleges and conservation corps that support the water sector

   b. Identify water sector career ladders
   c. Utilize employer-based customized recruitment and training
   d. Link apprenticeships to vocation and trade school students for summer experience

11 Support training programs for young adults (e.g., *Generation Water*)

12 Track job opportunities in water conservation, recharge, and reuse occupations regionally, collaborating with the *WorkSource/One-Stop Centers* network.

13 Involve local community stakeholders in job outreach to link local residents with local jobs:

   a. Water conservation, environmental advocates
   b. Green jobs networks

14 Prioritize *local* investments in reducing, reusing, and conserving water after it has already been distributed for consumption ahead of centralized projects that allocate the investments and environmental burden for a *statewide* need to a single region of the state. Investments in *local, distributed* water use efficiency projects not only produce large multiplier effects in local economies where water users live and work, but also support better stewardship of this precious resource within communities of residential and commercial water consumers.

These policy actions can be an important catalyst for helping the region rebound from the worst recessions since the Great Depression, putting new and incumbent workers into jobs that also help us meet important environmental challenges.

Appendix A

First Tier of the Water Sector

The *first tier* industries are the businesses primarily involved in the region's water and wastewater sector, where most or all of their activity relates to water and/or wastewater:

Water Supply & Irrigation Systems (NAICS Code 221310) *This industry comprises establishments primarily engaged in operating water treatment plants and/or operating water supply systems. The water supply system may include pumping stations, aqueducts, and/or distribution mains. The water may be used for drinking, irrigation, or other uses.*

Sewage Treatment Facilities (221320) *This industry comprises establishments primarily engaged in operating sewer systems or sewage treatment facilities that collect, treat, and dispose of waste.*

Water & Sewer Line & Related Structures Construction (237110) *This industry comprises establishments primarily engaged in the construction of water and sewer lines, mains, pumping stations, treatment plants, and storage tanks. The work performed may include new work, reconstruction, rehabilitation, and repairs. Specialty trade contractors are included in this group if they are engaged in activities primarily related to water, sewer line, and related structures construction. All structures (including buildings) that are integral parts of water and sewer networks (e.g., storage tanks, pumping stations, water treatment plants, and sewage treatment plants) are included in this industry.*

Industrial Valve Mfg (332911) *This U.S. industry comprises establishments primarily engaged in manufacturing industrial valves and valves for water works and municipal water systems.*

Other Metal Valve & Pipe Fitting Mfg (332919) *This U.S. industry comprises establishments primarily engaged in manufacturing metal valves (except industrial valves, fluid power valves, fluid power hose fittings, and plumbing fixture fittings and trim).*

Pump & Pumping Equipment Mfg (333911) *This U.S. industry comprises establishments primarily engaged in manufacturing general purpose pumps and pumping equipment (except fluid power pumps and motors), such as reciprocating pumps, turbine pumps, centrifugal pumps, rotary pumps, diaphragm pumps, domestic water system pumps, oil well and oil field pumps and sump pumps.*

The first tier of the water sector is a mix of utility operations, specialized construction services, and manufacturers.

Second Tier of the Water Sector:

The *second tier* industries are businesses that have some, but not all or most, of their activity in this sector, playing a supporting or indirect role in providing goods and services:

Land Subdivision (237210) *This industry comprises establishments primarily engaged in servicing land and subdividing real property into lots, for subsequent sale to builders. Servicing of land may include excavation work for the installation of roads and utility lines. The extent of work may vary from project to project. Land subdivision precedes building activity and the subsequent building is often residential, but may also be commercial tracts and industrial parks. These establishments may do all the work themselves or subcontract the work to others. Establishments that perform only the legal subdivision of land are not included in this industry.*

Other Heavy & Civil Engineering Construction (237990) *This industry comprises establishments primarily engaged in heavy and engineering construction projects (excluding highway, street, bridge, and distribution line construction). The work performed may include new work, reconstruction, rehabilitation, and repairs. Specialty trade contractors are included in this group if they are engaged in activities primarily related to engineering construction projects (excluding highway, street, bridge, distribution line, oil and gas structure, and utilities building and structure construction). Construction projects involving water resources (e.g., dredging and land drainage), development of marine facilities, and projects involving open space improvement (e.g., parks and trails) are included in this industry.*

Electrical Contractors & Other Wiring Installation Contractors (238210) *This industry comprises establishments primarily engaged in installing and servicing electrical wiring and equipment. Contractors included in this industry may include both the parts and labor when performing work. These contractors may perform new work, additions, alterations, maintenance, and repairs.*

Plumbing, Heating, & Air-Conditioning Contractors (238220) *This industry comprises establishments primarily engaged in installing and servicing plumbing, heating, and air-conditioning equipment. Contractors in this industry may provide both parts and labor when performing work. The work performed may include new work, additions, alterations, maintenance, and repairs. Industry also includes lawn sprinkler system installation, sump pump installation, water heater, meter and softener installation, and water system balancing and testing contractors.*

Other Building Equipment Contractors (238290) *This industry comprises establishments primarily engaged in installing or servicing building equipment (except electrical, plumbing, heating, cooling, or ventilation equipment). The repair and maintenance of miscellaneous building equipment is included in this industry. The work performed may include new work, additions, alterations, maintenance, and repairs. Includes boiler and water pipe insulation.*

Industrial Gas Mfg (325120) *This industry comprises establishments primarily engaged in manufacturing industrial organic and inorganic gases in compressed, liquid, and solid forms.*

All Other Miscellaneous Chemical Product & Preparation Mfg (325998) *This U.S. industry comprises establishments primarily engaged in manufacturing chemical products (except basic chemicals, resins, synthetic rubber; cellulosic and noncellulosic fiber and filaments; pesticides, fertilizers, and other agricultural chemicals; pharmaceuticals and medicines; paints, coatings and adhesives; soap, cleaning compounds, and toilet preparations; printing inks; explosives; custom compounding of purchased resins; and photographic films, papers, plates, and chemicals).*

All Other Plastics Product Mfg (326199) *This U.S. industry comprises establishments primarily engaged in manufacturing plastics products (except film, sheet, bags, profile shapes, pipes, pipe fittings, laminates, foam products, bottles, plumbing fixtures, and resilient floor coverings).*

Rubber & Plastics Hoses & Belting Mfg (326220) *This industry comprises establishments primarily engaged in manufacturing rubber hose and/or plastics (reinforced) hose and belting from natural and synthetic rubber and/or plastics resins. Establishments manufacturing garden hoses from purchased hose are included in this industry.*

All Other Rubber Product Mfg (326299) *This U.S. industry comprises establishments primarily engaged in manufacturing rubber products (except tires; hoses and belting; and molded, extruded, and lathe-cut rubber goods for mechanical applications (except rubber tubing)) from natural and synthetic rubber. Establishments manufacturing rubber tubing made from natural and synthetic rubber, regardless of process used, are included in this industry.*

Metal Tank (Heavy Gauge) Mfg (332420) *This industry comprises establishments primarily engaged in cutting, forming, and joining heavy gauge metal to manufacture tanks, vessels, and other containers.*

Other Commercial & Service Industry Machinery Mfg (333319) *This U.S. industry comprises establishments primarily engaged in manufacturing commercial and service industry equipment (except*

automatic vending machines, commercial laundry, drycleaning and pressing machines, office machinery, optical instruments and lenses, and photographic and photocopying equipment).

Heating Equipment (except Warm Air Furnaces) Mfg (333414) *This U.S. industry comprises establishments primarily engaged in manufacturing heating equipment (except electric and warm air furnaces), such as heating boilers, heating stoves, floor and wall furnaces, and wall and baseboard heating units. Includes hydronic heating equipment manufacturing*

Air-Conditioning & Warm Air Heating Equipment & Commercial & Industrial Refrigeration Equipment Mfg (333415) *This U.S. industry comprises establishments primarily engaged in (1) manufacturing air-conditioning (except motor vehicle) and warm air furnace equipment and/or (2) manufacturing commercial and industrial refrigeration and freezer equipment. Includes water (i.e., drinking) coolers, mechanical, manufacturing.*

Turbine & Turbine Generator Set Units Mfg (333611) *This U.S. industry comprises establishments primarily engaged in manufacturing turbines (except aircraft); and complete turbine generator set units, such as steam, hydraulic, gas, and wind.*

All Other Miscellaneous General Purpose Machinery Mfg (333999) *This U.S. industry comprises establishments primarily engaged in manufacturing general purpose machinery (except ventilating, heating, air-conditioning, and commercial refrigeration equipment; metal working machinery; engines, turbines, and power transmission equipment; pumps and compressors; material handling equipment; power-driven handtools; welding and soldering equipment; packaging machinery; industrial process furnaces and ovens; fluid power cylinders and actuators; fluid power pumps and motors; and scales and balances).*

Other Electronic Component Mfg (334419) *This U.S. industry comprises establishments primarily engaged in manufacturing electronic components (except electron tubes; bare printed circuit boards; semiconductors and related devices; electronic capacitors; electronic resistors; coils, transformers and other inductors; connectors; and loaded printed circuit boards).*

Search, Detection, Navigation System & Instrument Mfg (334511) *This U.S. industry comprises establishments primarily engaged in manufacturing search, detection, navigation, guidance, aeronautical, and nautical systems and instruments. Examples of products made by these establishments are aircraft instruments (except engine), flight recorders, navigational instruments and systems, radar systems and equipment, and sonar systems and equipment.*

Automatic Environmental Control Mfg (334512) *This U.S. industry comprises establishments primarily engaged in manufacturing automatic controls and regulators for applications, such as heating, air-conditioning, refrigeration and appliances.*

Instruments & Related Products Mfg for Measuring, Displaying, & Controlling Industrial Process Variables (334513) *This U.S. industry comprises establishments primarily engaged in manufacturing instruments and related devices for measuring, displaying, indicating, recording, transmitting, and controlling industrial process variables. These instruments measure, display or control (monitor, analyze, and so forth) industrial process variables, such as temperature, humidity, pressure, vacuum, combustion, flow, level, viscosity, density, acidity, concentration, and rotation.*

Totalizing Fluid Meter & Counting Device Mfg (334514) *This U.S. industry comprises establishments primarily engaged in manufacturing totalizing (i.e., registering) fluid meters and counting devices. Examples of products made by these establishments are gas consumption meters, water consumption meters, parking meters, taxi meters, motor vehicle gauges, and fare collection equipment.*

Other Measuring & Controlling Device Mfg (334519) *This U.S. industry comprises establishments primarily engaged in manufacturing measuring and controlling devices (except search, detection, navigation, guidance, aeronautical, and nautical instruments and systems; automatic environmental controls for residential, commercial, and appliance use; instruments for measurement, display, and control of industrial process variables; totalizing fluid meters and counting devices; instruments for measuring and*

testing electricity and electrical signals; analytical laboratory instruments; watches, clocks, and parts; irradiation equipment; and electromedical and electrotherapeutic apparatus).

