STORMWATER CAPTURE

ENHANCING RECHARGE & DIRECT USE THROUGH DATA COLLECTION

SOUTHERN CALIFORNIA WATER COALITION
2018 WHITEPAPER UPDATE

SCWC Stormwater Task Force
April 2018

Table of Contents

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Executive Summary

The purpose of this 2018 whitepaper update is to gain a better understanding of actual stormwater runoff capture volumes, costs, benefits, and project performance across the region to inform future discussions. This whitepaper augments prior efforts and uses the most recent and best available stormwater project data.

Since SCWC's 2012 whitepaper, many of proposed projects were constructed and are now in operation. SCWC saw an opportunity to evaluate the costs and benefits of these constructed stormwater capture projects and pursued a whitepaper update.

In the spring of 2016, the Task Force embarked upon an ambitious data gathering project to get actual monitoring data – manually and/or automatically measured – for stormwater projects in Southern California.

The Task Force developed a detailed data collection form to acquire actual stormwater and urban water runoff capture volumes, costs, benefits, and performance of existing stormwater projects. The form was distributed to 30 agencies across Southern California.

Each project was reviewed and assessed for completeness using the following criteria:

- Actual stormwater flow monitoring data
- At least one full year of stormwater capture volumes
- Actual construction costs to complete the project

The main objective in the data analysis was to calculate the cost per acre-foot of captured stormwater. For each project, the annual cost per acre-foot of stormwater captured was calculated and compared with its average stormwater captured.

- Costs of the projects range from $59 per acre-foot to more than $250,000 per acre-foot. The median cost per acre-foot is $1,070 and is bracketed by the 25th and 75th percentiles costs range from $334 to $4,911.

- Projects that have the ability to annually capture larger amounts of stormwater (over 600 acre-feet) have a lower cost per acre-foot captured (less than $1,200).

- Median costs for distributed projects are $25,000 per acre-foot, new centralized projects are $6,900 per acre-foot, and retrofit projects are $600 per acre-foot.

- Retrofit Projects tend to be more cost effective than new projects. Since retrofit projects by their nature exclude costs such as land acquisition and have a simpler permitting process, they are generally less expensive than new projects.

Of the 54 projects, 32 projects (from 6 different agencies) had complete data and were analyzed. The majority of the projects with complete data were retrofit/rehabilitation centralized projects and had water supply as the primary project benefit.

- The average stormwater captured for all 32 projects during the 11-year period was 13,400 AFY.

- As more projects come online, there has been an increasing ability to capture more stormwater per inch of rainfall.

- There was a noticeable reduction in stormwater capture ability in 2016 and this is most likely attributed to a wet year following a period of drought where most rainfall is absorbed in the mountains and not converted to runoff for capture.

In summary, an average of 13,400 AFY of stormwater was captured from 2006 through 2016, with a total capital cost of $132 million from the 32 projects, and cost per acre-foot of stormwater captured ranging from $59 per acre-foot to more than $250,000 per acre-foot.

Stormwater capture is one of the many water supply opportunities for agencies and municipalities to pursue as they strive for a more sustainable and reliable water future. Cost and climate uncertainties may continue to be a barrier, and Southern California as a region should continue to invest in a broad range of water supply alternatives including, investments in imported supply reliability, recycled water, desalination, groundwater cleanup, and stormwater capture.

Introduction

A secure future for Southern California's water resources greatly depends on a diverse water supply portfolio in combination with smart and efficient management of this water. Groundwater sustainability – the long-term balance of production and recharge – is an integral part of ensuring continuing reliability within the region. The replenishment of the groundwater basins is important to meeting that goal (MWD, 2016). A key component of Southern California's sustainable water supply portfolio is stormwater.

Many Southern California agencies are focusing on local water supplies, such as stormwater, due to the impacts of climate change, drought, regulatory issues, and other water supply challenges. A paradigm shift from simply conveying stormflows off-site for flood control towards increasing stormwater capture and infiltration can serve multiple purposes. Many local agencies in Southern California have already implemented regional and distributed (also known as neighborhood-scale) stormwater projects to increase local water supply, improve water quality, and address flood risks. These projects have created an opportunity to evaluate actual data for stormwater projects. Unfortunately, the project data compiled in this paper were primarily projects in the Chino Groundwater Basin with some projects in LA County and none in Ventura, Orange, Riverside and San Diego Counties. The analysis of these data and its implications are the subject of this whitepaper.

SCWC and Stormwater Task Force Background

The Southern California Water Coalition (SCWC) spans Los Angeles, Orange, San Diego, San Bernardino, Riverside, Ventura, Kern, and Imperial counties, and is comprised of approximately 200 member organizations including leaders from business, regional and local government, agricultural groups, labor unions, environmental organizations, water agencies, as well as the general public. Key technical support is provided by flood control district staff, city engineers, urban planners and redevelopment staff, water resource planners, real estate development professionals, hydrogeologists, and experts from consulting firms.

In January 2011, the SCWC formed the Stormwater Task Force (Task Force), to develop regional consensus-based strategies and recommendations for utilizing stormwater effectively as an emerging new local water supply and to reduce water pollution from urban runoff within the region. This includes identifying potential issues, constraints and opportunities related to the management of stormwater and providing a forum for discussion and evaluation of challenges for individual watersheds within the coastal plain of Southern California.

Key focus areas are:

- Enhancing local water resiliency and adapting to climate change through stormwater capture
- Promoting stormwater capture, flood risk mitigation, and groundwater conjunctive use
- Advancing regional integrated water resources management strategies and plans
- Developing synergies in new local supplies including groundwater, recycled water, and stormwater within the coastal plain of Southern California
- Improving stormwater management as related to water quality and protection of beneficial uses of receiving waters

- Assessing the relationship between regulatory compliance and need for stormwater management and groundwater recharge
- Evaluating low impact design standards and development incentives

Purpose of Whitepaper

The purpose of this 2018 whitepaper update is to gain a better understanding of actual stormwater runoff capture volumes, costs, benefits, and project performance across the region to inform future discussions. This whitepaper augments prior efforts and uses the most recent and best available stormwater project data.

