SAN DIEGO REGION

Stormwater Capture and Use Feasibility Study

FINAL | November 2018

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Prepared for the
County of San Diego

Prepared by:

ESA

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with support from Katz and Associates

Contents

Available on Project Cleanwater at: http://www.projectcleanwater.org/stormwater-capture-and-use-feasibility-study/

Purpose, Goals, and Benefits

What is the purpose of this study?

The San Diego Region Stormwater Capture and Use Feasibility Study (SWCFS) is designed to provide a regional analysis of the feasibility of planning, constructing, operating, and managing facilities that capture and use stormwater for supply, restoring hydrology, irrigation, conservation, and other beneficial uses.

What are the goals of this study?

- Quantify the volume of stormwater that can be captured and stored on public lands and used in the San Diego region.
- Identify the opportunities and constraints for a range of stormwater capture and use alternatives to provide a management tool in the development and planning of similar projects.
- Assess the feasibility of implementing the potential stormwater use alternatives on a near-, mid-, and long-term basis.
- Support the goals of the updated (2019) Integrated Regional Water Management (IRWM) Plan, which addresses stormwater capture and use.

What are the benefits of this study?

- Water supply opportunities are identified and include 2,200 - 22,000 acre-feet/year of stormwater to capture and use.
- Pathways are identified to implement stormwater management projects.
- Project proponents can use the study to attract additional funding to the region.
- Useful management/planning tools for stormwater and water resource managers are provided.

A stormwater outfall


Low-impact development

Project Overview

Study Components

Development of the SWCFS consisted of five tasks:

1. Data collection and existing conditions analysis
2. Parcel feasibility analysis and quantification of stormwater capture and use
3. Cost analysis of stormwater capture and use alternatives
4. Implementation approach and prioritization
5. Preparation of this SWCFS

Tasks 1 through 4 are summarized in separate technical memoranda , which are provided at http://www.projectcleanwater.org/stormwater-capture-and-use-feasibility-study/. This Feasibility Report summarizes the findings of those previous tasks.

The SWCFS Tool Box

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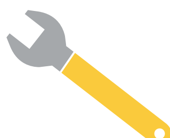
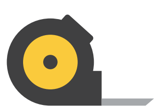
This study determines the feasibility of stormwater capture and use alternatives within San Diego County. Feasibility was assessed through a quantitative analysis of potential volumes and costs of implementing these alternatives on public parcels. Additionally, each alternative was evaluated and prioritized based on identified opportunities and constraints. The product of this study is a tool box, which water resource managers can use to identify, assess, and develop stormwater capture and use projects.

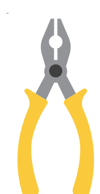


Regional Constraints and Opportunities: This planning tool can be useful in assessing a parcel's potential for capturing, storing, and using stormwater. To analyze a site's potential for capture and use, opportunities (such as gaining regulatory clarity) and constraints (such as limited funding) are analyzed and weighed to enable better decision making.

Parcel Assessments: The SWCFS includes shapefiles of the public parcels assessed throughout the County , which are available for download at http://www.projectcleanwater.org/stormwater-capture-and-use-feasibility-study/. This tool provides managers with an evaluation of the potential stormwater uses that may be feasible at each site.



Guidance for Proposition 1 and Other Grant Funding: This tool provides guidance to stormwater capture project leads on how to estimate capture and use volumes for project planning and design, and for Proposition 1 stormwater grant and other grant solicitation applications.



Example Projects: Over 20 example conceptual to constructed projects provide a management tool for project sponsors and leads in the identification and development of similar projects. These example projects include a summary of the constraints and opportunities for implementation and quantities of stormwater that can be used. These example projects can inform the planning of similar projects.

Regional Prioritization of Stormwater Use Alternatives: This tool provides managers with the results of the regional analysis of the use alternatives. In combination with the other tools, the prioritization provides regional managers with a planning tool to identify, assess, and develop stormwater capture and use projects for near-, mid- and long-term consideration.

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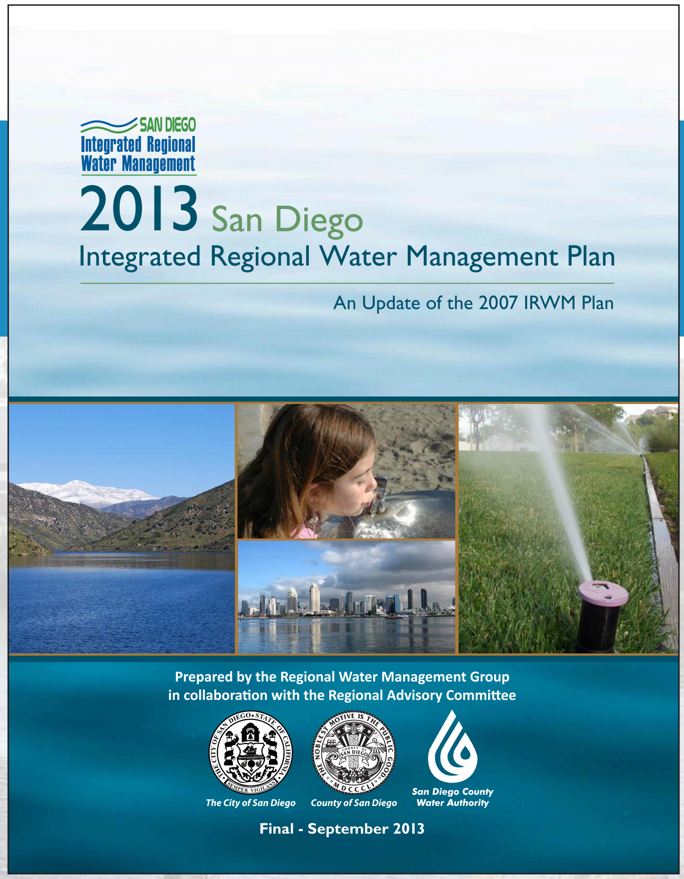
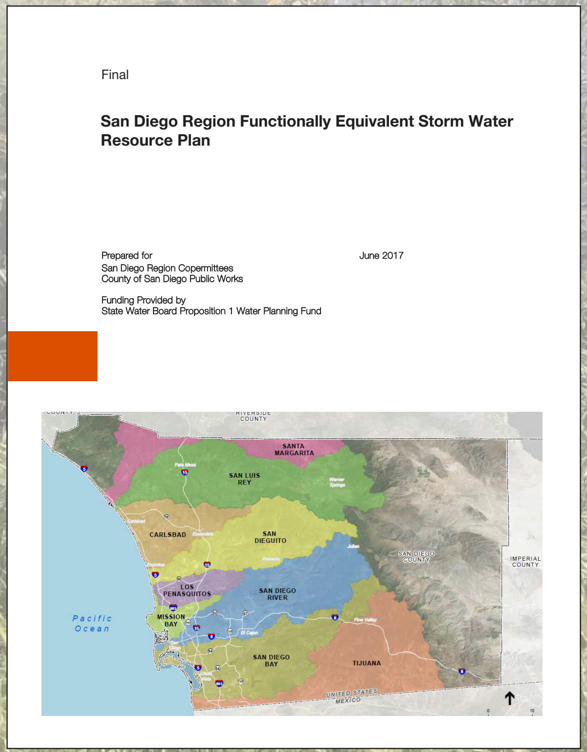
Related Plans



Integrated Regional Water Management (IRWM) planning is a state initiative, through the Department of Water Resources, aimed at developing long-term water supply reliability, improving water quality, and protecting natural resources. The San Diego IRWM Program began in 2005 and is an interdisciplinary effort by wastewater agencies, stormwater and flood managers, water retailers, watershed groups, the business community, tribes, and agriculture and nonprofit stakeholders to improve water resources planning in the San Diego IRWM Region. The 2013 IRWM Plan provides a mechanism for: 1) coordinating, refining, and integrating existing planning efforts within a comprehensive, regional context; 2) identifying specific regional and watershed-based priorities for implementation projects; and 3) providing funding support for the plans, programs, projects, and priorities of existing agencies and stakeholders.

The SWCFS will be incorporated into the next IRWM Plan update in 2019.