Electrical Apparatus & Equipment, Wiring Supplies, & Related Equipment Whsle (423610) *This industry comprises establishments primarily engaged in the merchant wholesale distribution of electrical construction materials; wiring supplies; electric light fixtures; light bulbs; and/or electrical power equipment for the generation, transmission, distribution, or control of electric energy.*

Plumbing & Heating Equipment & Supplies (Hydronics) Whsle (423720) *This industry comprises establishments primarily engaged in the merchant wholesale distribution of plumbing equipment, hydronic heating equipment, household-type gas appliances (except gas clothes dryers), and/or supplies.*

Refrigeration Equipment & Supplies Whsle (423740) *This industry comprises establishments primarily engaged in the merchant wholesale distribution of refrigeration equipment (except household-type refrigerators, freezers, and air-conditioners).*

Farm & Garden Machinery & Equipment Whsle (423820) *This industry comprises establishments primarily engaged in the merchant wholesale distribution of specialized machinery, equipment, and related parts generally used in agricultural, farm, and lawn and garden activities.*

Industrial Machinery & Equipment Whsle (423830) *This industry comprises establishments primarily engaged in the merchant wholesale distribution of specialized machinery, equipment, and related parts generally used in manufacturing, oil well, and warehousing activities.*

Service Establishment Equipment & Supplies Whsle (423850) *This industry comprises establishments primarily engaged in the merchant wholesale distribution of specialized equipment and supplies of the type used by service establishments (except specialized equipment and supplies used in offices, stores, hotels, restaurants, schools, health and medical facilities, photographic facilities, and specialized equipment used in transportation and construction activities).*

Other Chemical & Allied Products Whsle (424690) *This industry comprises establishments primarily engaged in the merchant wholesale distribution of chemicals and allied products (except agricultural and medicinal chemicals, paints and varnishes, fireworks, and plastics materials and basic forms and shapes).*

Architects' offices, Landscape (541320) *This industry comprises establishments primarily engaged in planning and designing the development of land areas for projects, such as parks and other recreational areas; airports; highways; hospitals; schools; land subdivisions; and commercial, industrial, and residential areas, by applying knowledge of land characteristics, location of buildings and structures, use of land areas, and design of landscape projects.*

Engineering Services (541330) *This industry comprises establishments primarily engaged in applying physical laws and principles of engineering in the design, development, and utilization of machines, materials, instruments, structures, processes, and systems. The assignments undertaken by these establishments may involve any of the following activities: provision of advice, preparation of feasibility studies, preparation of preliminary and final plans and designs, provision of technical services during the construction or installation phase, inspection and evaluation of engineering projects, and related services.*

Testing Laboratories (541380) *This industry comprises establishments primarily engaged in performing physical, chemical, and other analytical testing services, such as acoustics or vibration testing, assaying, biological testing (except medical and veterinary), calibration testing, electrical and electronic testing, geotechnical testing, mechanical testing, nondestructive testing, or thermal testing. The testing may occur in a laboratory or on-site.*

Environmental Consulting Services (541620) *This industry comprises establishments primarily engaged in providing advice and assistance to businesses and other organizations on environmental issues, such as the control of environmental contamination from pollutants, toxic substances, and hazardous materials. These establishments identify problems (e.g., inspect buildings for hazardous materials), measure and evaluate risks, and recommend solutions. They employ a multidisciplined staff of scientists, engineers, and*

other technicians with expertise in areas, such as air and water quality, asbestos contamination, remediation, and environmental law. Establishments providing sanitation or site remediation consulting services are included in this industry.

Research & Development in Biotechnology (541711) *This U.S. industry comprises establishments primarily engaged in conducting biotechnology research and experimental development. Biotechnology research and experimental development involves the study of the use of microorganisms and cellular and biomolecular processes to develop or alter living or non-living materials. This research and development in biotechnology may result in development of new biotechnology processes or in prototypes of new or genetically-altered products that may be reproduced, utilized, or implemented by various industries.*

Research & Development in the Physical, Engineering, & Life Sciences (except Biotechnology) (541712) *This U.S. Industry comprises establishments primarily engaged in conducting research and experimental development (except biotechnology research and experimental development) in the physical, engineering, and life sciences, such as agriculture, electronics, environmental, biology, botany, computers, chemistry, food, fisheries, forests, geology, health, mathematics, medicine, oceanography, pharmacy, physics, veterinary and other allied subjects.*

Landscaping Services (561730) *This industry comprises (1) establishments primarily engaged in providing landscape care and maintenance services and/or installing trees, shrubs, plants, lawns, or gardens and (2) establishments primarily engaged in providing these services along with the design of landscape plans and/or the construction (i.e., installation) of walkways, retaining walls, decks, fences, ponds, and similar structures.*

Hazardous Waste Treatment & Disposal (562211*) This U.S. industry comprises establishments primarily engaged in (1) operating treatment and/or disposal facilities for hazardous waste or (2) the combined activity of collecting and/or hauling of hazardous waste materials within a local area and operating treatment or disposal facilities for hazardous waste.*

Remediation Services (562910) *This industry comprises establishments primarily engaged in one or more of the following: (1) remediation and cleanup of contaminated buildings, mine sites, soil, or groundwater; (2) integrated mine reclamation activities, including demolition, soil remediation, waste water treatment, hazardous material removal, contouring land, and revegetation; and (3) asbestos, lead paint, and other toxic material abatement.*

Environment, Conservation & Wildlife Organizations (813312) *This U.S. industry comprises establishments primarily engaged in promoting the preservation and protection of the environment and wildlife. Establishments in this industry address issues, such as clean air and water; global warming; conserving and developing natural resources, including land, plant, water, and energy resources; and protecting and preserving wildlife and endangered species. These organizations may solicit contributions and offer memberships to support these causes.*

Sources: Executive Office of the President, Office of Management and Budget. *2007 North American Industry Classification System (NAICS), United States*. Lanham, Md.: Bernan Press. (Electronic Access: http://www.census.gov/epcd/www/naics.html)
WaterWorld. 2011. *On-Line Buyer's Product Guide*. Tulsa, OK. (Electronic Access: http://www.waterworld.com/) Magazine for the municipal, industrial and international water and wastewater industry; coverage of energy management, biosolids treatment and disposal, chemicals, pipe maintenance and repairs, privatization and contract O&M, stormwater management, computers and automation technology, and corrosion control.

Appendix B

Definitions of O*NET Basic and Cross-Functional Skills for Occupations

Occupational clusters presented in this report include levels of selected O*NET *Basic Skills* – developed capacities that facilitate learning or the more rapid acquisition of knowledge – and *Cross-Functional Skills* – developed capacities that facilitate performance of activities that occur across jobs. The following are descriptions of O*NET skills presented in Chapter 4 and three examples of skill levels on a scale of 1 to 100:

Reading Comprehension (2.A.1.a): Understanding written sentences and paragraphs in work related documents. Score meanings:

28 Reading step-by-step instructions for completing a form.
57 Reading a memo from management describing new personnel policies.
85 Reading a scientific journal article describing surgical procedures.

Active Listening (2.A.1.b): Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times.

28 Taking a customer's order.
57 Answering inquiries regarding credit references.
85 Presiding as judge in a complex legal disagreement.

Writing (2.A.1.c): Communicating effectively in writing as appropriate for the needs of the audience.

28 Taking a telephone message.
57 Writing a memo to staff outlining new directives.
85 Writing a novel for publication.

Speaking (2.A.1.d): Talking to others to convey information effectively.

28 Greeting tourists and explaining tourist attractions.
57 Interviewing applicants to obtain personal and work history.
85 Arguing a legal case before the Supreme Court.

Mathematics (2.A.1.e): Using mathematics to solve problems.

28 Counting the amount of change to be given to a customer.
57 Calculating the square footage of a new home under construction.
85 Developing a mathematical model to simulate and resolve an engineering problem.

Science (2.A.1.f): Using scientific rules and methods to solve problems.

28 Conducting standard tests to determine soil quality.
57 Conducting product tests to ensure safety standards are met, following written instructions.
85 Conducting analyses of aerodynamic systems to determine the practicality of an aircraft design.

Critical Thinking (2.A.2.a): Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions or approaches to problems.

28 Determining whether a subordinate has a good excuse for being late.
57 Evaluating customer complaints and determining appropriate responses.
85 Writing a legal brief challenging a federal law.

Active Learning (2.A.2.b): Understanding the implications of new information for both current and future problem-solving and decision-making.

28 Thinking about the implications of a newspaper article for job opportunities.
57 Determining the impact of new menu changes on a restaurant's purchasing requirements.
85 Identifying the implications of a new scientific theory for product design.

Instructing (2.B.1.e): Teaching others how to do something.

28 Instructing a new employee in the use of a time clock.
57 Instructing a co-worker in how to operate a software program.
85 Demonstrating surgical procedures to interns in a teaching hospital.

Complex Problem Solving (2.B.2.i): Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions.

28 Comparing invoices of incoming articles to ensure they meet required specifications.
57 Identifying and resolving customer complaints.
85 Analyzing corporate finances to develop a restructuring plan.