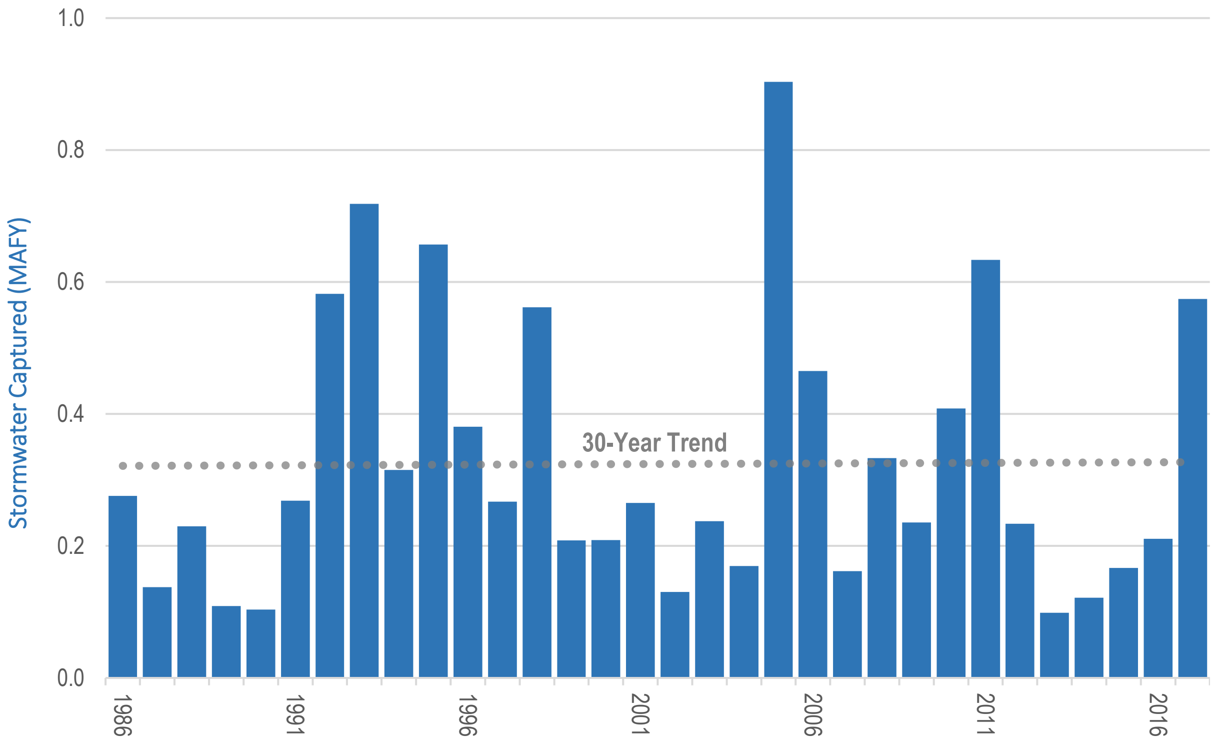
Previously in January 2012, the SCWC published its first whitepaper on stormwater titled *Stormwater Capture: Opportunities to Increase Water Supplies in Southern California* (SCWC 2012). The purpose of the 2012 whitepaper was to examine existing statewide policies, goals, and regional plans related to integrated stormwater management; trends, structure, and requirements of MS4 permits as they pertain to both opportunities and constraints to maximizing stormwater capture for water supply purposes; and the advantages and disadvantages of two strategies of stormwater management: onsite low impact development and regional stormwater capture and infiltration. Lastly, the 2012 whitepaper largely focused on conceptual stormwater projects and technical strategies for increasing stormwater capture.

Since the 2012 whitepaper, many of the proposed projects were constructed and in operation. Other plans such as Metropolitan's 2015 Integrated Resources Plan (MWD 2016), the City of Los Angeles's Stormwater Capture Master Plan (LADWP 2015), and Los Angeles County Flood Control District's LA Basin Study (LACFCD 2016) also estimated stormwater capture and costs. The SCWC saw an opportunity to evaluate the costs and benefits of these constructed stormwater capture projects and pursued a whitepaper update.

Stormwater Capture Overview

For over a century, the LACFCD and other agencies, including Orange County Water District, San Bernardino County Flood Control District and Chino Basin Water Conservation District, have been capturing stormwater for recharge in large centralized spreading grounds adjacent to flood control channels. Over the last 30 years, an average of approximately 324,000 AFY of stormwater (excluding Santa Ana River baseflow) has been captured and recharged in the Metropolitan service area. While this value varies from year to year, during the exceptionally wet winter of 2004-05 over 900,000 acre-feet of runoff was captured and infiltrated into the local groundwater basins. Figure 1 displays the amount of stormwater captured over the last 30 years and the trendline, which despite of the two recent severe droughts, is increasing.

Figure 1: *Historical Stormwater Capture in Metropolitan Service Area*



The existing stormwater capture system can recharge large amounts of water above its long-term average when rainfall is bountiful. This emphasizes the important role that centralized infrastructure plays in water resiliency as well as helping the region adapt to climate change, such as more intense storms, by capturing significant stormwater volumes during peak storm events.

There are three main types of stormwater capture projects within the region: 1) large, centrally located infrastructure projects; 2) smaller, distributed projects (or neighborhood projects) for groundwater recharge; or 3) distributed projects that make use of captured stormwater directly on the site.

Table 1: *Stormwater Capture Project Definitions*

Centralized for Recharge	Projects which capture rainfall and stormwater runoff from natural and engineered drainage systems and stored in centralized facilities such as spreading basins and recharge basins for the managed replenishment of local groundwater basins.
Distributed for Recharge	Projects which retain rainfall and stormwater runoff on site (at end user locations) to infiltrate into and replenish local groundwater basins. Examples of distributed recharge projects include green streets, park retrofits, permeable pavement and bio-swales.
Distributed for Direct Use	Projects which capture and store rainfall and stormwater runoff on site (at end user locations) which is then used to meet non-potable demands. Examples include stormwater capture using rain grading, tanks and cisterns, permeable pavement, and parkway basins. In some instances, stormwater capture for direct use may be used to meet potable demands as well.

Definitions adapted from LA Basin Study (Los Angeles County Flood Control District & Bureau of Reclamation 2014)

Historically, Southern California has primarily utilized centralized stormwater projects to capture and recharge large volumes of water every year. However, as water becomes increasingly more valuable along with urbanization developing much of the remaining open space, agencies are looking towards decentralized projects at parks and schools as new locations to help capture and recharge or reuse stormwater. When these stormwater projects – both large and small, for recharge and direct use – are combined into a comprehensive strategy, the region will be able to maximize its capture for water supply (LADWP 2015).

Evaluating the Data

Complete sets of high quality data can often reveal new insights for organizations and agencies to enhance customer service, improve their operations, and make more intelligent decisions. Within water resources management, good data can help to:

- Develop business cases
- Attract multiple project partners
- Drive meaningful and effective regulations

In the spring of 2016, the Task Force embarked upon an ambitious data gathering project to get actual monitoring data – manually and/or automatically measured – for stormwater projects in Southern California. The following section outlines the process for the data collection effort, the results, and the conclusions.

Data Collection

The Task Force developed a detailed data collection form to acquire actual stormwater and urban water runoff capture volumes, costs, benefits, and performance of existing stormwater projects. The form was distributed to 30 agencies across Southern California.

Data for a total of 54 projects was received. Each project was reviewed and assessed for completeness using the following criteria:

- Actual stormwater flow monitoring data
- At least one full year of stormwater capture volumes
- Actual construction costs to complete the project

Of the 54 projects, 32 projects (from 6 different agencies) had complete data and were analyzed. Table 2 shows the type of projects that were received and further analyzed. Additional information on the projects analyzed is provided in Appendix A. The majority of the projects with complete data were retrofit/rehabilitation centralized projects and had water supply as the primary project benefit. Figure 2 shows the location of the projects that were carried forward for the analysis.