Final

San Diego Region Functionally Equivalent Storm Water Resource Plan

Prepared for
San Diego Region Copermittees
County of San Diego Public Works

June 2017

Funding Provided by
State Water Board Proposition 1 Water Planning Fund

Stormwater resource plans (SWRP) are required by Senate Bill 985 for stormwater capture projects to be eligible to receive state grant funding. These plans list and prioritize projects designed to capture stormwater for multi-benefit use. The legislation is intended to change the perception of stormwater from a nuisance to a resource.

The SWCFS supplements the SWRP with more detailed analysis of stormwater capture and use opportunities. It also provides the tools to quantify and prioritize projects, which is required for grant funding.

Funding for this project was provided through the San Diego Integrated Regional Water Management (IRWM) Prop 1 Planning Grant and contributions from regional agencies and nongovernmental organizations.

Regional Setting

Current use and storage of stormwater in the San Diego region

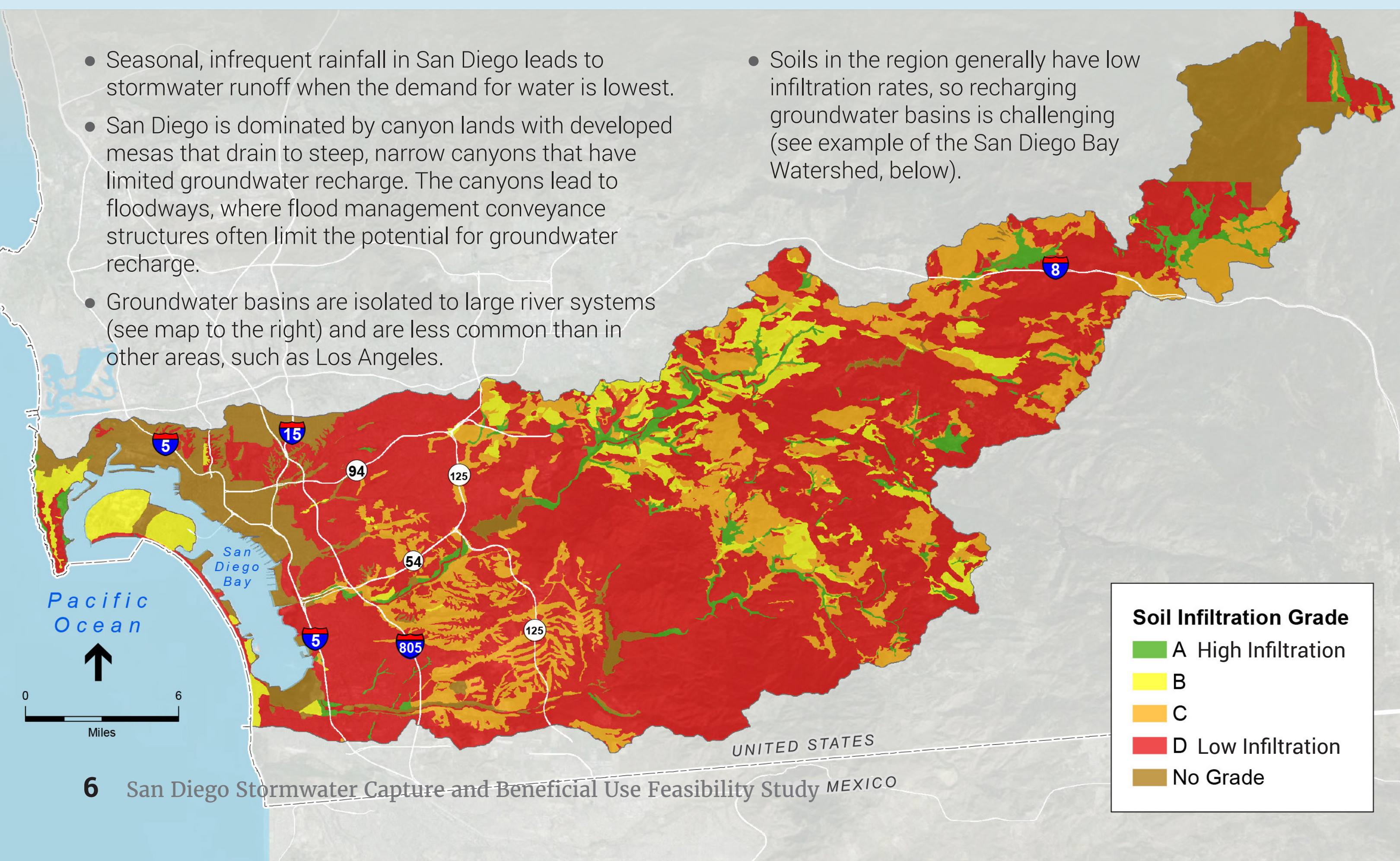
The storage and beneficial use of stormwater in the San Diego region is being effectively implemented in the upper watersheds. As shown on the map to the right, a system of reservoirs captures and stores runoff from the less-urbanized, upstream portions of the county's watersheds. Opportunity for future local water supply augmentation is likely to come from stormwater capture in the urbanized, downstream portions of the watersheds. Capture and use of stormwater in those urbanized areas is currently limited.