Installation (2.B.3.d): Installing equipment, machines, wiring, or programs to meet specifications.

28 Installing a new air filter in an air conditioner.
57 Installing new switches for a telephone exchange.
85 Installing a "one of a kind" process production molding machine.

Programming (2.B.3.e): Writing computer programs for various purposes.

28 Writing a program in BASIC to sort objects in a database.
57 Writing a statistical analysis program to analyze demographic data.
85 Writing expert system programs to analyze ground radar geological data for probable existence of mineral deposits.

Repairing (2.B.3.l): Repairing machines or systems using the needed tools.

28 Tightening a screw to get a door to close properly.
57 Replacing a faulty hydraulic valve.
85 Repairing structural damage to a building following an earthquake.

Quality Control Analysis (2.B.3.m): Conducting tests and inspections of products, services, or processes to evaluate quality or performance.

28 Laying out tools to complete a job.
57 Classifying library materials according to subject matter.
85 Developing a prototype for a new database system.

Systems Analysis (2.B.4.g): Determining how a system should work and how changes in conditions, operations, and the environment will affect outcomes.

28 Determining why a co-worker has been overly optimistic about how long it took to complete a task.
57 Determining why a manager has under estimated production costs.
85 Evaluating the long-term performance problem of a company.

Time Management (2.B.5.a): Managing one's own time and the time of others.

28 Keeping a monthly calendar of appointments.
57 Allocating the time of subordinates to projects for the coming week.
85 Allocating the time of scientists to multiple research projects.

Source: *O*NET Version 15*. National Center for O*NET Development, North Carolina Employment Security Commission, P.O. Box 27625, Raleigh, NC 27605. On-line: www.onetcenter.org

Note: O*NET is a US Department of Labor, Employment and Training Administration (DOL/ETA) sponsored project.

Appendix C

Water Use Efficiency Projects Contributors List

Conservation Projects

Name: Complete Restroom Retrofit Monitoring Program (ICP Program)
Description: *This program piggy-backs on the Restroom Retrofit Program by monitoring the water savings from self-closing faucets.*
Budget Amount: $22,750
Source: Leighanne Kirk, West Basin Municipal Water District

Name: Complete Restroom Retrofit Project
Description: *Installation of high-efficiency toilets, high-efficiency urinals and faucet sensors in non-residential settings.*
Budget Amount: $1,773,600
Source: Leighanne Kirk, West Basin Municipal Water District

Name: Food Facilities Audit, Incentive and Training Program (Enhanced Conservation Program)
Description: *Targets large to medium sized food service facilities to market water efficient equipment to replace older existing equipment and promote water saving training.*
Budget Amount: $128,800
Source: Leighanne Kirk, West Basin Municipal Water District

Name: Green Garden Program
Description: *This program involves four phases: pre-installation site surveys, Smart Irrigation Controller Exchange Events (including a 1-hour training session), a post-installation site visit, and water savings verification research.*
Budget Amount: $607,100
Source: Leighanne Kirk, West Basin Municipal Water District

Name: High-Efficiency Toilet Distributions
Description: *In FY 2010-11, West Basin will provide 2,000 free HETs to residents through 5 one-day events.*
Budget Amount: $301,500
Source: Leighanne Kirk, West Basin Municipal Water District

Name: Local Water Conservation Plans for Water Purveyors
Description: *These plans are developed to help water retailers comply with SB 7x7 and their Best Management Practices by developing and planning for programs that meet the targets.*
Budget Amount: $223,000
Source: Leighanne Kirk, West Basin Municipal Water District

Name: MWD Conservation Proposal- Landscape Audits/Water Budgets/Equipment Incentives
Description: *Perform water audits, develop water budgets, and identify appropriate equipment incentives and upgrades, and provide information on training classes and "Smart" irrigation controllers.*
Budget Amount: $109,640
Source: Leighanne Kirk, West Basin Municipal Water District

Name: Ocean Friendly Landscape Project
Description: *Installation of centralized irrigation controller systems and weather-based irrigation controllers at sites of greater than 1 acre, conducting landscape classes for residents, installing demonstration gardens in public sites (cities or schools), providing WBIC rebates and conducting a run-off study.*
Budget Amount: $2,600,000
Source: Leighanne Kirk, West Basin Municipal Water District

Name: Re-circulate & Save Program (CII Incentive Program)
Description: *Provides businesses and facilities with incentives, resources, and technical assistance to install water efficient equipment.*
Budget Amount: $873,000
Source: Leighanne Kirk, West Basin Municipal Water District

Name: Residential Indoor Plumbing Retrofit Kits
Description: *Implement 20,000 residential water and energy audits and device retrofits to 6th grade students.*
Budget Amount: $932,961
Source: Leighanne Kirk, West Basin Municipal Water District

Name: Water & Energy Efficiency Multi-Family Program (Enhanced Conservation Program)
Description: *Direct installation of both water and energy efficiency devices in multi-family dwellings. Replacement includes: installation of High-Efficiency Toilets (1.28 gallons per flush), installation of 9,000 13Watt twist Compact Fluorescent Light bulbs (CFLs).*
Budget Amount: $836,500
Source: Leighanne Kirk, West Basin Municipal Water District

Graywater Projects

Name: (ReWater project prototypes)
Description: *Installing graywater systems that captures, filters, and reuses shower, tub, bathroom sink, laundry, and other sources of good water.*
Budget Amount: $645 per household
Source: Steve Bilson, ReWater

Name: Casa Dominguez
Description: *An innovative development comprised of 70 units of affordable housing, which includes a graywater system for capturing, filtering, and re-using laundry water for exterior irrigation.*
Budget Amount: $28,037,000 total development cost; used as reference only
Source: Abode Communities

Groundwater Projects

Name: (Groundwater Treatment Facility)
Description: *Impaired groundwater treatment project, brackish supply that required a 6 mgd desalination plant > New potable water source, from brackish local groundwater with nitrate contamination.*
Budget Amount: $35,300,000
Source: Gil Crozes, VP, Carollo Construction Engineers

Name: Tujunga Wellfield Liquid Phase Granular Activated Carbon (GAC) Project
Description: *Provide treatment for Tujunga Well Numbers 6 & 7 to recover the use of two wells.*
Budget Amount: $12,000,000
Source: Penny Falcon, LA City Department of Water and Power

Recycled Water Projects

Name: Anza Avenue Lateral, Phase I
Description: *The total length for Anza Ave Lateral Phase I is estimated to be 14,500 lineal feet of 8-, 6-, and 4-inch diameter recycled water pipeline.*
Budget Amount: $562,765
Source: Leighanne Kirk, West Basin Municipal Water District

Name: Anza Recycled Water Lateral, Phase II
Description: *Approximately 11,000 feet of purple recycled irrigation water pipeline that will save potable water for other purposes in the City of Torrance.*
Budget Amount: $609,141
Source: Leighanne Kirk, West Basin Municipal Water District

Name: Ashwood Lateral, City of Inglewood
Description: *The Project consists of approximately 2,700 lineal feet of 4-inch diameter recycled water pipeline (purple pipes) and, by irrigating these two locations with recycled water, will conserve approximately 10 acre-feet of potable water a year.*
Budget Amount: $119,646
Source: Leighanne Kirk, West Basin Municipal Water District

Name: California State University Dominguez Hills Lateral Extension
Description: *Consists of a recycled water transmission pipeline within the City of Carson connecting to the end point of the Victoria Lateral and extending throughout the CSUDH campus. The Lateral serves over 98 million gallons of recycled water annually for irrigation use at multiple on-site facilities, including the recently-built Home Depot National Training Center.*
Budget Amount: $280,198
Source: Leighanne Kirk, West Basin Municipal Water District

Name: Corporate Campus El Segundo Lateral
Description: *The 4,000 feet of pipeline will carry recycled water for landscaping and other uses to allow the city to protect precious drinking water for El Segundo businesses and residents.*
Budget Amount: $97,692
Source: Leighanne Kirk, West Basin Municipal Water District

Name: Fullerton Road reclaimed Pipeline
Description: *Fullerton Road reclaimed Pipeline (Arenth to connection point @ Sta 1+00)*
Budget Amount: $4,956,233
Source: Ken Deck, GM, Rowland Water District, and Paula Daniels, Office of the Mayor of Los Angeles

Name: Groundwater Recharge System (GWRS) Phase 1, Orange Co. Water District
Description: *Maximizing waste water recycling through indirect potable reuse, 72,000 acre-ft/year of recycled water; phase 2 expansion is under way.*
Budget Amount: $498,980,000
Source: Gil Crozes, VP, Carollo Construction Engineers

Name: Groundwater Replenishment Project
Description: *The objectives of this project are to 1) reduce dependence on imported water supplies, 2) maximize recharge in the San Fernando Basin aquifer, 3) maintain deliveries of non-potable recycled water to existing users served by DCT, and 4) beneficially use DCT effluent to support groundwater recharge.*
Budget Amount: $293,000,000
Source: Penny Falcon, LA City Department of Water and Power

Name: Harbor Refineries Recycled Water Project (1)
Description: *The objective of this project is to construct the facilities necessary to produce and convey up to 9,300 AFY of recycled water to various industrial and irrigation users in the Los Angeles Harbor Area, more than doubling the amount of recycled water currently being used throughout the City of LA. This objective will be met by constructing approximately 60,000 feet of 30-inch diameter pipeline and expanding the nitrification treatment facilities at West Basin's Carson Regional Water Recycling Plant.*
Budget Amount: $45,700,000
Source: Penny Falcon, LA City Department of Water and Power

Name: Harbor Refineries Recycled Water Project (2)
Description: *The objective of this project is to construct the facilities necessary to produce and convey up to 9,300 AFY of recycled water to various industrial and irrigation users in the Los Angeles Harbor Area, more than doubling the amount of recycled water currently being used throughout the City of LA. This objective will be met by constructing approximately 60,000 feet of 30-inch diameter pipeline and expanding the nitrification treatment facilities at West Basin's Carson Regional Water Recycling Plant.*
Budget Amount: $27,700,000
Source: Penny Falcon, LA City Department of Water and Power