Figure 2: *Existing Stormwater Projects by Type and Average Stormwater Captured*

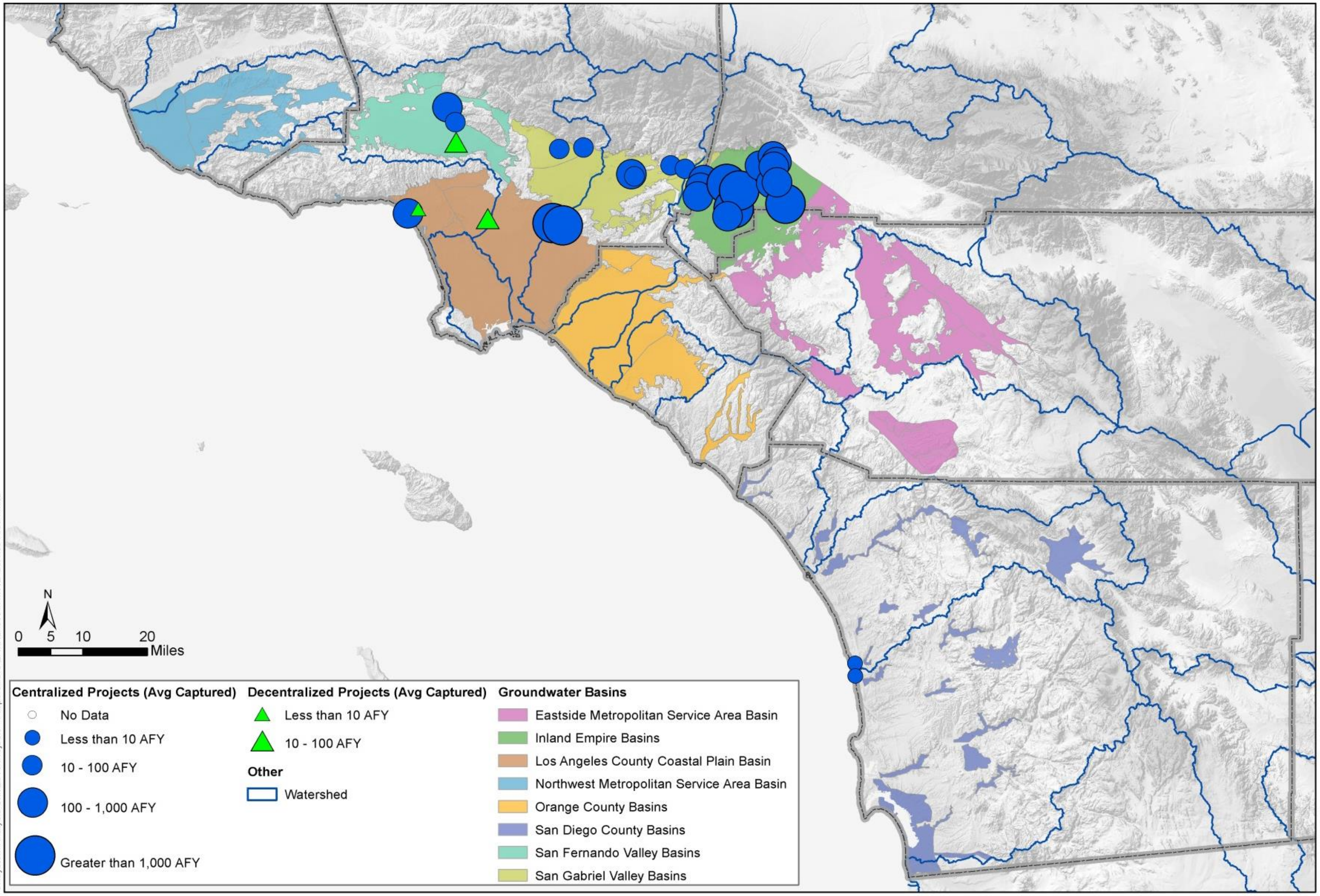


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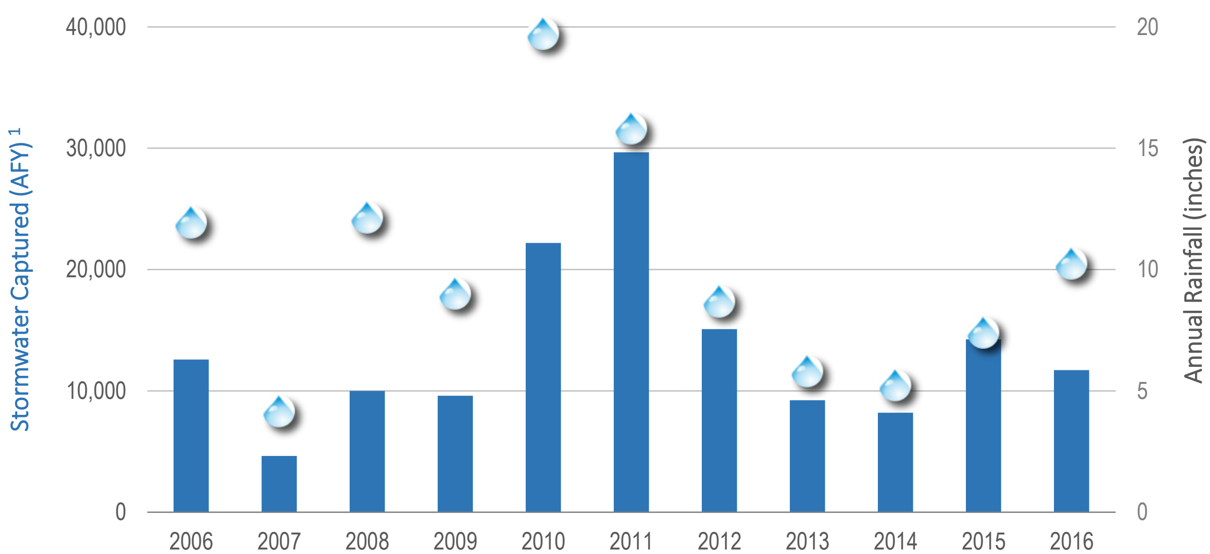
__Table 2:__ Types of Stormwater Projects Analyzed (32 total)

Type of Project	No. of Projects
Centralized	
New	4
Retrofit/Rehabilitation	25
Distributed	
New	3

Primary Project Benefit	No. of Projects
Water Supply	27
Flood Risk Mitigation	2
Water Quality	3

Based on the data received, Figure 3 shows the amount of stormwater captured per year versus annual rainfall. Over this period, stormwater capture and rainfall averaged 13,400 AFY and 10.0 inches, respectively. Generally, stormwater capture volumes are directly related to annual rainfall. Minimum stormwater capture occurred during 2007 which had the lowest annual rainfall, while maximum capture was in 2011 which was slightly wetter than average. Although 2010 was the wettest year with nearly 20 inches of rain, stormwater capture was ranked second. It is speculated that the dry years leading up to 2010 reduced stormwater capture due to the upstream watersheds being parched, absorbing more rainfall than normal, and preventing runoff from making it to stormwater projects.