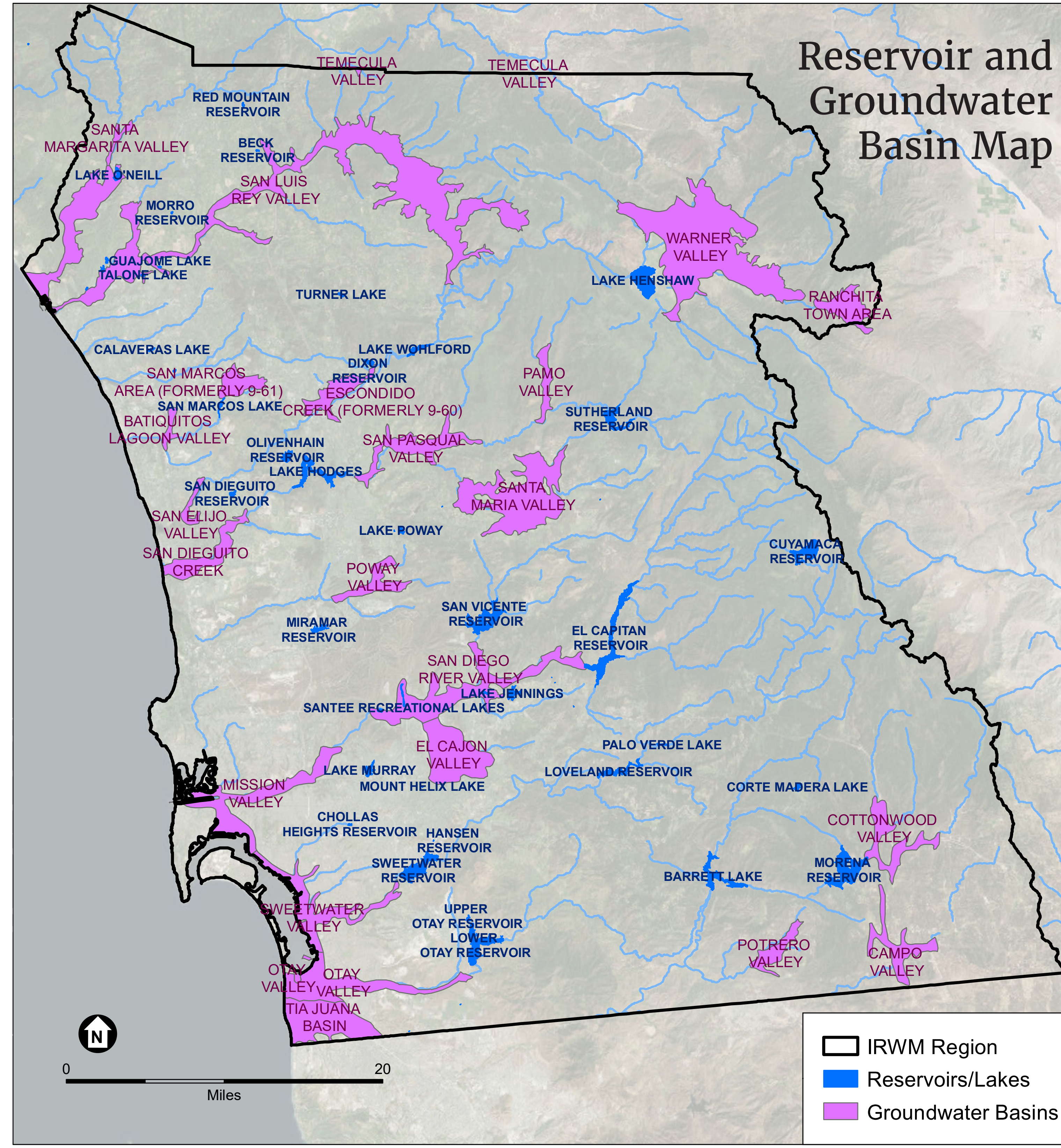
A local reservoir

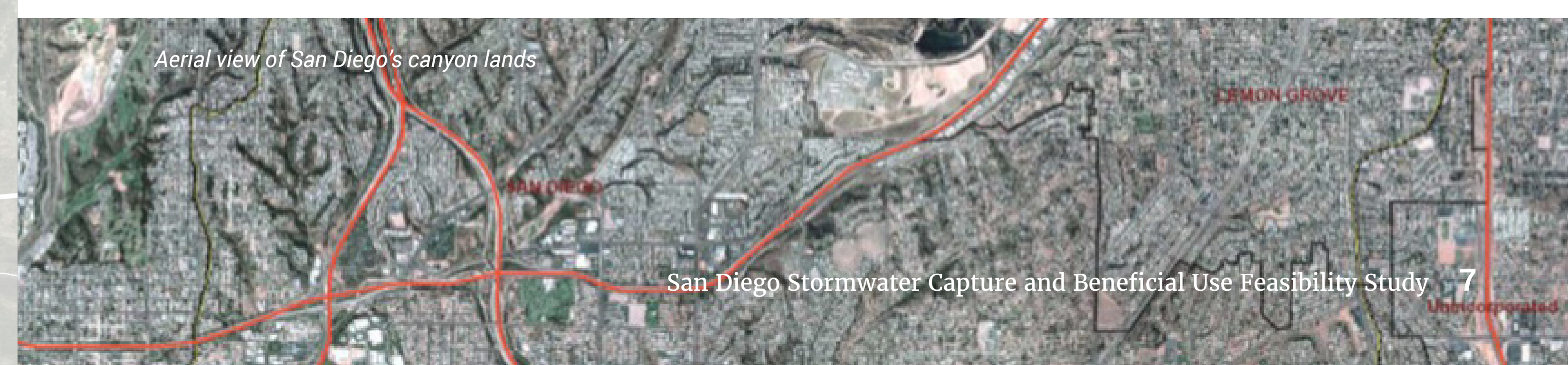
What makes San Diego different? Challenges for Stormwater Use

The San Diego region has unique geology, topography, and micro-climates, when compared to many other areas in the state.

- Seasonal, infrequent rainfall in San Diego leads to stormwater runoff when the demand for water is lowest.
- San Diego is dominated by canyon lands with developed mesas that drain to steep, narrow canyons that have limited groundwater recharge. The canyons lead to floodways, where flood management conveyance structures often limit the potential for groundwater recharge.
- Groundwater basins are isolated to large river systems (see map to the right) and are less common than in other areas, such as Los Angeles.
- Soils in the region generally have low infiltration rates, so recharging groundwater basins is challenging (see example of the San Diego Bay Watershed, below).



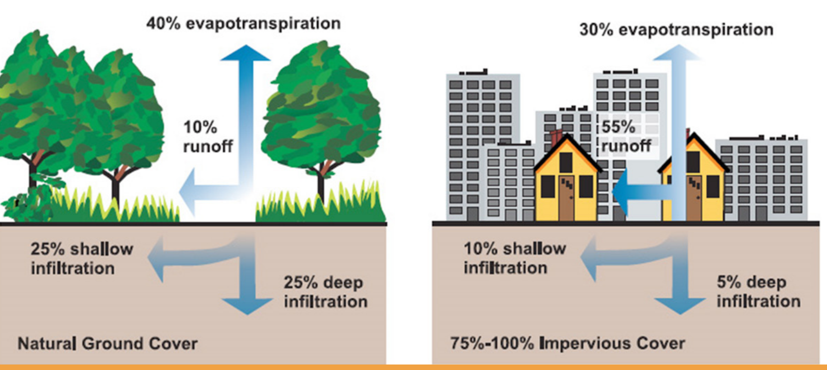




Aerial view of San Diego's canyon lands

Why is Stormwater Storage Important?

Stormwater in Urban Areas

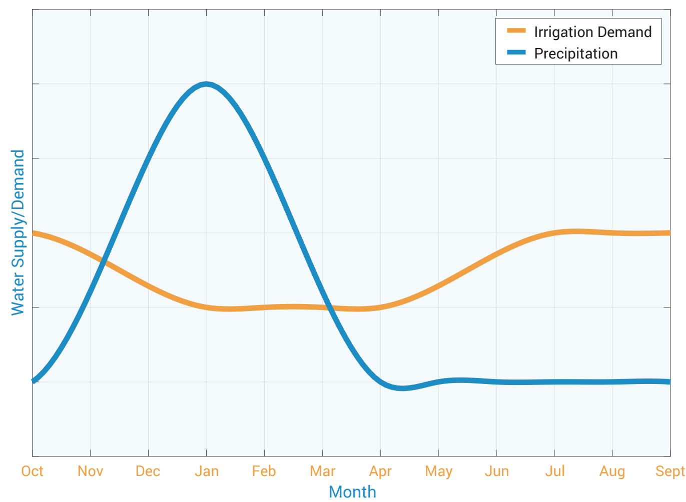


In urbanized areas, greater amounts of impervious cover increase the volume and velocity of stormwater runoff. The Municipal Separate Storm Sewer System (MS4) and flood control channels are designed to convey the runoff to the ocean quickly to protect the community from flooding. Under natural conditions, more stormwater infiltrates into the ground, which provides storage for future use.

Urban areas produce greater volumes of stormwater than under natural conditions due to impervious cover and/or limited infiltration opportunities.

Local river during storm event in urbanized area

Storage is required to use stormwater, since stormwater comes at times when demand for water is low, as shown in the adjacent figure. Because stormwater is delivered in variable, and sometimes large, volumes during a short timeframe, stormwater collection and storage is needed prior to distribution to a beneficial use. Conveyance of stormwater to wastewater treatment plants via existing sanitary sewer lines is also constrained during storm events, since increased infiltration to the system results in reduced sewer line capacity. Furthermore, fully-saturated subsurface soils may limit the rate of stormwater infiltration, requiring temporary storage of collected stormwater.



The Stormwater Challenge: supply vs. demand and the need for storage.

Low-impact development

Storage of stormwater in urbanized areas is often limited; however, current development and re-development regulations encourage the use of low-impact development (LID) to increase retention time of stormwater and allow stormwater to infiltrate into the soil. The filtration reduces impacts of pollutants and peak flows on receiving waters, and provides opportunities for greater storage, while helping restore natural hydrological conditions.

The availability and capacity of stormwater storage is often the limiting factor for use and must be assessed prior to identifying and quantifying potential use alternatives, particularly in urban settings.

Water Quality of Stormwater

Urban stormwater runoff collects and transports numerous constituents from roadways, landscaped areas, and various commercial, industrial, and residential land uses and activities. These constituents include bacteria, metals, pesticides, sediment, nutrients, and trash. Treatment to address these constituents may be required prior to use or conveyance to a wastewater facility, depending on the end use and established water quality standards, treatment facility requirements, and quality of the stormwater captured.

Urbanized areas have greater water quality challenges that include trash

SWCFS Conceptual Model

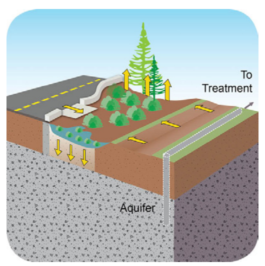
The SWCFS is based on a framework that considers each step of the stormwater capture and use process. As discussed above, stormwater collection and storage is needed first. Depending on the stormwater use alternative identified, stormwater may need to be treated. Lastly, the treated stormwater needs to be distributed to the end user.