Name: Harbor Refineries Recycled Water Project (3)
Description: *The objective of this project is to construct the facilities necessary to produce and convey up to 9,300 AFY of recycled water to various industrial and irrigation users in the Los Angeles Harbor Area, more than doubling the amount of recycled water currently being used throughout the City of LA. This objective will be met by constructing approximately 60,000 feet of 30-inch diameter pipeline and expanding the nitrification treatment facilities at West Basin's Carson Regional Water Recycling Plant.*
Budget Amount: $40,000,000
Source: Penny Falcon, LA City Department of Water and Power

Name: Hyperion Secondary Effluent Pump Station
Description: *This is located at the southwest corner of the Hyperion Waste Water Treatment Plant and provides the only source of water for West Basin's recycled water system.*
Budget Amount: $35,277
Source: Leighanne Kirk, West Basin Municipal Water District

Name: Mariposa Lateral
Description: *Approximately 1,500 feet of pipeline that will serve customers within the City of El Segundo.*
Budget Amount: $207,147
Source: Leighanne Kirk, West Basin Municipal Water District

Name: Michelson Upgrade Project
Description: *Decentralized wastewater treatment plant for recycled water irrigation per Title 22 Rules: 10 mgd addition to existing facility.*
Budget Amount: $119,200,000
Source: Gil Crozes, VP, Carollo Construction Engineers

Name: Rowland Water District: Arenth Reclaimed Water Pipeline
Description: *Arenth Reclaimed Water Pipeline PH 1 - rev 1 (6-16-08)*
Budget Amount: $5,047,716
Source: Ken Deck, GM, Rowland Water District, and Shelley Luce, ED, Santa Monica Bay Restoration Foundation

Name: Title 22 Distribution System
Description: *Title 22 Product Water Storage - consist of two 5.0 million gallon (MG) circular storage reservoirs. The reservoirs attenuate daily peaking of customer demands.*
Budget Amount: $44,436
Source: Leighanne Kirk, West Basin Municipal Water District

Name: Torrance Booster Pump Station
Description: *The proposed booster pump station will serve over 20 customers at an ultimate capacity of 1,150 gallons per minute.*
Budget Amount: $76,683
Source: Leighanne Kirk, West Basin Municipal Water District

Name: Whittier Narrows Water Reclamation Plant UltraViolet Disinfection System Facilities
Description: *Address NDMA concentrations in tertiary effluent to allow continued groundwater recharge of 7,000 AFY (on average) for indirect potable reuse by converting from chloramination to UV disinfection.*
Budget Amount: $11,522,886
Source: Sharon Green, Sanitation Districts of Los Angeles County, email on November 15, 2010

Stormwater Projects

Name: *Andrews Park Subsurface Storage, Use and Infiltration*
Description: *The BMP treats runoff from 122 acres and consists of a diversion, conveyance pipes, a gross solids removal device (GSRD), an irrigation storage tank, and an infiltration gallery. Dry- and wet-weather flows are diverted from the existing storm drain and into the irrigation storage tank through the conveyance pipe and GSRD. Flows fill the storage tank until ponding depths reach the elevation of an overflow pipe, then overflow into the infiltration gallery. The system fills until inflows no longer exceed loss rates, at which time the basin will drawdown. When persistent flow fills the system to storage capacity, runoff in the storm drain bypasses the diversion until capacity is freed up through infiltration losses and irrigation use.*
Budget Amount: $6,860,601
Source: Mark Hanna, GeoSyntec

Name: *Broadous Elementary School Project*
Description: *Captures, treats and infiltrates stormwater that used to flood and run off the campus. The project includes: A stormwater treatment unit that treats stormwater collected from the campus; An underground infiltration system that stores water.*
Budget Amount: $306,738
Source: Edith de Guzman

Name: *Bull Creek Restoration Project*
Description: *Ecosystem Restoration Project, under the Army Corp of Engineers' CAP (Continuing Authority Program) section 1135.*
Budget Amount: $6,273,595
Source: Edward Belden, formerly with the Los Angeles & San Gabriel Rivers Watershed Council

Name: Elmer Avenue Project
Description: *Street widening, C&G, sidewalk, infiltration basin, infiltration swale, planting & drip irrigation (Elmer Ave between Stagg St & Keswick St.)*
Budget Amount: $1,100,000
Source: Bureau of Engineering, Department of Public Works, City of Los Angeles; Council for Watershed Health

Name: Herondo Parking Lot Detention & Beach Infiltration
Description: *The BMP treats runoff from 3,000 acres and consists of a diversion, conveyance pipes, a gross solids removal device (GSRD), an underground detention facility, and a pump. Wet-weather flows are diverted from the existing storm drain and flow into the storage unit through the conveyance pipe and GSRD, then pumped to the Hermosa Beach infiltration trench. The system fills until inflows no longer exceed loss rates, at which time the facility will drawdown. When persistent flows fill the system to storage capacity, runoff in the storm drain bypasses the diversion until capacity is freed up. Design storage volume = 2.7 AF.*
Budget Amount: $8,740,000
Source: Mark Hanna, GeoSyntec

Name: Imperial Highway Stormwater Best Management Practices
Description: *The project will install sunken infiltration trenches and grass buffer strips, with native vegetation and plants, along the Imperial Highway median from Pershing Drive to California Street in the Playa del Ray area. The project will capture and treat surface runoff from Imperial Highway through the grass buffer strips and infiltration trenches prior to discharging into the existing drainage system.*
Budget Amount: $2,723,403
Source: Mark Hanna, GeoSyntec

Name: Los Angeles Zoo Parking Lot
Description: *Demolish the main LA Zoo parking lot and construct a new parking lot with stormwater best management practices elements such as pervious asphalt, pervious concrete, and interlocking pavers. This project will improve water quality by reducing pollutant runoff, use reclaimed water for irrigation, provide aesthetic benefits, increase green space, improve parking lot circulation, install trash screen inserts for storm drains, install parking lot lights, construct bioswales and plant 262 trees and over 17,000 California native shrubs.*
Budget Amount: $13,904,243
Source: Wendy Young, Proposition O Bond Program, City of Los Angeles DPW

Name: Malibu Legacy Park
Description: *Multi-benefit regional facility that captures and stores more than 2 million gallons of stormwater and urban runoff per day. This captured runoff is treated, disinfected, and then used for irrigation. Project puts an entire segment of the City of Malibu into compliance with stringent Bacteria TMDL [Total Maximum Daily Loads] requirements, while also creating valuable, rare and diminishing habitat along the California Coastline.*
Budget Amount: $50,000,000
Source: Wendy Young, Proposition O Bond Program, City of Los Angeles DPW

Name: Manhattan Heights Subsurface Infiltration Gallery
Description: *The BMP consists of a diversion, conveyance pipes, a gross solids removal device (GSRD), forebay, and an infiltration gallery. Dry- and wet-weather flows are diverted from the existing storm drain and flow into the forebay through the conveyance pipe and GSRD and begin to infiltrate into site soils. Flows exceeding the loss rate of the forebay fill the forebay and ultimately overflow via a notched weir into the infiltration gallery, where additional infiltration will occur. The system will fill until inflows no longer exceed loss rates, at which time the basin will drawdown. When persistent flows fill the system to storage capacity, runoff in the storm drain bypasses the diversion until capacity is freed up through infiltration losses. Design storage volume = 2.6 AF.*
Budget Amount: $7,708,339
Source: Mark Hanna, GeoSyntec

Name: Mar Vista Recreation Center Stormwater
Description: *Construct a stormwater treatment system, which consists of a diversion structure, trash maintenance hole, pump stations, hydrodynamic separator, underground storage tank, chlorination/dechlorination system and appurtenant electrical system at Mar Vista Recreation Center Park located at 11430 Woodbine Street in Mar Vista. The project will divert and treat dry weather flows and a portion of wet weather flows from the existing 63-inch drainage system that runs adjacent to the park. Heavy sediments, oil, grease, and trash will be removed and an underground cistern will further treat stormwater.*
Budget Amount: $4,556,186
Source: Mark Hanna, GeoSyntec

Name: Marshland Enhancement (Sanitation Districts of Los Angeles County)
Description: *Restoration of vegetation and wildlife habitat value of the 17 acre freshwater JWPCP marshland that provides stormwater treatment, flood control; Project includes educational and recreational facilities.*
Budget Amount: $3,297,430
Source: Wendy Young, Proposition O Bond Program, City of Los Angeles DPW

Name: Open Charter Magnet Elementary School
Description: *The project was conceived to provide a working demonstration of new approaches to managing the urban environment while addressing site-specific problems. By capturing stormwater that used to run off the campus, the project reduces pollutant loads to nearby water bodies and provides a new source of water for irrigating the campus. The demonstration project consists of three components: 1) A system of trees, vegetation and mulched swales slows, filters and safely channels rainwater through the campus. 2) A treatment device removes pollutants from water collected on campus. 3) A 110,000-gallon underground cistern stores the treated rainwater and feeds the irrigation system.*
Budget Amount: $673,925
Source: Sharon Green, Sanitation Districts of Los Angeles County, email on November 15, 2010

Name: Peck Park Canyon Enhancement
Description: *Installation of vegetated bio-swales, infiltration strips, stormwater catch basins, and a step-pool channel into Peck Park. Additional portions of the project are funded by a State Prop 50 grant and a State Recreation and Trails grant. The grant work includes renovation of an existing trail, creation of a new trail, planting native riparian plants, and installing park amenities including bridges to facilitate trail navigation.*
Budget Amount: $6,190,000
Source: Edith de Guzman