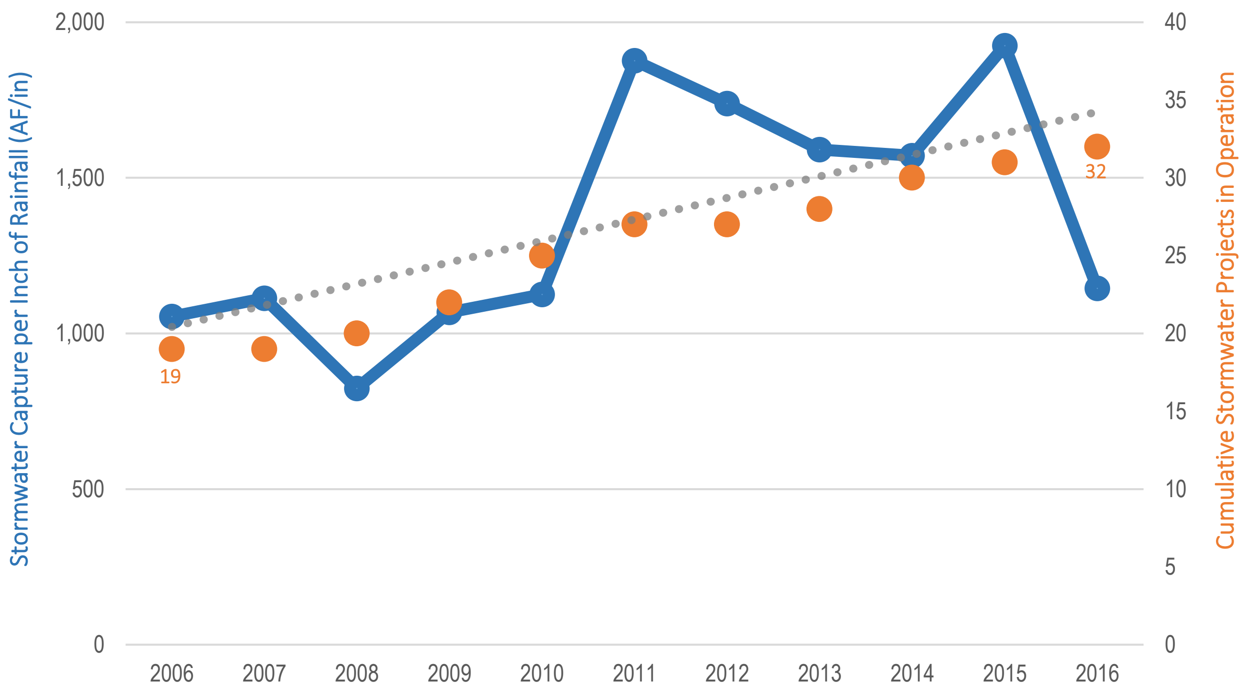
***Figure 3:** Actual Stormwater Captured and Rainfall by Year*



[1]Total annual stormwater captured by the 32 projects.

As more projects come online, there has been an increasing ability to capture more stormwater per inch of rainfall as shown by the positive trend in Figure 4. For this analysis, there were 19 stormwater projects operational in 2006 with a project coming online approximately once a year. By 2016, there were 13 additional projects for a total of 32, and which helped to increase the capture ability by nearly 700 acre-feet per inch of rain over this 11-year period. There was a noticeable reduction in stormwater capture ability in 2016 and this is most likely attributed to a wet year following a period of drought where most rainfall is absorbed in the mountains and not converted to runoff for capture. Overall, as more stormwater capture projects are constructed, it is encouraging to observe average stormwater capture volumes and the capture ability trendline increasing independently from cycles of wet and dry years.

Figure 4: *Increasing Stormwater Capture Ability per Inch of Rainfall for Projects Evaluated*



The average stormwater captured for all 32 projects during the 11-year period was 13,400 AFY. During this period average rainfall was 10.0 inches, which is below the long-term average of 15.2 inches. The key data evaluated is summarized in Table 3.

Table 3: *Summary of Data Collected*

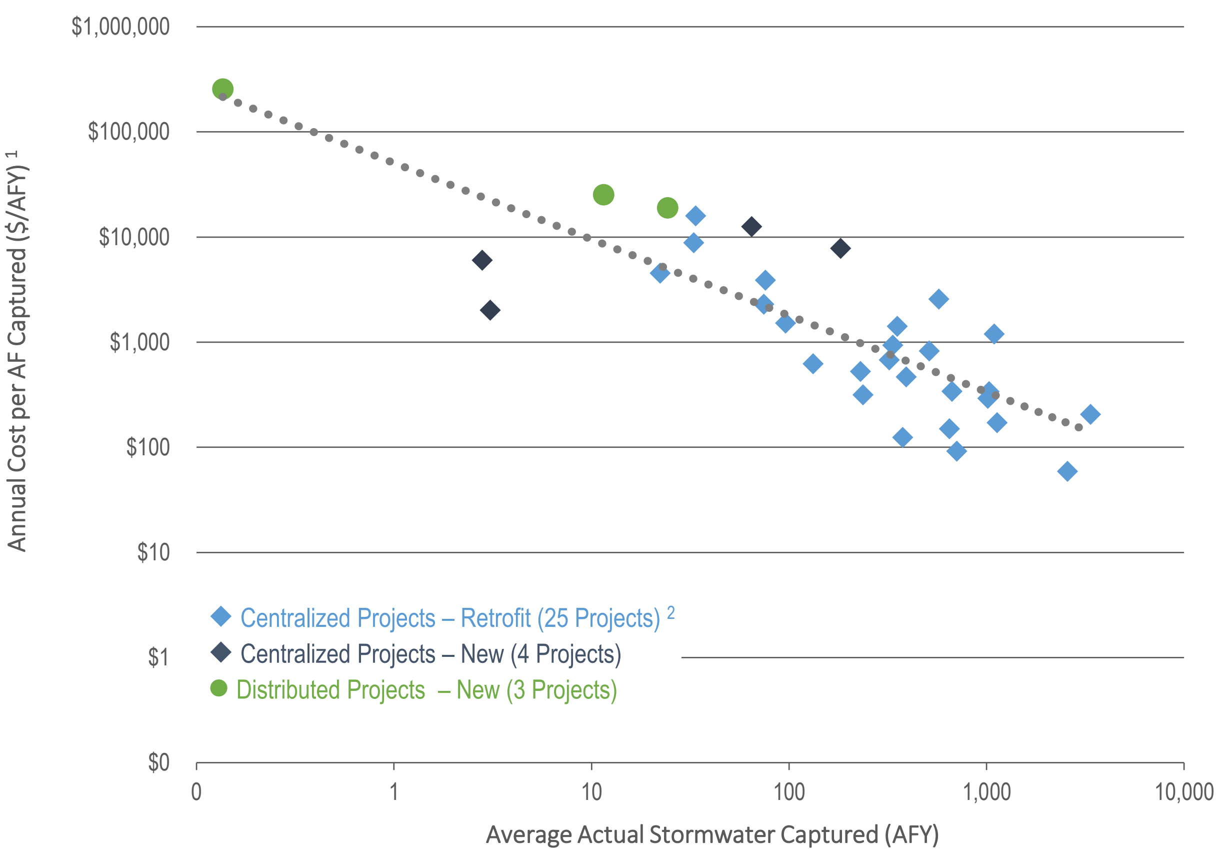
Period of Analysis	Number of Projects Analyzed	Average Stormwater Capture from Projects	Average Rainfall During Period of Analysis	Total Construction Cost
2006-2016	32	13,400 AFY	10.0 inches	$132 million