1. Collection and distribution to storage
2. Retention and storage
3. Identification of stormwater use alternative
4. Conveyance to treatment system
5. Treatment for stormwater use alternative
6. Distribution to end user

Alternative Uses for Stormwater in the San Diego Region

Eight separate stormwater use alternatives were identified and evaluated for their feasibility in the San Diego Region. These alternatives were identified based on existing projects in the San Diego County region and Southern California, and input from the Technical Advisory Committee (TAC; see page 19 for information on the TAC).

As presented in the SWCFS Conceptual Model (page 9), all use alternatives require stormwater capture and storage. Collected stormwater is then treated on-site, infiltrated, or diverted to a treatment facility. The feasibility of the implementation of these eight alternatives (described below) is assessed and prioritized in this study.



A

Direct discharge to designated groundwater basins to be extracted for potable use.

B

Discharge to groundwater to reestablish natural hydrology and, by extension, to restore biological uses.

C

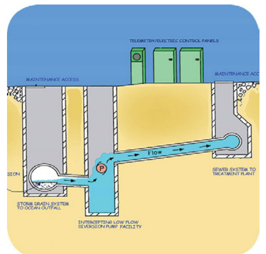
Irrigation to be used on-site or at nearby parks, golf courses, or recreational areas on public parcels.

D

Small scale, on-site use for irrigation and other private use on private parcels.

E

Flow-through to sustain vegetation in natural treatment system (treatment wetlands) and/or restoration sites.



F

Controlled discharge of dry-weather flows to wastewater treatment plants to help move waste material through the system (aka "solids management").

G

Controlled discharge of stormwater to wastewater treatment plants for indirect potable use.

H

Controlled discharge of stormwater to wastewater treatment plants for recycled water use.

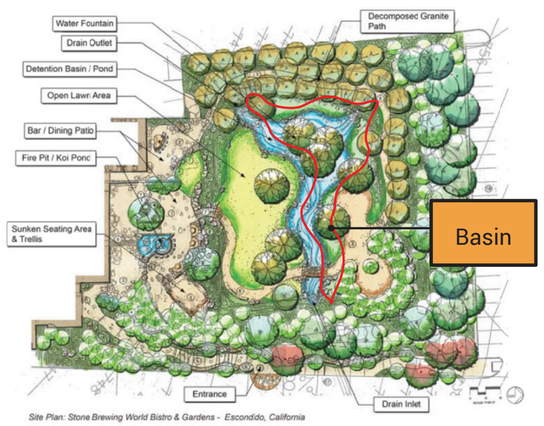
Example Stormwater Use Projects

In addition to local reservoirs, there are a number of existing and conceptual stormwater capture and use projects within the San Diego Region and Southern California. Examples of completed, pending, and conceptual projects for each stormwater capture and use opportunity are presented in the following pages. These projects provide examples of each of the eight alternatives assessed in this study.

Implemented Projects

Franklin D. Roosevelt Park Regional Stormwater Capture Project

The Los Angeles County Department of Public Works (LACDPW) took an innovative approach to achieve MS4 permit requirements by using the Franklin D. Roosevelt (FDR) Park to capture and infiltrate runoff from storm events. The 195-acre drainage area contains two underground infiltration systems and seven underground drywells. Prior to infiltration, the diverted stormwater passes through a baffle filtration unit, a sediment removal chamber, a screen system to capture and store solid debris, and a skimmer system that removes hydrocarbons. Annually, the FDR is expected to infiltrate to groundwater 120 acre-feet for potable use **(Alternative A)**.



Stone Brewing World Bistro and Gardens

Stone Brewing World Bistro and Gardens

The Stone Brewing World Bistro and Gardens in Escondido converted approximately one acre of impervious land to a landscaped stormwater detention facility. The park-like area is also graded to collect runoff from surrounding industrial park buildings. The facility includes pervious paths, a detention basin and pond, and an on-site rain garden **(Alternative B)**. Annually, the one-acre plot captures and infiltrates approximately 9 acre-feet of stormwater.

A Avenue

National City "A" Avenue Green Street

National City has implemented an integrated stormwater capture and use system to Kimball Park, along "A" Avenue in National City. The project includes low-impact development infrastructure, which improves infiltration to groundwater and water storage for irrigation **(Alternative A and Alternative B)**. The project constructed infiltration basins that are capped with river rock to prevent erosion and include a thick layer of rock and sediment through which water percolates into the natural groundwater system. In addition to the infiltration basins, the project also constructed a filtration and 30,000-gallon cistern system beneath Kimball Park. Annually, the project captures 90.5 acre-feet.

Planned/Conceptual Projects

San Elijo Joint Powers Authority Stormwater Use Alternative Project

This conceptual project, at the existing San Elijo Water Reclamation Facility in Cardiff, proposes altering and expanding the existing stormwater channel, check dam, and sediment collection area. The expansion would allow stormwater to infiltrate and recharge the shallow groundwater table **(Alternative A)**. Following infiltration, the stored stormwater would be pumped from a groundwater well, treated to Title-22 standards, and used as recycled water. The proposed project will result in the infiltration and potential reuse of approximately 12 acre-feet per year.

SEWRF Stormwater Capture Elements

Telegraph Canyon Channel Improvement Project

The City of Chula Vista has plans to improve portions of the Telegraph Canyon Channel to increase stormwater detention and infiltration and alleviate flooding. The concept-level project will increase the channel capacity and introduce vegetated bioswales into the improved channel **(Alternative B)**. These modifications will allow for increased stormwater detention, infiltration, and controlled discharge, which in turn will reduce surface flows and decrease flooding potential along the creek. The project modifications will also encourage channel bank revegetation and stabilization.

Telegraph Canyon Channel Improvement Proposed Project Location

Example Stormwater Use Projects

Planned/Conceptual Projects (Continued)

Santa Monica Sustainable Water Infrastructure Project

The City of Santa Monica, as part of their Sustainable Water Infrastructure Project (SWIP), is implementing a recycled municipal wastewater treatment and conjunctive reuse project at the planned SWIP Recycled Water Treatment Facility (SRWTF). The proposed project will have the capacity to harvest and divert approximately 4.5 million gallons of stormwater from a single storm event into the SRWTF **(Alternative G)**.

San Diego Safari Park

San Diego Zoo Safari Park – Green Parking Lot and Stormwater Capture and Use Project

The San Diego Zoo Safari Park in Escondido proposes to use innovative best management practices to capture, treat, and reuse stormwater from two parking lots. The 52-acre concept project utilizes low-impact development techniques, including permeable pavers and improved surface materials, to capture 5.1 acre-feet of stormwater per year. As runoff from parking lots often carries oils, grease, heavy metals, and other environmental stressors, the captured stormwater will be treated through a biofiltration system before being used for irrigation within the Safari Park **(Alternative C)**.

Dry-Weather Flow Diversion at Los Coches Creek Outfall, Alternative 1

The Ray Stoyer Water Reclamation Facility in Lakeside is investigating the feasibility and benefits of augmenting flow through the facility by diverting dry-weather discharge from a site adjacent to the Los CochEs Road Bridge **(Alternative F)**. The diversion would increase flows through the facility by 2.6 million gallons annually. The diversion would also serve to reduce pathogen levels in discharge to Los Coches Creek.

Los Coches Creek

Olivenhain Municipal Water District 4S Ranch Pilot Stormwater Treatment for Recycled Water

This conceptual project at the 4S Ranch Water Reclamation Facility would to expand the production of recycled water using captured and stored stormwater **(Alternative H)**. Stormwater would be treated using the older 0.2 million gallons per day (MGD) treatment facility that has been replaced and upgraded by a new 2.0 MGD treatment system. Stormwater would be collected from the community MS4 and stored in a basin or underground vault on public lands. Stored stormwater would then be diverted at a controlled flow to the facility as a separate inflow from the wastewater.