Name: Polliwog Park Subsurface Infiltration Gallery
Description: *The BMP consists of a diversion, conveyance pipes, a gross solids removal device, a forebay, and an infiltration gallery. Dry- and wet-weather flows are diverted from the existing storm drain into the forebay through the conveyance pipe and GSRD, then begin to infiltrate into the site soils. Flows exceeding the loss rate of the forebay fill the forebay and ultimately overflow via a notched weir into the infiltration gallery, where additional infiltration occurs. The system fills until inflows no longer exceed loss rates, at which time the basin will drawdown. When persistent flows fill the system to storage capacity, runoff in the storm drain bypasses the diversion until capacity is freed up through infiltration losses. Design storage volume = 3.4 AF.*
Budget Amount: $13,429,956
Source: Wendy Young, Proposition O Bond Program, City of Los Angeles DPW

Name: Riverdale Avenue Green Street Project
Description: *Stormwater capture pilot project, with planning performed by LA City Bureau of Engineering*
Budget Amount: $621,331
Source: Ding Lee, Bureau of Engineering, Dept of Public Works, City of LA; Paula Daniels

Name: SMB 5-1 Subsurface Infiltration Trenches Project
Description: *Stormwater treatment for six outfalls that drain to monitoring location SMB-5-1. An individual infiltration trench treats runoff from each of five outfalls. Each BMP consists of a pretreatment device, an in-line forebay, and an infiltration trench. Dry- and wet-weather runoff flows through the pretreatment device into the in-line forebay, then enters the subsurface infiltration trench consisting of gravel and numerous perforated pipes. When flows in the forebay exceed the ponding depth, runoff exits the forebay system via an overflow pipe and re-enters the existing drainage system.*
Budget Amount: $1,075,550
Source: Mark Hanna, GeoSyntec

Name: SMB-5-2 Subsurface Infiltration Trench
Description: *The BMP treats runoff from 1,565 acres and consists of pretreatment and an infiltration trench. Dry- and wet-weather flows from the 28th Street storm drain enters the forebay and trash nets for pretreatment, then flows into a series of sixteen parallel perforated pipes extending laterally from both sides of the forebay. The perforated pipes are lain amongst a bed and fill of gravel to enhance storage prior to infiltration into site soils. When persistent flows fill the system to storage capacity, additional runoff will overflow from the forebay via an overflow chute and re-enter the existing drainage system. Dry- and wet-weather flows from secondary outfalls are*

treated by pretreatment units and diverted from existing storm drains upstream and over the trench into an open-bottom concrete vault, allowing flows to infiltrate into the trench from above. Design storage volume = 9.1 AF.
Budget Amount: $12,760,989
Source: Mark Hanna, GeoSyntec

Name: SMB 5-3 Subsurface Infiltration Trenches Project
Description: *Stormwater treatment for nine outfalls that drain 161 acres near or to monitoring location SMB-5-3. An individual infiltration trench treats runoff from five outfalls. Each BMP consists of a pretreatment device, an in-line forebay, and an infiltration trench. Dry- and wet-weather runoff flows through the pretreatment device into the in-line forebay, then enters the subsurface infiltration trench consisting of gravel and numerous perforated pipes. When flows in the forebay exceed the ponding depth, runoff exits the forebay system via an overflow pipe and re-enters the existing drainage system.*
Budget Amount: $2,342,000
Source: Mark Hanna, GeoSyntec

Name: SMB 5-4 Subsurface Infiltration Trenches Project
Description: *The project drains approximately 211 acres of Manhattan and Hermosa Beach and consists of an in-line forebay with trash nets (for pretreatment) and an infiltration trench. Dry- and wet-weather runoff from the 1st Street and 35th Street storm drains is diverted upstream of the outfalls and routed to the BMP. Runoff flows through trash nets into the inline forebay from the storm drains. The runoff then enters the subsurface infiltration trench consisting of gravel and eight perforated pipes. When flows in the forebay exceed the ponding depth of 4 feet, runoff exits the forebay system via an overflow pipe and discharges to the beach.*
Budget Amount: $4,126,500
Source: Mark Hanna, GeoSyntec

Name: South Park Subsurface Infiltration Gallery
Description: *The BMP treats runoff from 151 acres and consists of a diversion, conveyance pipes, a gross solids removal device (GSRD), forebay, and an infiltration gallery. Dry- and wet-weather flows are diverted from the existing storm drain and into the forebay through the conveyance pipe and GSRD, then infiltrate into site soils. Flows exceeding the loss rate of the forebay fill the forebay and ultimately overflow via a notched weir into the infiltration gallery, where additional infiltration will occur. The system fills until inflows no longer exceed loss rates, at which time the basin will drawdown. When persistent flows fill the system to storage capacity, runoff in the storm drain bypasses the diversion until capacity is freed through infiltration losses. Design storage volume = 1.9 AF.*
Budget Amount: $6,441,816
Source: Mark Hanna, GeoSyntec

Name: Tujunga Spreading Grounds Upgrade
Description: *Los Angeles Department of Water and Power (LADWP) and the Los Angeles County Flood Control District (LACFCD) are cooperatively working to enhance the Tujunga Spreading Grounds. Enhancements include; consolidating and deepening the existing spreading basins, installing two high flow intakes with 60-foot inflatable rubber dams, and modifying the existing intake to improve water quality and remove sediments. Other equipment to be installed include; control houses, slide gates and spillways, and a remote control telemetry system. The project plan incorporates community access and open space for passive recreation, limited to operational constraints.*
Budget Amount: $24,000,000
Source: Mark Hanna, GeoSyntec

Name: Westchester Stormwater BMP Project
Description: *Stormwater treatment project designed to treat wet and dry weather runoff from Argo ditch and adjacent County storm drain to improve water quality at downstream Dockweiler Beach. Flow is tapped off using low flow diversions, debris is collected in a trash net system, storage tank provides settling prior to being pumped to an infiltration system.*
Budget Amount: $23,134,451
Source: Penny Falcon, LA City Department of Water and Power

Name: Westminster Dog Park Stormwater Best Management Practices
Description: *Install several Best Management Practices (BMP) elements, including a vegetated swale, shallow sub-drain system and a stormwater treatment unit, to capture and treat site runoff from the Westminster Dog Park. Treated runoff will be dispersed to the existing catch basin located on Main Street, north of Westminster Avenue.*
Budget Amount: $1,438,755
Source: Mark Hanna, GeoSyntec

Name: Westside Park Rainwater Irrigation
Description: *Provide pre-treatment and treatment of pollutants of concern, including bacteria, oil, grease, gasoline, suspended sediments and heavy metals, through filtration and a dry creek (bio-retention basin). The subsurface irrigation system will also assist in offsetting potable water demands by utilizing the dry weather runoff in the storm drain. The project will also provide the surrounding community with various park improvements, including open green space, sensory garden, exercise equipment, walking paths, a Universally Accessible Playground (UAP), perimeter fencing, solar security lighting and drinking foundation.*
Budget Amount: $6,904,589
Source: Wendy Young, Proposition O Bond Program, City of Los Angeles DPW

Appendix D

Graywater Systems for Residential Dwelling Units

The following is a correspondence with ReWater Founder and CEO Steve Bilson, discussing the jobs implications of graywater irrigation systems. Given the limited availability of budget data on recent projects, we rely on ReWater's experience in the industry to create estimates of economic and job impacts.

From: Steve Bilson
Sent: Tuesday, December 14, 2010 1:45 PM
Subject: Jobs Implications of Greywater Irrigation

A greywater irrigation system provides many benefits, all of which have financial values, most of which have job implications. I want to expand upon your understanding of these systems in order to provide the answers I think you are seeking. Those benefits are more water, efficient irrigation, wastewater reduction, urban run-off pollution prevention, and decreased energy demand and carbon emissions. The following data analysis was derived from ReWater's 3-year interaction with the California State Water Resources Control Board's (SWRCB) State Revolving Fund (SRF) Funding Branch during their 1998-2001 consideration of the City of Chula Vista's application for SRF funding for a 650-home greywater irrigation program and on more recent events.

Water

Water in the City of LA costs $3.70 -$5.83 per unit, mainly depending on how much landscape you irrigate and thus which rate tier you're in. The average greywater production according to a definitive 1997 AWWA study of 1,200 homes entitled the End Use Survey is 39.1 gallons per day. The average home has 3.2 people in it. That means the average home produces 125 gallons per day or 45,625 gallons per year, or 61 units of water per year. 61 x $3.70 = $225 per year. The high value is $356 per year. That is the present water value. The water values in *future* years are significantly higher. As water rates went rise, those future values rise equally. In 5-6 years, this value will have doubled at present rate increases.

To plumb a home correctly for greywater use, the showers, tubs, bathroom sinks, and laundry water must be kept separate from the sewage sources. That requires creating a smaller secondary greywater main pipe of the same quality as a sewage pipe, usually of ABS, though commercial systems would use cast iron in LA. That secondary plumbing system would only add costs according to the length and difficulty of installing that main pipe. Each fixture already had to have a drain, p-trap, and vent connection if plumbed conventionally, so those are not "extra" costs. The only other extra costs are for connecting the greywater filter system to that pipe outside the home and overflowing it to the sewer as required for a fail-safe design.

We have provided hundreds of systems over the lat 20 years and those homes range in size and price from small and inexpensive to huge and outrageously expensive. We have also provided systems to two subdivisions of production (tract) homes. In those subdivisions, we had contracted to have our systems plumbed in repetitively. The manner of construction and costs for those home installations would be

representative of the vast majority of homes built in California. The first subdivision consisted of 4-bedroom/3-bath single story homes of about 2,800 square feet, and the extra plumbing costs were about $750 per home. The second subdivision consisted of 3-bedroom/3-bath two-story homes of about 2,100 square feet, where the upstairs bathrooms were directly over the downstairs laundry, and the extra plumbing costs were about $540 per home.

In both subdivisions, the materials costs for the extra plumbing represented about ¼ of the total extra cost. The labor costs were about ¾, or $562 and $405 respectively. At the labor rates back then, that represented about 14 and 10 hours per system respectively.