Data Analysis

The 32 projects were analyzed based on average stormwater capture for all operational years and project costs, including capital cost and annual operations and maintenance (O&M) costs. Capital costs were escalated to July 2017 dollars and amortized at 5 percent over 30 years. If a project did not have annual O&M data available, O&M was assumed to be three percent of the capital cost of the project to align with the 2015 IRP Update. Total capital cost for the 32 projects was $132 million in 2017 dollars.

The main objective in the data analysis was to calculate the cost per acre-foot of captured stormwater. For each project, the annual cost per acre-foot of stormwater captured was calculated and compared with its average stormwater captured. Figure 5 shows the average stormwater capture versus the annual cost per acre-foot captured on a log-log scale. As shown in the figure, projects that have the ability to annually capture larger amounts of stormwater (over 600 acre-feet) have a lower cost per acre-foot captured (less than $1,200). Distributed projects tend to have higher annual costs per acre-foot captured since they involve more infrastructure to capture smaller amounts of stormwater. It is also important to note that retrofit projects were less expensive than new projects. However, it is difficult to parse out the incremental stormwater benefit of the improvements from the original yield. Modeling the pre- and post-project design conditions using recorded rainfall would be able to show these incremental benefits, however, this would require a significant effort and was beyond the scope of this whitepaper.

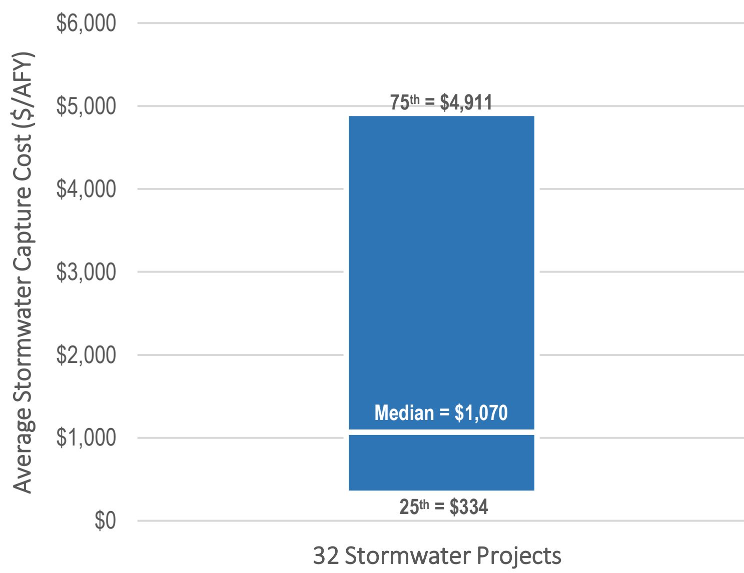
Figure 5: *Unit Cost by Amount of Stormwater Captured*



[1]Capital costs amortized over 30 years
[2]Includes capture by the entire spreading grounds (does not isolate the marginal capture of the retrofit)

The range of stormwater capture costs for the 32 projects analyzed are shown in Figure 6. Costs of the projects range from $59 per acre-foot to more than $250,000 per acre-foot. The median cost per acre-foot is $1,070 and is bracketed by the 25th and 75th percentiles costs range from $334 to $4,911, respectively. It is important to note that most of the projects (25 of the 32) in the database were from centralized retrofit projects. These projects tend to cost less than the new projects (as shown in Figure 5) so the median cost may not be a representative cost for future stormwater projects. Median costs for distributed projects are $25,000 per acre-foot, new centralized projects are $6,900 per acre-foot, and retrofit projects are $600 per acre-foot.

***Figure 6:** Range of Stormwater Capture Costs for 32 Projects (25th, Median, and 75th Percentiles)*



Challenges

Many challenges were encountered when trying to collect stormwater project data. The first challenge was actually collecting the project data. Most of the data is stored internally within organizations and required information requests to access it. Secondly, the small quantity of data collected made it difficult to fully characterize stormwater project capture volumes and costs. Looking ahead, although stormwater project data sets are small currently, this is an emerging field and the availability of data is expected to keep increasing.

Once collected, some of the most common issues encountered with the data itself were:

- Obtaining actual flow data
    - Most projects do not have flow monitoring in place because monitoring devices are expensive and/or there isn't sufficient funding to support staff to collect metering data
    - Some projects with flow meters had technical difficulties and only partial data were available

- Estimating additional stormwater capture at retrofit/rehabilitation projects is burdensome
    - Since retrofit projects enhance existing facilities, it is challenging to parse out any additional stormwater capture during less than average storm seasons

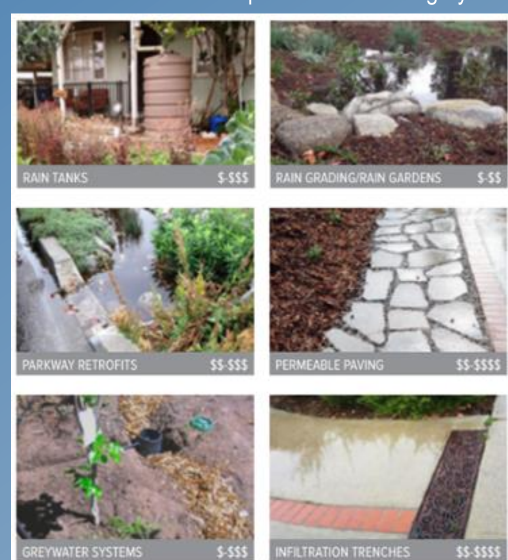
- Obtaining project costs may be difficult
    - Extracting only the costs associated with the stormwater capture when part of a larger multi-benefit project is unclear depending on cost tracking
    - Some projects were constructed many years ago and the historical records are tough to obtain
    - Records that were spread across the multiple agencies and/or departments involved made data retrieval difficult
    - Identifying and disaggregating various costs such as planning, design, construction, and ongoing O&M is difficult depending on cost tracking methods or systems

- Standardizing project records is problematic
    - Data is often maintained in differing formats by the various agencies
    - Staff within the same organization may store data differently

UP & COMING STRATEGIES | WaterLA Case Study

The WaterLA program was developed to explore how residents of Los Angeles could play a role in helping to manage the region's stormwater. With the goal of maximizing runoff capture, water conservation, and reuse on individual properties, this pilot offered a model for how to design sustainable home landscapes that could, in aggregate, create a more climate-resilient Los Angeles.