4S Ranch Water Reclamation Facility

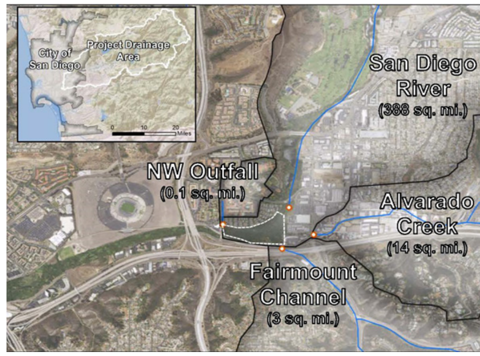
San Marino Drive Green Street and Dry-Weather Flow Management

This concept-level project in the community of Lake San Marcos in Unincorporated San Diego County proposed to use green street best practices (including low-impact development features and incorporating smaller impervious areas) to treat and infiltrate the persistent dry-weather flow that currently enters the County's MS4 system along San Marino Drive. In addition to capturing and treating the dry-weather flow, the proposed project will discharge the captured stormwater to the groundwater and help restore natural hydrology for biological purposes **(Alternative B)**. The project will incorporate approximately 9,500 square feet of green street low-impact development. Quantities of stormwater captured and infiltrated are not yet available.

San Marcos Drive

Mission Valley Stormwater Capture Project

This concept-level project within the City of San Diego will help achieve the City's desire to focus on a strategic stormwater capture framework that will help address a number of water management concerns, including maintaining a reliable and local water source, improving water quality in impaired waterbodies, and flood risk reduction. The City of San Diego has identified a parcel located upstream of the SDCCU Stadium at the approximate confluence of three stream or tributary systems – the San Diego River, Alvarado Creek, and Fairmont Channel. The City of San Diego plans to install both a detention facility paired with an injection well, and an infiltration gallery on the identified parcel for direct discharge to designated groundwater basin for future potable-use extraction **(Alternative A)**. These conceptual facilities could potentially receive runoff from four diversion structures, for a total of 1,900 acre-feet per year of captured stormwater.



Map of the Project Site, Stream Inputs, and Their Corresponding Drainage Areas
Source: TetraTech, 2017

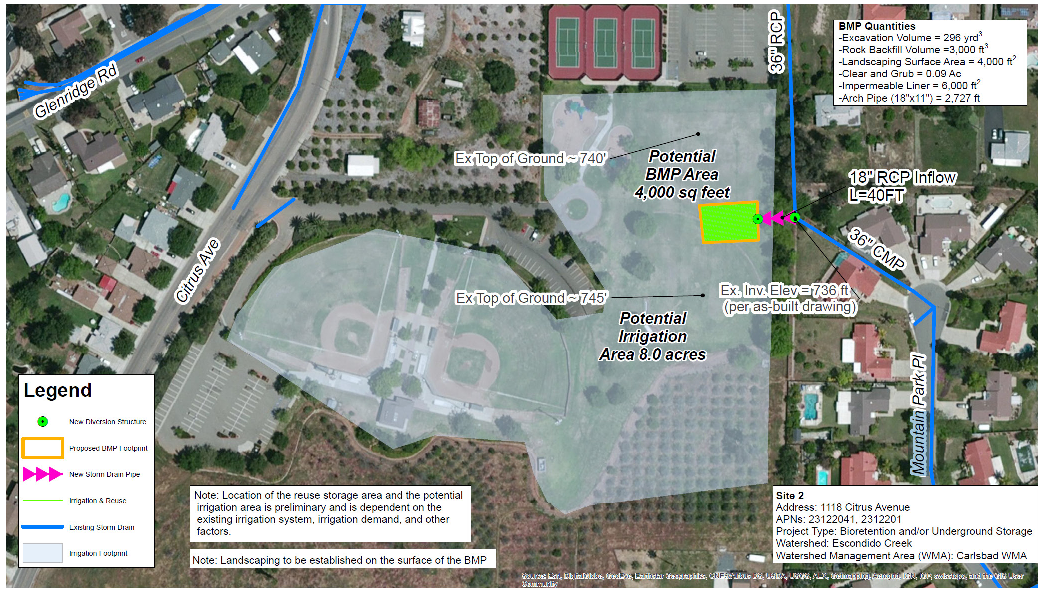
Planned/Conceptual Projects (Continued)

Lindbergh Field Terminal 2 Parking Plaza

This project at the San Diego International Airport will capture and store stormwater beneath the Terminal 2 Parking Garage for re-use at the airport's Central Utilities Plant cooling towers **(Alternative D)**. A series of 36-inch-diameter pipes will hold the runoff collected from inlets on the roof of the parking structure before being routed through a cartridge filtration and ultra-violet light treatment system and then reused in the heating, ventilation, and air conditioning cooling towers. The project is estimated to capture and reuse 6.1 acre-feet per year.

Mountain View Park Retrofit Project, Escondido

The City of Escondido recently evaluated three water quality retrofit projects (bioretention, underground storage and infiltration, and runoff storage and use for irrigation) at Mountain View Park. The conceptual project would implement a retrofit of an existing 36-inch reinforced concrete storm drain on the eastern side of the park. Escondido has performed a hydraulic study of potential alternative compliance projects to estimate the volumes of stormwater captured, stored, and used for each of the three project alternatives **(Alternative B and Alternative C)**. The annual volume of stormwater infiltrated or used for irrigation under the project alternatives ranged from 2.7 to 6.5 acre-feet.



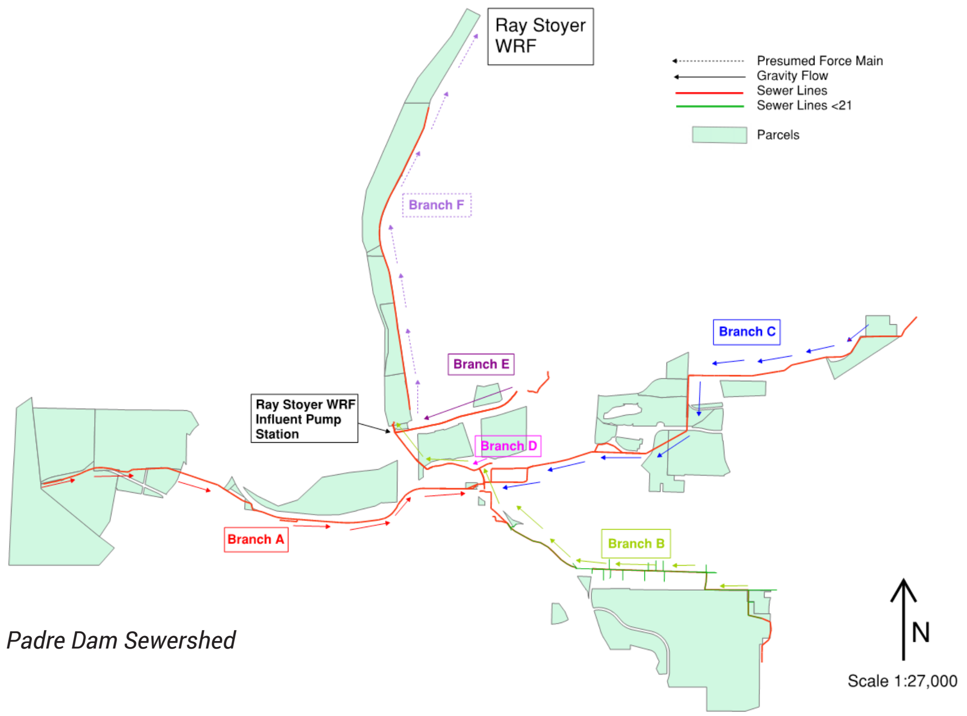
Alternative Compliance Potential Projects Assessment

Rincon Band- Luiseño Indian Reservation Regional Stormwater Capture Project

The tribal government of the Rincon Band of Luiseño Indians is seeking funding to implement a phased stormwater capture and infiltration project to secure adequate and sustainable water supply and water quality for over 170,000 people who live in the tribal reservation in the San Luis Rey River watershed. The conceptual project includes an evaluation of appropriate locations within the reservation to capture and contain stormwater to reduce contaminant contaminants, including metals, bacteria, and nutrients from migrating, into the San Luis Rey River **(Alternative B and Alternative C)**. Approximate capture and use volumes have not yet been calculated.