Efficient Irrigation

A legal greywater irrigation system must use underground irrigation. It can't use a system that broadcasts water into the air, such as sprinklers. The only way to achieve uniform irrigation over a large area is to have a pressurized irrigation system that can counter the ups and downs of varied topography. The only type of pressurized irrigation that doesn't broadcast water is a drip system. According to a definitive 1996 USDA study on 51 studies of underground drip irrigation, underground drip is at least 30 percent more efficient than sprinklers and up to 60 percent more efficient. Using that 1.3 efficiency multiplier, we take the 45,625 gallons of annual greywater and end up with the equivalent of 59,312 gallons of irrigation water.

Installing that type of underground drip system takes more time than installing a sprinkler system, though not as much time as some might initially imagine. Sprinklers require trenching of the main lines and laterals, and constructing valve manifolds, and creating sprinklers risers hopefully with swivels to counter breakage, then placing the sprinklers on those risers and adjusting them. Drip irrigation requires the same main line and manifolds, but additional trenching for the drip lines. Installing those drip lines is however easier than creating risers and sprinklers. We have found that it takes about 20 percent longer to install underground drip. The materials costs are virtually identical.

On both subdivisions, only the front yards received greywater irrigation. Of those two subdivisions, the first had front yards of approximately 1,300 square feet. This meant the $1 per square foot for installing sprinklers back then went up to $1.20 per square foot for installing underground drip, resulting in an additional $260 in labor costs. On the second subdivision, the front yards were only about 1,000 square feet, resulting in an additional $200 in labor costs. At the labor rate for landscapers back then, that equaled about 13 and 10 hours respectively.

Wastewater

Wastewater costs almost as much to treat as freshwater does to deliver to the home. The current rate of $3.27 per unit is the going price. That means the 61 units of greywater has another value of $199. This assumes that all that greywater will be reused and not sent down to the sewer, which may not be entirely true if the homeowner shuts down their irrigation system in the winter because they did not have enough landscape to use all the greywater during this period of decreased evapo-transpiration. At homes with larger landscapes, which use more water for irrigation than greywater can provide in the summer, all the greywater could still be used in the winter. Thus, a sewer rate schedule predicated on a homeowner's winter month's fresh water usage would still provide sewer rate savings to a greywater system owner during summer months.

The labor cost of achieving these sewer treatment savings has already been written off in the water savings discussion above. Reading a post-filter greywater meter, if one was required to assess any sewer rate reduction under some other form of financial incentive program, would add labor costs. Discussions have been held with various water departments where they proffered that their employees could annually check a post-filter greywater meter at the same time as when they read the water meter, adding an incremental charge to the water bill. This added time might be 1-10 minutes per system, depending on whether the meter was readable from the front yard via telemetry or not.

Run-off Pollution Prevention

The run-off pollution prevention values of underground drip irrigation as required for a legal greywater system are not yet quantified. However, run-off pollution is the leading cause of water pollution along the coast. The Building Industry Association complained in their legal briefs all the way up to the state Supreme Court that it would cost $20,000 per home to mitigate run-off pollution per the SWRCB's new rules. They lost. Because a legal greywater irrigation system must keep the surface dry, the landscape acts as a collection area for that dirty first rain that would have run off a saturated surface. The fertilizers, pesticides, herbicides, and silt that would have gone into the stormwater system are instead soaked up by that dry landscape surface.

The labor cost these savings are already factored into the cost of water savings. If a SRF loan were used for the purchase of these systems, which is an option, then maintenance of those systems would need to be guaranteed by the city per US EPA's SRF Guidelines. The best way to determine if a system needs maintenance is to check to see if it's working. The way to measure whether it's working is to measure its greywater output. Such being the case, the systems would have to include a post-filter greywater meter, and that meter would have to be read annually. The cost of a LADWP employee reading that meter would add to the extra labor cost of SRF-funded systems. The time it takes to read that meter depends on what type of meter is used.

Energy and Carbon

In 2007, the California Energy Commission found that 19 percent of all energy goes to pumping water around the state. In 1979, UCLA Professor Murray Milne reported in his book Residential Water Reuse that 25 percent of all energy used in the City of LA goes to pumping water. That equates to billions of dollars per year. When you're pumping water a couple hundred feet around the landscape instead of from a couple hundred miles away, it doesn't take a rocket scientist to know there are more savings to be accrued. Those savings have yet to be quantified.

I'm not sure these energy and greenhouse values create any jobs, except that the health care industry will not have so many breathing disorder cases to handle in the future due to less particulate matter in the air due to homes with greywater irrigation systems instead of being built conventionally.

Steve Bilson, Founder and CEO
ReWater
P.O. Box 19364
Thousand Oaks, CA 91319
Phone: (805) 262-2954

END NOTES

[1] U.S. Bureau of Labor Statistics

[2] "Investments that green the urban infrastructure, such as capturing, recharging, treating and re-using water locally, stand to reduce our demand by over 50% – a low estimate for outdoor use in Southern California. Capture systems like rainwater harvesting, green rooftops, and permeable pavement optimize local water storage, while bioswales along streets and rooftop gardens naturally treat water on-site. The National Academy of Science suggests that most U.S. urban centers, which average 75% impervious surfaces, could undergo radical transformations providing co-benefits like water quality improvement, flood risk mitigation, and heat island effect reductions. Water reuse investments can also come in the form of graywater systems, re-using indoor residential water outdoor, and sewage reclamation undergoing the most advanced levels of treatment. Additionally, conservation investments can also come in the form of more sophisticated consumption tracking, fixing plumbing and irrigation leaks, and retrofitting landscapes with drought-tolerant plants." Source: Correspondence with Caryn Mandelbaum, Freshwater Program Director, Environment Now.

[3] The basic reporting unit in data used for this report is an establishment, a single place of employment of two or more employees, operated by a single private, public or non-profit employer. Employers that operate more than one establishment location are required to submit separate payroll tax reports for each establishment in these data, and so each location is a separate establishment in the data. Thus, "establishment" is the term we use throughout this report.

[4] The activities of water sector businesses captured in the "second tier" industries include pipe repairs and maintenance, corrosion control of water infrastructure, chemical treatment and removal of bio-solids from contaminated water, stormwater management, operation and management of water-related facilities, and automated, computer control technology.

[5] The term "person-years of employment" in IMPLAN input-output analysis includes all types of jobs, whether they are full-time or part-time, regular or intermittent, paid based on hourly wages or salary basis. It includes the types of employment that normally occur in a given industry.

[6] Data for Figure A, "Sectors of Businesses Carrying Out Water Efficiency Projects, by Project Type," is as follows:

NAICS Industry Sector	Conservation	Graywater*	Groundwater	Recycled Water	Stormwater
21 Excavation & Mining				$5,000,000	$97,165
22 Utilities	$836,500			$33,869,135	
23 Construction & Plumbing		$500,000	$40,100,000	$900,727,006	$91,584,033
31-33 Manufacturing	$1,745,686			$1,593,830	$20,022,082
42-43 Wholesale Trade	$375,000			$63,710	$685,985
44-45 Retail Trade					$89,503
51 Publishing & Telecomm.				$3,629	$3,270
54 Legal, Arch., Scientific & Tech. Svcs	$1,729,787		$7,200,000	$88,779,991	$48,146,380
56 Landscape, Waste & Remediation Svcs		500,000		$27,596	$1,518,866
71 Recreation, Museums & Parks	$92,000				
81 Envir. Orgs., Admin. Svcs. & Repair	$340,776				$214,086
92 Gov't Sector				$20,944,057	$3,187,638

* Graywater systems category is based upon a hypothetical case, with all work carried out equally split between the construction services (plumbing contractors) and landscape services industries.

[7] Mike Cohen, Pacific Institute. 2011. *Municipal Deliveries of Colorado River Basin Water*. Pacific Institute. Table 9, Page 19. Los Angeles has measurable rainfall on less than 40 days per year.

[8] Source: Correspondence with Caryn Mandelbaum, Freshwater Program Director, Environment Now.

[9] Boxall, Bettina. 2011. "The energy, and expense, of bringing water to the Southland," Los Angeles Times, November 13, page 1. "The twin forces of power costs and climate-change regulations are threatening Southern California's long love affair with imported water, forcing the region to consider more mundane sources closer to home."

[10] "On average, [current water consumption] provides the 3.8 million residents of the City of LA approximately 176 gallons [of water] per capita per day, which is almost triple the consumption level of our counterparts in Mediterranean Australia, Spain or Israel. In LA, an estimated 58% of that water goes to outdoor irrigation." – Caryn Mandelbaum, Environment Now.

[11] Mike Cohen, Pacific Institute. 2011. *Municipal Deliveries of Colorado River Basin Water*. Pacific Institute. Executive Summary, Page iii.

[12] Interview with Caryn Mandelbaum, Environment Now, October 2011. In 2009, California's Legislature instituted conservation mandates, requiring all local retail water agencies in the state to reduce per capita consumption rates by 20 percent by the year 2020.

[13] Reisner, Marc. 1986. *Cadillac Desert: The American West and its Disappearing Water*. Viking Press. Historical efforts by the Bureau of Reclamation and U.S. Army Corps of Engineers to open up the formerly dry regions of the country to large-scale agriculture has led to long-term damage of the environment and water quantity, including the drawing down of aquifers throughout the Southwest US.

[14] Data are drawn from Los Angeles Department of Water and Power, Water Operations Division - Water Control Group, "City of Los Angeles Sources of Water Supply" using their 5-year average for 2005-2010:

2005-2010 5-year average	Los Angeles Aqueduct	Local Groundwater	Metropolitan Water District	Recycled Water	Transfer, Spread, Spill, & Storage Change	Total Los Angeles Water Supply
Acre-Feet	220,512	67,435	325,044	5,262	1,770	620,023
Percent	35.6%	10.9%	52.4%	0.8%	0.29%	100%

Notes: All reported volumes are in acre-feet (one acre-foot is approximately 326,000 gallons). LAA, MWD, and local groundwater deliveries were provided by the Water Operations Division. Local groundwater values include pumped water from the San Fernando, Sylmar, and Central Basins. Recycled water data accounts for that amount which displaces potable water supply.