WaterLA installed a combination of stormwater BMPs at 22 locations in the San Fernando Valley at an average cost of $5,200 per household. The findings are promising – a total of 1.2 million gallons of stormwater can be captured in an average year along with a 25% reduction in residential water use.



WaterLA is an example of a distributed stormwater capture program. This pilot was considered for the 2017 Whitepaper analysis since it had well documented construction costs, however, the stormwater capture volumes were modeled and not monitored. This highlights a key need for future distributed projects – some solution needs to be achieved that balances the ease of modeling stormwater capture volumes versus the more accurate yet logistically daunting task of monitoring numerous locations. As more and more distributed projects are implemented, understanding how much stormwater is being captured and subsequently recharged into the groundwater basins will be important to track.

Water LA
capture · conserve · reuse

For additional information on WaterLA, please visit the Water LA website at: https://www.WaterLA.org or access the Water LA Report at:

https://www.theriverproject.org/water-la-2018-report

Key Insights and Findings

From the 32 projects analyzed, an average of 13,400 AFY of stormwater was captured with a total capital cost of $132 million during the 11-year analysis period. Costs of the projects range from $59 per acre-foot to more than $250,000 per acre-foot with most of the projects being less expensive retrofit projects. Median costs for distributed projects are $25,000 per acre-foot, new centralized projects are $6,900 per acre-foot, and retrofit projects are $600 per acre-foot. Key insights and findings of this analysis include:

Retrofit Projects tend to be more cost effective than new projects. Since retrofit projects by their nature exclude costs such as land acquisition and have a simpler permitting process, they are generally less expensive than new projects.

Distributed Projects are usually designed for multiple benefits, with one of them being water supply. Within this study, distributed projects provided smaller capture volumes, yet demonstrated the potential to meaningfully contribute to regional water supply if implemented on a broad scale. Additionally, because of their multiple benefits (e.g., water quality improvement, recreation, open space, and habitat restoration), there are ample partnership opportunities with other agencies.

Good Monitoring is essential. Many projects do not include monitoring in the budget. These findings suggest that actual yield can be significantly less than the modeled or estimated yield of the project, especially during droughts or other periods of low stormwater runoff.

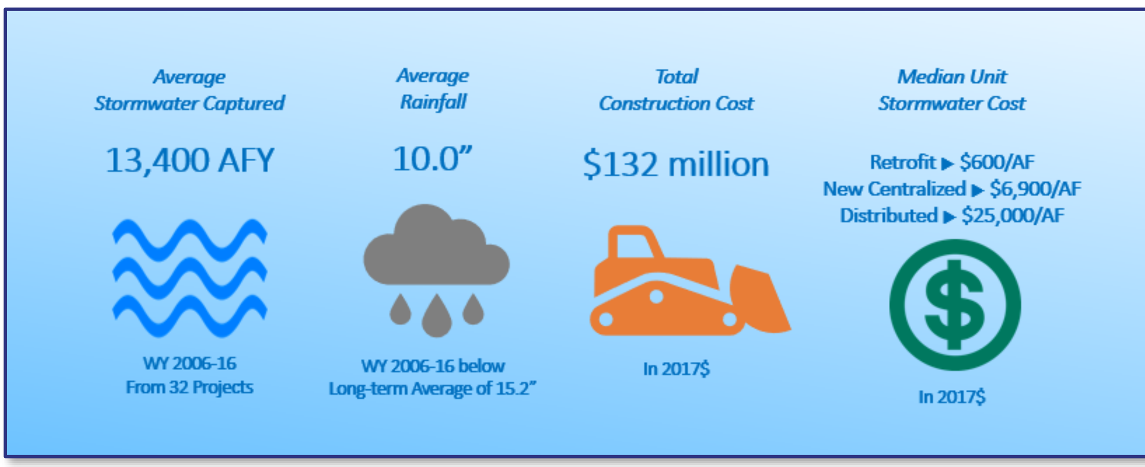
Summary and Recommendations

Summary

The LACFCD and other agencies have been capturing stormwater for groundwater recharge for over a hundred years. With ongoing issues of climate change, new regulations, and water resiliency, stormwater has an increasingly essential role to play. The focus of this 2018 whitepaper was to collect and evaluate actual stormwater project performance data and identify challenges encountered. Based on the 54 projects received, 32 projects had the actual monitoring data for at least a year and actual construction costs. Obtaining actual monitoring data and actual costs is a challenge, especially for distributed projects.

In summary, an average of 13,400 AFY of stormwater was captured from 2006 through 2016, with a total capital cost of $132 million from the 32 projects, and cost per acre-foot of stormwater captured ranging from $59 per acre-foot to more than $250,000 per acre-foot (Figure 7). Key findings of the whitepaper are that retrofit projects can be a smart way for agencies to start capturing stormwater at a reasonable cost, distributed projects create opportunities for agencies and the public to collaborate, and good monitoring data is critical to the success of projects.

Figure 7: *Summary of Data Set Used in Analysis*



Recommendations and Next Steps

Some recommendations for the future studies and actions include:

- **Study the relationship between stormwater capture and water supply yield.**

  An important subject to understand is how stormwater capture relates to increased groundwater production or yield. Optimum locations for stormwater capture include areas with high permeability and infiltration rates in unconfined aquifers. This is typically found closer to the foothill regions and alongside natural or historic waterways where there are coarse grain materials such as sand and gravel. In addition, many groundwater basins are adjudicated and have a fixed pumping rate. It will be important to work with the basin managers to evaluate how stormwater capture can lead to increased production.

- **Explore opportunities for multiple agencies to partner on stormwater projects.**

There is a growing trend, both at the state and local levels, to prioritize grant funding for projects that can demonstrate multiple benefits. For example, living streets combine LID elements including sustainably landscaped green streets, heat radiant cool streets, and bike and pedestrian-friendly complete streets. Although, regional or sub-regional storage facilities such as recharge basins and spreading grounds will continue to play a predominant role in terms of storage and infiltration for water supply augmentation, neighborhood and distributed stormwater capture projects can facilitate infiltration and water supply augmentation while enhancing flood hazard mitigation, augmenting habitat, and benefitting local communities, thereby creating opportunities for multiple stakeholders and partners to come to the table.