Flow Augmentation to the Ray Stoyer Water Reclamation Facility for Non-Potable and Indirect Potable Reuse

The Padre Dam Municipal Water District (Padre Dam) is planning a major three-phase expansion of the Ray Stoyer Water Reclamation Facility (RSWRF) for the production of recycled water for non-potable reuse **(Alternative G)**. Over the three phases, the RSWRF will increase its current treatment volume from 2 MGD to 21 MGD. Padre Dam has begun an evaluation of volumes of stormwater in the RSWRF's sewershed, and has investigated the sewer system's capacity to handle flows from controlled discharge. The preliminary investigation evaluated the maximum flow available to augment RSWRF and whether there are any capacity limitations within the existing sewer system. The modeling performed for the Phase 1 analysis indicates that the project has the potential to increase recycled water generation and distribution up to 3.9 MGD or 4,380 acre-feet per year.



Padre Dam Sewershed

Study Process

The SWCFS followed an eight-step process that built on the preliminary estimate of potential stormwater capture volumes conducted for the Stormwater Resource Management Plan (SWRP, see page 5). The work completed in the SWRP is shown as Steps 1 and 2. The third step was the identification of the eight stormwater capture and use alternatives based on input from the Technical Advisory Committee (TAC) and a review of available studies. Steps 4 and 5 refined the estimated volumes from the SWRP. Refinement was completed by first screening public parcels based on the feasibly of implementing the alternative, for example, soil permeability for infiltration or proximity to a sanitary sewer for treatment for recycled water use. Conceptual projects were then applied to a select number of screened public parcels and modeled using a continuous simulation model based on over 40 years of rainfall data. The result was a quantified range of capture and use volumes that was used to both refine the regional volume range and also provide a quantified metric under the volume criteria to assess the feasibility and prioritization of each of the alternatives. Cost estimates for the conceptualized projects were then developed in Step 6 to prioritize each alternative in the final step of the study.

Technical Advisory Committee

Stakeholder engagement was essential to the development of the SWCFS, and was a requirement of receiving grant funding through the San Diego IRWM Program. To ensure stakeholder input, feedback was obtained through the study development process throughout the Technical Advisory Committee (TAC). The TAC consisted of representatives from identified stakeholder groups including stormwater, water supply, flood management, and wastewater practioners. Members of the TAC were responsible for sharing data sources and reviewing and providing input on technical memos and ultimately the SWCFS. TAC meetings were held periodically during the development of the study and were open to the public. A public comment period was held at the end of every meeting.

Steps in the Process

1. **Identification of Potential Capture and Storage Sites**
2. **High-Level Estimated Total Potential Stormwater Storage**
3. **Identification of Uses**
4. **Identification, Development, & Quantification of Typical Projects for Each Use Alternative**
5. **Refine Parcel List and Match to Potential Uses**
6. **Determine Costs for Typical Projects and Apply to Refined Parcel List**
7. **Develop and Apply Criteria to List Stormwater Use Alternatives**
8. **Prioritize Stormwater Use Alternatives**

Methodology

Step 1:
- 12,731 public parcels in the region
- Found 1,200 parcels feasible for capture, storage, and use.

Step 2:
- Quantified potential capture for three stormwater use alternatives

Step 3:
- Eight stormwater use alternatives identified (uses described on pages 10 and 11).

Step 4:
- Used case studies provided by the TAC and conceptual projects applied to screened public parcels to develop methods to quantify stormwater capture for typical projects

Step 5:
- Applied rigorous screening criteria and found 211 – 977 feasible parcels
- Applied quantification to estimate potential volume for region

Step 6:
- Used case studies, conceptual projects, and literature values to develop typical unit costs
- Applied unit costs to projects and parcels
- Compared cost to the cost of desalination

Step 7:
- Volume captured criteria
- Cost criteria
- Multi-benefit criteria
- Opportunities and constraints criteria

Step 8:
- Prioritized as near-, mid-, or long-term projects based on feasibility given constraints today

Technical memorandums documenting each step

Steps 1–2: Presented in Appendix H of the SWRP (ESA 2017)

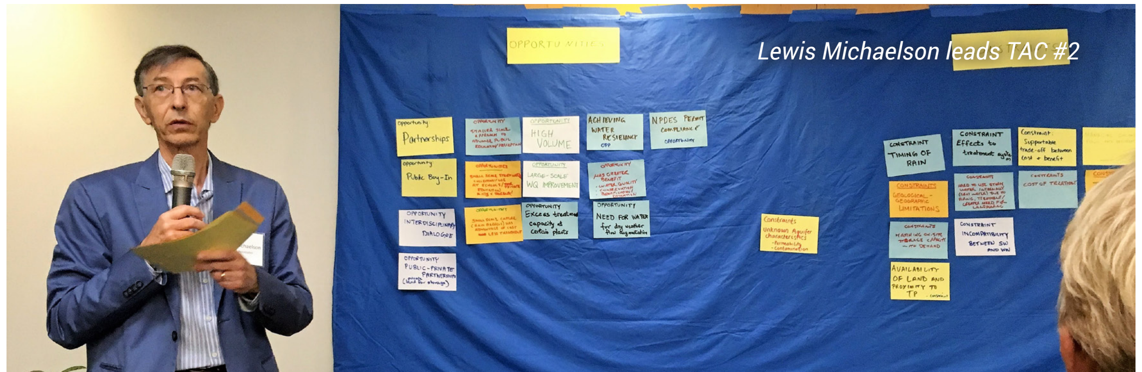
Steps 3–5: Presented in the SWCFS Modeling Approach and Results Memorandum (ESA 2018)

Step 6: Presented in the SWCFS Cost Analysis Memorandum (ESA 2018)

Steps 7–8: Presented in the SWCFS Prioritization Analysis and Results Memorandum (ESA 2018)

★ Indicates when a TAC meeting was held in the process.

The TAC



Lewis Michaelson leads TAC #2

David Pohl presents results to the TAC

Stormwater Alternatives Feasibility Assessment Criteria

The method for prioritizing stormwater use alternatives was based on a set of evaluation criteria that include:

1) Potential Volume of Stormwater Use;

2) Cost per Volume;