[15] Mike Cohen, Pacific Institute. 2011. *Municipal Deliveries of Colorado River Basin Water*. Pacific Institute. Executive Summary, Page iii.

[16] Interview with Caryn Mandelbaum, Environment Now, October 2011.

[17] The potential for stormwater capture and reuse is one dimension of low impact development (LID), and is an emerging source of water for urban regions:

- The executive director of the Southern California Water Committee (SCWC), Richard W. Atwater, stated in an April 2011 press release that Los Angeles County had captured approximately 230 Thousand Acre-Feet (TAF) of stormwater and that Southern California could capture 500 TAF. Note: 2011 is an exceptionally wet year in California. (SCWC works to educate Southern Californians about the region's water needs and state's water resources.)
- The National Resources Defense Council's report, *A Clear Blue Future*, (previous cited) includes estimates that the Los Angeles Metropolitan region has the potential to capture 275 TAF of stormwater/urban runoff once retrofitted. "In just the urbanized areas of southern California and limited portions of the San

Francisco Bay area, LID could provide 229,000-405,000 acre-feet of water per year by 2030, with a corresponding annual electricity savings of 573,000- 1,225,500 megawatt-hours of and a reduction of 250,500-535,500 metric tons of CO^2 … these figures will increase with continued development and redevelopment after 2030. As much as an additional 75,000 acre-feet of water could be saved annually by 2030 through implementing LID practices at new industrial, government and public use, and transportations development or redevelopment in southern California alone." Source: *Clear Blue Future*, p.20.

- "There is a significant potential for LID practices that emphasize infiltration of stormwater to replenish water supply in this area … Water capture techniques are typically … used to harvest rooftop runoff and can be applied at both large scale in commercial developments and residential subdivision and a at small scale using cisterns of rain barrels. … As the average roof at a residential or commercial development account for 40 to 60 percent of the site's total impervious surface area … vast quantities of water are available for harvesting…" Source: *Clear Blue Future*, p.20.

[18] Recycled water, also referred to as reclaimed water, is former wastewater (sewage) that is treated to remove solids and certain impurities, and used in sustainable landscaping irrigation or to recharge groundwater aquifers. The Metropolitan Water District of Southern California has 326 Thousand Acre-Feet (TAF) of reclaimed sewage water in production and an additional 100 TAF in development within its service area. Note: The MWD service area larger than Los Angeles County: "The Metropolitan Water District of Southern California is a consortium of 26 cities and water districts that provides drinking water to nearly 19 million people in parts of Los Angeles, Orange, San Diego, Riverside, San Bernardino and Ventura counties." Source: Metropolitan Water District of Southern California.

[19] *A Clear Blue Future: How Greening California Cities Can Address Water Resources and Climate Challenges in the 21st Century*. By David S. Beckman, Noah Garrison, NRDC; Robert C. Wilkinson, Ph.D., Donald Bren School of Environmental Science and Management; Richard Horner, Ph.D., University of Washington . August 2009, page 20.

[20] Gregory Freeman, Myasnik Poghosyan AND Matthew Lee. 2008. Where Will We Get the Water? Assessing Southern California's Future Water Strategies. Los Angeles Economic Development Corporation.

[21] David S. Beckman, Noah Garrison, Robert C. Wilkinson, Richard Horner. 2009. A Clear Blue Future: How Greening California Cities Can Address Water Resources and Climate Challenges in the 21st Century. Natural Resources Defense Council., page 14.

[22] Based in Commerce, California, the Central Basin Municipal Water District service area covers parts of 34 cities and unincorporated areas: Division I: Bell Gardens, Downey, Montebello, Norwalk and Vernon. Division II: La Habra Heights, La Mirada, Pico Rivera, Santa Fe Springs, Whittier and unincorporated areas of West Whittier-Los Nietos and South Whittier. Division III: Bell, Commerce, Huntington Park, Maywood, Walnut Park and portions of Cudahy, Monterey Park and unincorporated areas of East Los Angeles. Division IV: Lynwood, South Gate, Florence-Graham, Willowbrook and portions of Cudahy, Compton and Carson. Division V: Artesia, Bellflower, Cerritos, Hawaiian Gardens, Lakewood, Paramount and Signal Hill. Source: Central Basin Metropolitan Water District.

[23] Based in El Monte, California, the Upper San Gabriel Valley Municipal Water District provides "approximately 60,000 acre-feet of imported water is served through these connections each year, with the majority of the water being used for groundwater recharge." Its service area includes the following: Golden State Water Company, City of South Pasadena, Main San Gabriel Basin Watermaster, Suburban Water Systems, City of Alhambra, City of Arcadia, City of Monrovia, City of Azusa, Valley County Water District. Source: Upper San Gabriel Valley Municipal Water District.

[24] Based in Carson, California, the West Basin Municipal Water District 185-square mile service area "serves a population of nearly a million people living within 17 cities in the South Bay and unincorporated areas of Los Angeles County." West Basin's service area includes all or portions of the following: City of Carson, City of Culver City, City of El Segundo, City of Gardena, City of Hawthorne, City of Hermosa Beach, City of Inglewood, City of Lawndale, City of Lomita , City of Malibu, City of Manhattan Beach, City of Palos Verdes Estates, City of Rancho Palos Verdes, City of Redondo Beach, City of Rolling Hills , City of Rolling Hills Estates, City of West Hollywood. Source: West Basin Municipal Water District.

[25] The estimated total population of the City of Los Angeles in 2010 is 3,797,144, with a margin of error +/-74. Source: U.S. Census Bureau, 2010 American Community Survey 1-Year Estimates for Los Angeles city, California. Universe: Total population, variable B01003: Total Population.

[26] City of Los Angeles, Department of Water and Power. 2010. "Analysis of Consumption and Earnings: Water System: 12 Months Ending December 2009." Pages 45-54, 57-66, 69-78, 81-89.

[27] Carnegie Mellon University Green Design Institute. (2008) Economic Input-Output Life Cycle Assessment (EIO-LCA), US 1997 Industry Benchmark model [Internet], Available from:<http://www.eiolca.net> Accessed 20 October, 2010.

[28] California Employment Development Department. Quarterly Census of Employment and Wages, 3rd Quarter 2009.

[29] Power utility establishments in Los Angeles County likely consume less water than the national-level estimates in the Economic Input-Output Life Cycle Assessment (EIO-LCA), since companies such as Southern California Edison use sea water to help cool some of their power generation towers. Thus, the estimated water consumed per job for this industry is likely less than that shown the figure.

[30] The North American Industry Classification System (NAICS) is used by government and business to classify business establishments according to type of economic activity (process of production) in Canada, Mexico and the United States. The NAICS has largely replaced the older Standard Industrial Classification (SIC) system, and is updated every five years after being first released in 1997.

[31] The WaterWorld Buyer's Guide was used to capture the variety of international businesses that participate in the *Second Tier* of water sector, based upon their 6-digit NAICS code. Most, but not all, of the industries these businesses are in are present in Los Angeles' economy. Source: WaterWorld On-Line Magazine. 2011. Buyer's Product Guide. Tulsa, OK. (http://www.waterworld.com/)

[32] Environmental Business Journal. 2010. Water & Wastewater. Vol XXIII No 11: pg. 1-5.

[33] The number of workers employed at establishments located within the City of Los Angeles is 1,459,214 of Los Angeles County's total 3,681,050 total employed workforce, or 39.64 percent. Source: Economic Roundtable analysis; California Employment Development Department. 2011. Quarterly Census of Employment and Wages - September 2009; Los Angeles.

[34] The location quotient is expressed as a ratio of an industry's local percentage of employment divided by the nation's percentage employment in the same industry, where 1.0 shows the local region to be identical to the nation. The formula for computing location quotients is as follows $LQ = (e_i / e) / (E_i / E)$ where:

e_i = Local employment in industry i
e = Total local employment, all industries
E_i = National employment in industry i
E = Total national employment, all industries

The industry and year of the data must be identical in these four variables.

[35] While *Landscaping and Groundskeeping Workers* are not as well represented in Los Angeles County as in the nation as a whole (location quotient = 0.738), it is the water occupation with the highest employment in the county (18,380 jobs). The abundance is partly due to the low mean wages paid to this occupation, as well as the high demand for these services by private households, apartment and commercial property managers.

[36] The Occupational Employment Statistics (OES) program produces employment and wage estimates for over 800 occupations based on a recurring survey of employers. This survey produces estimates of the number of people employed in different occupations, and estimates of the wages paid to them. Self-employed persons are not included in the estimates. These estimates are available for the nation as a whole, for individual States, and for metropolitan and nonmetropolitan areas; national occupational estimates for specific industries are also available. Source: Bureau of Labor Statistics, http://www.bls.gov/oes/

[37] The Occupational Information Network (O*NET) is a database of worker attributes and occupational requirements. The data describe occupations in terms of their required skills and knowledge, how the work is performed, and typical work settings. The latest version of the O*NET is on-line at http://www.onetonline.org

[38] National Ready Mixed Concrete Association. 2011. *Pervious Concrete Pavement: An Overview*. http://www.perviouspavement.org/

[39] As recently as 2007, labor unions claimed 6,600 members working in the construction of commercial buildings in Los Angeles County. Source: Daniel Flaming, Economic Roundtable. 2007. *Economic Footprint of Unions in Los Angeles*. Prepared for the Los Angeles County Federation of Labor, AFL-CIO (LACFL), Table 1.

[40] "Person-years of employment" describes the number of jobs supported for one year by each sector's change in economic activity. The IMPLAN input-output model counts each job, whether full-time or part time, the same.

[41] Where operation and maintenance data are available, it is analyzed separately in this study.

[42] Manufactured goods have a smaller variety of upstream material inputs, resulting in fewer sectors benefitting from indirect impacts.

[43] Recent stormwater projects in Los Angeles with operations and maintenance budgets include: the Broadous Elementary School Project, the Bull Creek Restoration Project, the Marshland Enhancement (Sanitation Districts of Los Angeles County), and the Tujunga Spreading Grounds Upgrade.