- **Continue regional collaboration on stormwater data and monitoring.**

  Continuing the efforts of the SCWC Stormwater Task Force on data collection and monitoring is key for stormwater development in the region. There are many other stormwater data collection efforts underway which are being led by organizations such as the Southern California Stormwater Monitoring Coalition (Standardized Monitoring and CLEAN Project), LACFCD (Watershed Reporting Adaptive Management Planning System), and Army Corps Silver Jackets (Green Infrastructure Interagency Project). It will be important for the region to collaborate and exchange stormwater data between all of these efforts, and potentially consolidate the information into a single database.

Additional Information

To access SCWC's Stormwater Project Database, please visit the website at:

http://www.socalwater.org/stormwater/

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Project No.	Leading Organization	Project Name	Stormwater Project Type	Type of Project	Project Benefits (Primary = Ⓟ, Secondary = ✓)					Average Stormwater Capture (AFY)	Construction Completion Year	Total Cost (2017 $)	"Analysis" Annual O&M Cost (2017 $)	Description
					Water Supply Augmentation	Water Quality Improvement	Open Space Recreation	Habitat Restoration	Flood Risk Mitigation					
1	LACFCD	Citrus SG Modification Project	Centralized	Retrofit/ Rehabilitation	Ⓟ					132	2006	$867,363	$26,000	Connect Basins 2 and 3, raise western levee of Basin 2, construct outlet from Basin 3 to Big Dalton Wash
2	LACFCD	Eaton Spreading Grounds Improvements	Centralized	Retrofit/ Rehabilitation	Ⓟ					34	2011	$5,637,482	$169,000	The proposed improvements include: 1) Upgrading the intake capacity to 125 cfs. The vehicle access slab will be replaced with a removable metal grate. 2) Combine Basin 1 and 2 by removing the levee and expansion of basins further south. 3) Replace the intake pipe to the shallow basins to eliminate the seepage problem and increase storage capacity to 575 AF along the basin expansion. 4) Excavation of approximately 115,145 cubic yards of soil and inert material to enlarge Basin 1, construction of a reinforced concrete retaining wall and rubber dam gate in the channel to divert water to the spreading grounds, and the performance of other appurtenant work.
3	LACFCD	Hansen SG Basin Improvements	Centralized	Retrofit/ Rehabilitation	Ⓟ					573	2010	$15,481,960	$464,000	Hansen Spreading Grounds is located adjacent to the Tujunga Wash Channel downstream form the Hansen Dam. This site is owned and operated by the Los Angeles County Flood Control District (LACFCD). The LACFCD and the City of Los Angeles Department of Water Power elected to modernize the facility to increase intake and storage capacity thereby improving groundwater recharge, water quality, flood protection while providing opportunities in the future for passive recreation and native habitat improvements.
4	LACFCD	Live Oak SG Improvements	Centralized	Retrofit/ Rehabilitation	Ⓟ					33	2015	$3,067,523	$92,000	The Live Oak Spreading Grounds Improvement Project consisted of installation of a rubber dam, electric motor operated gates, diversion/bypass pipeline, and water line extension. The improvements optimize groundwater recharge at the facility by increasing the intake capacity and utilizing the existing debris inlet as a storage basin. Rubber dam is 8-foot high by 35-foot long.
5	LACFCD	Rio Hondo Cleanout Basin 1	Centralized	Retrofit/ Rehabilitation	Ⓟ					2,569	2009	$1,605,742	$48,000	The subject project proposes the excavation of approximately 130,000 cubic yards at the Rio Hondo Coastal Spreading Grounds Basin 1E. The sediment will be removed from the facility by trucking. The excavated sediment will be hauled to the Manning Pit Sediment Placement Site located in the City of Irwindale. This cleanout will promote the effective operation of the Spreading Grounds and help increase the percolation rate of the basin, which has decreased over time due to sediment accumulation from the Rio Hondo Channel.
6	LACFCD	San Dimas Spreading Grounds/Puddingstone Diversion	Centralized	Retrofit/ Rehabilitation	Ⓟ					75	2008	$1,801,413	$54,000	The project will restore water conservation efforts of 1,900 acre-feet per year and prevent potential erosion of channel behind residential properties below the spillway.
7	LACFCD	San Dimas Wash, Ben Lomond Spreading Ground, Interconnecting Drain to Citrus	Centralized	Retrofit/ Rehabilitation	Ⓟ					96	2010	$1,537,515	$46,000	Construction of a 3,700 feet long 48-inch reinforced concrete pipe (RCP) pipeline to allow water from San Dimas Wash to be diverted from Ben Lomond Spreading Grounds to Citrus Spreading Grounds. Construction of a 4-foot by 4-foot gated inlet structure with a motor operator in Basin 1 of Ben Lomond Spreading Grounds. Flowmeter installed in the RCP prior to entering Citrus Spreading Grounds. Installation of an outlet structure and sloped protection barrier in Basin 1 of Citrus Spreading Grounds.