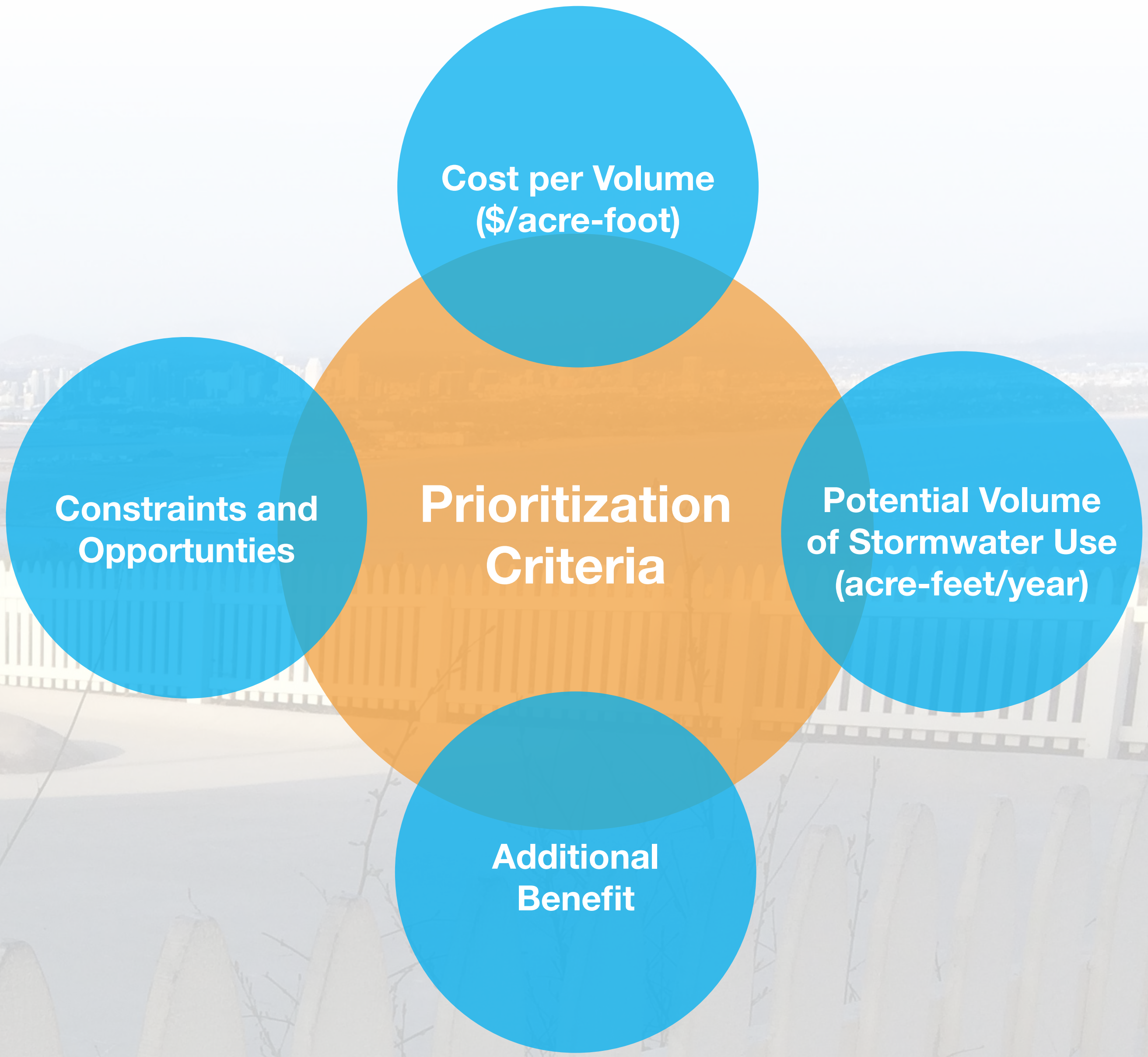
3) Additional Benefits; and,

4) Constraints and Opportunities.

The prioritization criteria, their metrics, and the method and source for developing those metrics are presented in the table below. Further detail is provided in the referenced technical memos (http://www.projectcleanwater.org/stormwater-capture-and-use-feasibility-study/).

Prioritization Criteria and Metrics

Criteria	Metrics	Basis of Assessment	References
Potential Volume	Acre-feet/year of stormwater used	• Volume range developed from modeled parcels • Number of parcels identified	Modeling Approach and Results Memorandum (Attachment B, ESA 2018)
Cost	Cost in $/acre-foot (in 2018 dollars)	• Total cost including operations and maintenance over the project life divided by the total stormwater volume used over the project life • Cost of providing potable water from desalination as a cost benchmark for comparison • Costs for groundwater extraction, treatment, and distribution not included, consistent with alternatives discharging to a sanitary sewer, which assumes the infrastructure exists.	Cost Analysis Memorandum (Attachment C, ESA 2018)
Additional Benefits	Number of additional benefits	• A numerical value is assigned for each of the SWRP benefit categories that can be achieved: Water Quality, Environment, Flood Management, and Community	SWRP (ESA 2017) Prioritization Analysis and Results Memorandum (Attachment D, ESA 2018)
Constraints and Opportunities	Qualitative assessment of the constraints and opportunities developed by TAC	• Informed by the Constraints and Opportunities identified for each example project • Constraints and Opportunities identified for each alternative	Attachment A of Cost Analysis Memorandum (Attachment C, ESA 2018) Prioritization Analysis and Results Memorandum (Attachment D, ESA 2018)



Overview of Prioritization Process:

A defined goal of the SWCFS is the prioritization of the stormwater use alternatives based on a set of criteria that identify whether the alternative can be realistically implemented in the near, mid- or long-term. The prioritization concludes the eight-step study process. Alternatives are assessed based on both quantitative and qualitative criteria. The quantitative criteria include the range of stormwater volumes that are captured and used based on the public parcel screening and modeling. Prioritization is also based on the estimated range of cost per volume for each alternative. The qualitative criteria include benefits achieved, and the constraints and opportunities of each alternative that affect their implementation timeframe. During the TAC review process, constraints were represented as "gates", or barriers to implementation, and opportunities were represented as "keys" to overcome these contraints. The prioritization analysis concludes by identifying regional constraints in order to guide the region over time as those constraints are overcome. Overcoming these constraints, or "gates", will allow some near- and potentially mid-term projects and alternatives to move forward toward implementation.

How can Water Resource Managers Use the Results of this Study?

A local stormwater pond

A dry stormwater capture basin

A local groundwater well and pump station

Low-impact development

The results of the study provide a timeline for feasibility of implementation for the different stormwater alternatives. This classification of the alternatives can inform planning efforts on a program- or project-level.

Local river during storm event

PROGAM-LEVEL PLANNING: At the program level, stormwater use alternatives that have an identified near-term feasibility through the assessment process may have available program resources directed toward their development and implementation. For example, near-term alternatives could be used in implementing a watershed-wide stormwater quality program, in accordance with a Water Quality Improvement Plan (WQIP). Whereas, alternatives that need a longer-term period to address constraints may lead managers to focus available program resources on addressing those constraints.

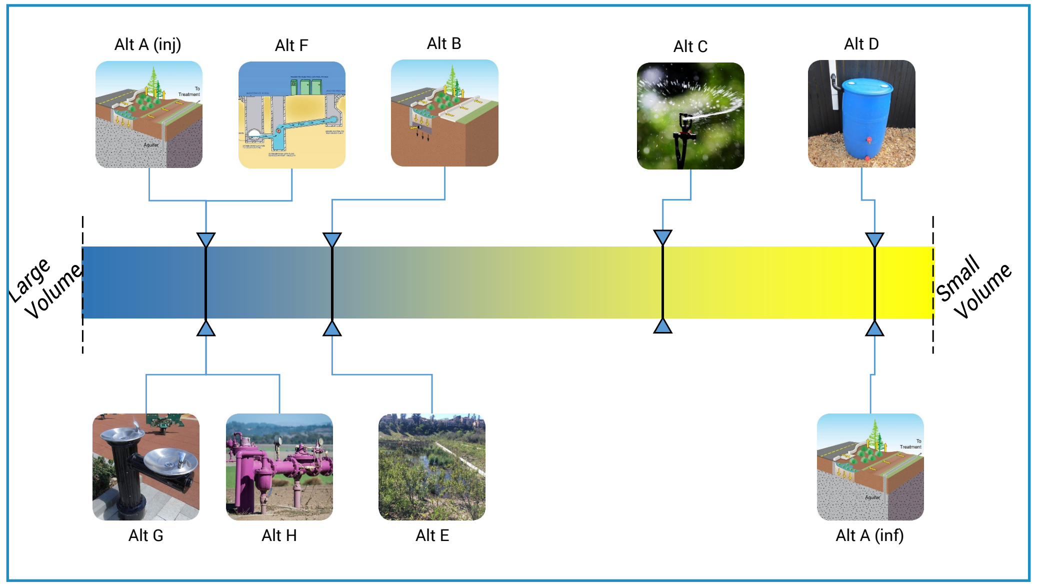
EXAMPLE: For example, the outcome of this feasibility assessment indicates that infiltration to groundwater for hydrology is a near-term alternative. Using the criteria and assessment from this study, a watershed or water resource manager as part of an overall program may plan to direct more available program resources to the planning and implementation of this alternative. The process and outcome of this study are not recommendations, rather planning tools for managers to apply to their own programs and projects. The quantification methods also provide guidance for planning programs and applying for stormwater capture grant funding.

PROJECT-LEVEL PLANNING: On a project level, the prioritization process may be used during project development to evaluate a project's constraints and opportunities and help identify where additional assessment is needed. This process can be used to identify the more feasible alternatives for stormwater capture and use or a possible hybrid approach using multiple alternatives. This can also help project leads assess projects for application of stormwater capture and use in order to improve the competitiveness of the project for grant funding.