[44] Because one of the major recycled water projects (*Groundwater Recharge System (GWRS) Phase 1, Orange Co. Water District*) studied is located in Orange County, "Local" covers both Los Angeles and Orange Counties in this case study.

[45] Reclaimed water is the former term for municipally treated sewage, which is now included under the category of "recycled" water in California. Information drawn from email correspondence with *ReWater* founder and CEO, Steve Bilson, dated October 18, 2011.

[46] Occupation data presented – including average hourly wage, average annual wage, and average entry level wage – are specific to those hired in industries involved in Los Angeles' recycled water projects, as opposed to occupational data on Los Angeles' overall economy.

[47] The methodology used in the operations and maintenance budgets of these projects are blended together in order to provide a richer picture of possible future projects' operations and maintenance budgets. This section's estimates represent the subsequent years of operation and maintenance after the 'first year' of project construction, and are annualized. Portions of project budget described as "initial" operations and maintenance are considered to have

been spent during the 'first year' of projects immediately after construction, and are not included in the analysis of operations and maintenance impacts. Only local economic and job impacts are presented; it is assumed that all operations and maintenance will be performed by local establishments.

[48] The economic and job impacts of recycled water operations and maintenance are calculated using the Los Angeles County input-output model. While the actual projects are located in Orange County, their operations and maintenance budgets are analyzed as a proxy for potential future investments in recycled water facilities in Los Angeles County.

[49] Groundwater fills pore space in between sand, silt, clay and gravel in water-bearing formations known as aquifers. Green, Dorothy. 2007. *Managing Water: Avoiding Crisis in California*. University of California Press.

[50] Occupation data presented – including average hourly wage, average annual wage, and average entry level wage – are specific to those hired in industries involved in Los Angeles' groundwater management / remediation projects, as opposed to occupational data on Los Angeles' overall economy.

[51] Non-local employment effects are excluded from lists of occupations, since it is considered a "leaked" economic effect, not benefitting the local economy.

[52] The State Department of Health Services detected methyl tertiary butyl ether (MTBE) at wells operated by the City of Los Angeles Department of Water and Power (LADWP) in the Tujunga Wellfield (Wells No. 4 and 5) located within the San Fernando Valley Groundwater Basin. MTBE is thought to be a human carcinogen in high doses.

[53] The methodology used in the operations and maintenance budgets of these projects are blended together in order to provide a richer picture of possible future projects' operations and maintenance budgets. This section's estimates represent the subsequent years of operation and maintenance after the 'first year' of project construction, and are annualized. Portions of project budget described as "initial" operations and maintenance are considered to have been spent during the 'first year' of projects immediately after construction, and are not included in the analysis of operations and maintenance impacts. Only local economic and job impacts are presented; it is assumed that all operations and maintenance will be performed by local establishments.

[54] Occupation data presented – including average hourly wage, average annual wage, and average entry level wage – are specific to those hired in industries involved in Los Angeles' water conservation programs and projects, as opposed to occupational data on Los Angeles' overall economy.

[55] The 2011 US Department of Health and Human Services *Poverty Guidelines*, which varies by household size, are as follows:

Persons in Family	48 Contiguous States and D.C.	Alaska	Hawaii
1	$10,890	$13,600	$12,540
2	$14,710	$18,380	$16,930
3	$18,530	$23,160	$21,320
4	**$22,350**	$27,940	$25,710
5	$26,170	$32,720	$30,100
6	$29,990	$37,500	$34,490
7	$33,810	$42,280	$38,880
8	$37,630	$47,060	$43,270
For each additional person, add	$3,820	$4,780	$4,390

Source: Federal Register, Vol. 76, No. 13, January 20, 2011, pp. 3637-3638.

Note: An alternative measure of poverty is the US Census' 2010 poverty thresholds, which sets **$22,113** as the amount below which a two-parent household with two children is considered impoverished. Source: U.S. Census Bureau. *Poverty Thresholds for 2010 by Size of Family and Number of Related Children Under 18 Years*.

[56] Generation Water. 2011. "Water Efficiency. Workforce Development. Green Jobs." http://www.generationwater.org/, Telephone interview with Marcus Castain on April 22, 2011.

[57] Generation Water estimates through its water efficiency audits and irrigation systems surveys of Los Angeles Unified School System (LAUSD) campuses thus far that 41 percent of sprinkler heads are broken. LAUSD campuses thus frequently need follow-on retrofit services to repair and upgrade their aging irrigation systems.

[58] The California Plumbing Code section on graywater offers the following definitions:

> **"Graywater**. Pursuant to Health and Safety Code Section 17922.12, "graywater" means untreated wastewater that has not been contaminated by any toilet discharge, has not been affected by infectious, contaminated, or unhealthy bodily wastes, and does not present a threat from contamination by unhealthful processing, manufacturing, or operating wastes. "Graywater" includes but is not limited to wastewater from bathtubs, showers, bathroom washbasins, clothes washing machines, and laundry tubs, but does not include wastewater from kitchen sinks or dishwashers."

In addition to the sources specified in the definition above, graywater also includes water used in reverse osmosis devices and Jacuzzis, as well as water discharged by air conditioners.
Source: California Building Standards Commission. 2011. *California Plumbing Code 2010.* Sacramento, CA. Chapter 16A "Non-Potable Water Reuse Systems," § 1602A.0 "Definitions." Additional detail on the definition drawn from email correspondence with *ReWater* founder and CEO, Steve Bilson.

[59] "Graywater System. A system designed to collect graywater and transport it out of the structure for distribution in an Irrigation or Disposal Field. A graywater system may include tanks, valves, filters, pumps or other appurtenances along with piping and receiving landscape." Source: California Building Standards Commission. 2011. *California Plumbing Code 2010.* Sacramento, CA. Chapter 16A "Non-Potable Water Reuse Systems," § 1602A.0 "Definitions."

[60] AB 3518, authored by Assemblyman Byron D. Sher of Palo Alto, required the California Department of Water Resources to establish code for graywater systems in single family residences.

[61] Residential dwelling units in Los Angeles use ABS piping (Acrylonitrile-Butadiene-Styrene piping, made from thermoplastic resin) and commercial systems use cast iron piping for graywater.

[62] Information drawn from email correspondence with *ReWater* founder and CEO, Steve Bilson, dated April 15, 2011.

[63] In the 1990s, installing a residential graywater system was a newly emerging trade in California, not carried out by local plumbing contractors, but instead by specialized companies pioneering this form of distributed water use efficiency investment. As graywater systems were subsequently entered into the state plumbing code and became a serious option for new home developments and renovations of existing homes, mainstream plumbing contractors and their trade associations have created graywater training courses. Graywater systems companies such as ReWater now design systems for sale, with the installation work carried out by traditional plumbing contractors.

[64] According to Steve Bilson, founder and CEO of *ReWater*, traditionally trained plumbers usually understand graywater systems the first time they encounter one. Training for installing and servicing graywater systems are increasingly being offered by traditional plumbing trades unions, such as through the International Association of Plumbing and Mechanical Officials' "Green Plumbers Training program."

[65] The number of homes in this model is drawn from the average of 1,807 new housing permits issued in the City of Los Angeles 1997-2009, and assuming that the City of Los Angeles is the site for one third of the new housing built in Los Angeles County. Source: Economic Roundtable; City of Los Angeles Department of Building and Safety permit data 1997-2009; Los Angeles County Assessor's Office, 2009 Secured Basic File Abstract (DS04).

[66] Estimated cost data for installing graywater systems is provided by Stephen Wm. Bilson, who founded the Thousand Oaks, CA-based company ReWater in 1990. ReWater provides "graywater irrigation systems that meet the long-term needs of homeowners, property managers, and others interested is reusing graywater." (ReWater.com). A recent Los Angeles-area housing project, *Casa Dominguez*, also serves as a reference point for this. This is one of the first multi-family, affordable housing properties built with a graywater irrigation system in it to recycle laundry water for use in landscape irrigation. Casa Dominguez was built by Abode Communities: http://abodecommunities.org/site/development/casa-dominguez-dev/. For more information on this project, see: O'Young, Mignon. 2010. *A Success Story: Healthy Homes, Neighborhood Revitalization, and L.A. County's First Graywater Irrigation System*. Green Architecture and Building Report, March edition: http://www.gabreport.com/2010/03.

[67] Installing graywater systems in one-of-a-kind new homes, or in existing homes, costs more per housing unit. Our model of installing these systems in standardized new homes makes our estimates of economic and job impacts conservative.

[68] The number of new housing units in 2008 is used as an "average" year, but we included information on economic impacts per $1 million spent later in this section.

[69] A definition for this industry sector, Plumbing, Heating, and Air-Conditioning Contractors (NAICS 238220), can be found in Appendix A.

[70] In the IMPLAN Input Output model, the work is categorized as *Construction of New Residential Permanent Site Single- and Multi-Family Structures* (Sector 37).

[71] This assumption is made to demonstrate the potential local impacts if enough local graywater companies could start-up and grow to the point of installing all of the graywater systems needed for each new housing unit built in the county. In reality, the companies doing the work would likely be a mix of those located in Los Angeles County as well as in neighboring counties, since construction companies operate over a wide market area.

[72] This assumption is fairly realistic: because installations of graywater systems in residential properties are small jobs, the cost competitive companies to carry out the work are found within the Los Angeles region.

[73] Information drawn from email correspondence with *ReWater* founder and CEO, Steve Bilson, dated October 18, 2011.

[74] Noah Garrison and David Beckman. 2009. Water Facts Series: Water Saving Solutions: Stopping Pollution at its Source with Low Impact Development. Natural Resources Defense Council.

[75] Daniel Flaming, Michael Matsunaga and Patrick Burns. 2010. Ebbing Tides in the Golden State: Impacts of the 2008 Recession on California and Los Angeles County. Economic Roundtable, June 2009, pages 9-16.