Project No.	Leading Organization	Project Name	Stormwater Project Type	Type of Project	Project Benefits (Primary = Ⓟ, Secondary = ✓)					Average Stormwater Capture (AFY)	Construction Completion Year	Total Cost (2017 $)	"Analysis" Annual O&M Cost (2017 $)	Description
					Water Supply Augmentation	Water Quality Improvement	Open Space Recreation	Habitat Restoration	Flood Risk Mitigation					
8	LACFCD	San Gabriel Coastal Basin Spreading Grounds Pump station and Pipeline Project	Centralized	Retrofit/ Rehabilitation	Ⓟ					3,356	2011	$7,275,735	$218,000	Construction of a pipeline between RHCBSG and SGCBSG to allow 150 cfs to either gravity flow from RHCBSG to SGCBSG or flow in the opposite direction using a four pump system. The project consisted of approximately 6,000 linear feet of 78-inch rubber gasketed reinforced concrete pipe, reinforced concrete transition box conduit, a concrete outlet structure at RHCBSG Basin 2 and SGCBSG Basin 2, and four variable speed pumps which draw water from a sump constructed in the canal at SGCBSG. The entire system is linked together with a telemetry system ensuring the proper operation of the gates when the pump is active.
9	LACFCD	Santa Anita Spreading Grounds Improvements	Centralized	Retrofit/ Rehabilitation	Ⓟ					22	2009	$1,062,999	$32,000	This project involves mostly earthwork and other pertinent maintenance work required for efficient operation of the spreading grounds. The project proposes to modify the overflow channel, located adjacent to the spreading grounds and convert the Borrow Pit area into three spreading basins. The proposed project will increase the capacity of SASG from 38 acre-feet to 62 acre-feet, conserving an average of 314 acre-feet per year and 1,782 acre-feet during a wet year.
10	LACFCD	Sun Valley Park Drain and Infiltration System	Centralized	New	✓	✓			Ⓟ	65	2006	$8,517,875	$256,000	The project alleviates localized flooding in the residential area tributary to the project. Street runoff is routed through a water quality treatment system at the park and directed into two underground infiltration chambers for infiltration.
11	IEUA	Chino Basin Facilities Improvement - College Heights	Centralized	Retrofit/ Rehabilitation	Ⓟ	✓				76	2005	$4,111,281	$28,600	Groundwater recharge and groundwater quality improvement (TDS and NO3), diluent water for recycled water recharge
12	IEUA	Chino Basin Facilities Improvement - 8th St	Centralized	Retrofit/ Rehabilitation	Ⓟ	✓				1,028	2005	$4,384,929	$64,300	Groundwater recharge and groundwater quality improvement (TDS and NO3), diluent water for recycled water recharge
13	IEUA	Chino Basin Facilities Improvement - Banana	Centralized	Retrofit/ Rehabilitation	Ⓟ	✓				237	2005	$628,744	$34,000	Groundwater recharge and groundwater quality improvement (TDS and NO3), diluent water for recycled water recharge
14	IEUA	Chino Basin Facilities Improvement - Brooks	Centralized	Retrofit/ Rehabilitation	Ⓟ	✓				392	2005	$2,073,367	$49,100	Groundwater recharge and groundwater quality improvement (TDS and NO3), diluent water for recycled water recharge
15	IEUA	Chino Basin Facilities Improvement - Declez	Centralized	Retrofit/ Rehabilitation	Ⓟ	✓				668	2005	$2,970,478	$35,100	Groundwater recharge and groundwater quality improvement (TDS and NO3), diluent water for recycled water recharge
16	IEUA	Chino Basin Facilities Improvement - Ely	Centralized	Retrofit/ Rehabilitation	Ⓟ	✓				1,132	2005	$2,005,395	$63,600	Groundwater recharge and groundwater quality improvement (TDS and NO3), diluent water for recycled water recharge
17	IEUA	Chino Basin Facilities Improvement - Etiwanda DB	Centralized	Retrofit/ Rehabilitation	Ⓟ	✓				230	2005	$1,520,959	$22,900	Groundwater recharge and groundwater quality improvement (TDS and NO3), diluent water for recycled water recharge
18	IEUA	Chino Basin Facilities Improvement - Hickory	Centralized	Retrofit/ Rehabilitation	Ⓟ	✓				352	2005	$6,893,717	$50,400	Groundwater recharge and groundwater quality improvement (TDS and NO3), diluent water for recycled water recharge
19	IEUA	Chino Basin Facilities Improvement - Lower Day	Centralized	Retrofit/ Rehabilitation	Ⓟ	✓				322	2005	$2,879,579	$31,400	Groundwater recharge and groundwater quality improvement (TDS and NO3), diluent water for recycled water recharge
20	IEUA	Chino Basin Facilities Improvement - Montclair	Centralized	Retrofit/ Rehabilitation	Ⓟ	✓				706	2005	$619,749	$24,700	Groundwater recharge and groundwater quality improvement (TDS and NO3), diluent water for recycled water recharge
21	IEUA	Chino Basin Facilities Improvement - RP3	Centralized	Retrofit/ Rehabilitation	Ⓟ	✓				1,095	2005	$17,676,328	$163,400	Groundwater recharge and groundwater quality improvement (TDS and NO3), diluent water for recycled water recharge
22	IEUA	Chino Basin Facilities Improvement - San Sevaine	Centralized	Retrofit/ Rehabilitation	Ⓟ	✓				648	2005	$701,309	$51,700	Groundwater recharge and groundwater quality improvement (TDS and NO3), diluent water for recycled water recharge

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					Water Supply Augmentation	Water Quality Improvement	Open Space Recreation	Habitat Restoration	Flood Risk Mitigation					
23	IEUA	Chino Basin Facilities Improvement - Turner 1&2	Centralized	Retrofit/ Rehabilitation	Ⓟ	✓				1,016	2005	$3,574,494	$64,600	Groundwater recharge and groundwater quality improvement (TDS and NO3), diluent water for recycled water recharge
24	IEUA	Chino Basin Facilities Improvement - Turner 3&4	Centralized	Retrofit/ Rehabilitation	Ⓟ	✓				512	2005	$5,690,086	$53,500	Groundwater recharge and groundwater quality improvement (TDS and NO3), diluent water for recycled water recharge
25	IEUA	Chino Basin Facilities Improvement - Upland	Centralized	Retrofit/ Rehabilitation	Ⓟ	✓				376	2005	$372,814	$22,600	Groundwater recharge and groundwater quality improvement (TDS and NO3), diluent water for recycled water recharge
26	IEUA	Chino Basin Facilities Improvement - Victoria	Centralized	Retrofit/ Rehabilitation	Ⓟ	✓				336	2005	$3,626,615	$79,500	Groundwater recharge and groundwater quality improvement (TDS and NO3), diluent water for recycled water recharge
27	San Elijo JPA	San Elijo Stormwater Diverter	Centralized	New	Ⓟ	✓				3	2013	$64,296	$2,000	Divert low flow urban runoff into the sewer system for treatment and reuse
28	San Elijo JPA	Seascape Sur Diversion Structure	Centralized	New	✓	Ⓟ				3	2014	$181,071	$5,000	Divert low flow urban runoff away from beach and into sewer system for treatment and reuse
29	Santa Monica	Santa Monica Urban Runoff Recycling Facility	Centralized	New	✓	Ⓟ				183	2001	$17,328,122	$300,000	Collect dry weather runoff from central part of Santa Monica, and west Los Angeles, from Kenter Canyon. Treat and reuse for landscape irrigation and flushing. Offset using potable water for non-potable purposes.
30	Santa Monica	Virginia Avenue Park Library Rainwater Harvesting Project	Distributed-type BMPs for Direct Use	New	Ⓟ	✓				0.1	2014	$440,819	$6,000	Collect onsite rainwater from buildings' roofs, store, treat and use onsite for bathroom flushing. Supplemental local water supply to replace potable; keep runoff pollution out of the Bay.
31	City of Los Angeles	Elmer Avenue	Distributed-type BMPs for Direct Use	New	✓			✓	Ⓟ	12	2010	$3,060,117	$92,000	The Elmer Avenue Neighborhood Retrofit transformed a typical residential street into a model "green street" by incorporating stormwater best management practices and educating residents. Elmer Avenue includes underground infiltration galleries, open bottom catch basins, bioswales, rain barrels, permeable pavers, climate-appropriate landscapes, and solar street lights.
32	City of Los Angeles	Broadway Neighborhood Stormwater Greenway Project	Distributed-type BMPs for Direct Use	New	✓	Ⓟ	✓			24	2016	$4,752,297	$150,000	A combination of BMPs were deployed, including a large infiltration chamber, dry wells, pre-cast concrete sidewalk bioswales, and 20 residential landscape projects. The project will help augment groundwater recharge to the Central and West Coast Basins.