Dry-weather flows from an urbanized watershed

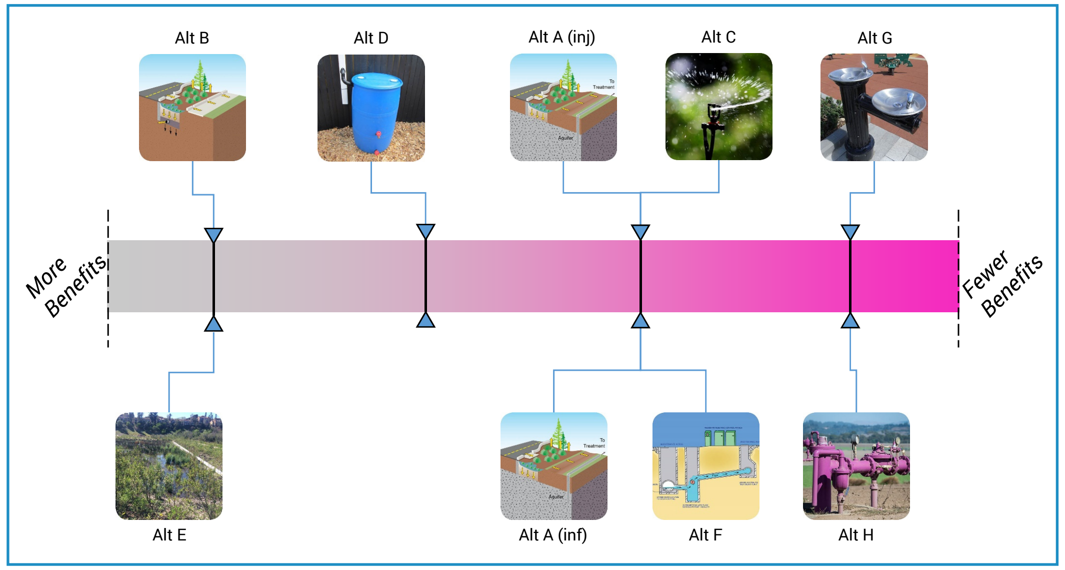
Key Findings on Prioritization Criteria (Study Process Step 7)

Volume Captured Criteria (Study Process Steps 3-5)



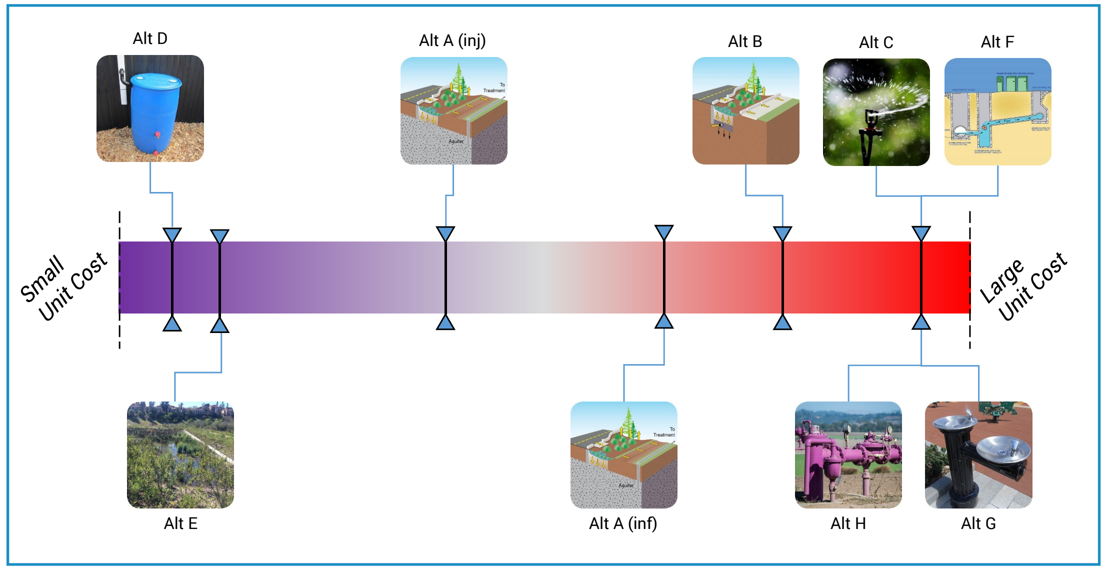
Key Findings: This criterion was based on the potential range of capture and use volumes on a parcel basis and the total potential regional volumes. The results indicate groundwater injection (Alternative A), controlled discharge to wastewater treatment plant for recycled use (Alternative H) and potable reuse (Alternative G), and dry-weather diversion to wastewater treatment plant (Alternative F) are ranked highest. This is due to either the large annual volumes (due to utilization of dry-weather flows) or the greater number of feasible sites. Lower ranked alternatives have constraints that limit the site volumes. Limited numbers of parcels that meet screening criteria also reduce the ranking. Rain barrels and down-spout disconnects are ranked lowest due to the small site-level volumes captured. The number of sites used in this analysis is based on available data of actual rain barrels installed and projected participants in rebate programs.

Additional Benefit Criteria



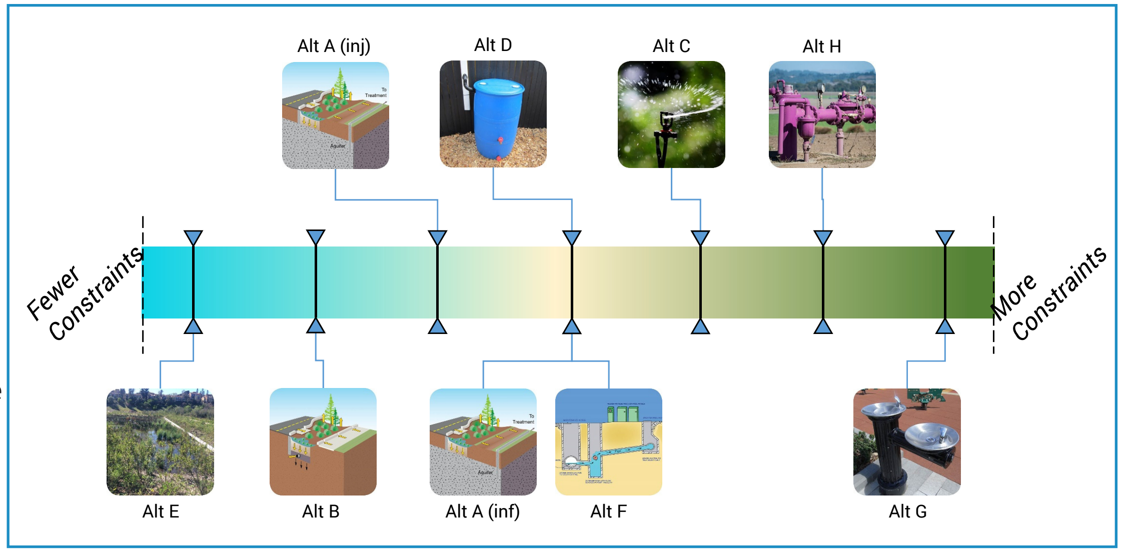
Key Findings: The additional benefits criterion identified benefits alternatives could achieve beyond water supply. Alternatives that achieve a greater number of benefits may be more feasible through greater opportunity for grant funding and multiple agency and stakeholder support. The result of this qualitative analysis is that many of the alternatives achieve water quality, flood management, environmental enhancement, and community benefits. These additional benefits may also provide cost offsets to address issues like water quality compliance.

Cost Criteria (Study Process Step 6)



Key Findings: This criterion uses cost (in dollars per acre-foot) as a metric for cost-effectivness when compared to the cost of desalination: $2,500 per acre-foot (in 2018 dollars, SDCWA 2016, 2017). This provides a comparison of the stormwater alternatives to the highest local water source alternative. The results of this ranking indicate that the lowest unit cost alternatives are treatment wetlands (Alternative E) and private parcel capture (Alternative D). This is a result of the lower implementation costs and higher annual volumes through the use of dry-weather flows. When pre-treatment is required and discharge rates are limited (for example constrained by soil infiltration or discharge to a sanitary sewer line) unit costs per volume are higher ranking these alternatives lower.

Opportunities and Constraints Criteria



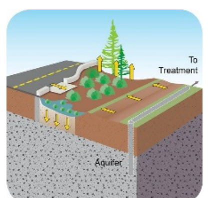
Key Findings: The constraints and opportunities criterion provides a qualitative measure of conditions that may affect design and implementation of an alternative. The number of constraints and the opportunities to overcome the "gates" provide a basis to define near- and longer-term priorities. Alternatives are ranked higher when the "gates" generally have existing "keys", compared to those where constraints have not yet been addressed. The results of applying this criterion to the alternatives indicate treatment wetlands (Alternative E), infiltration to restore natural hydrology (Alternative B), and groundwater injection (Alternative A) are ranked higher as they have fewer constraints and more opportunities.

What are the Overall Feasibility Assessment Results?

Feasibility Timeline: The results of applying the four criteria to each of the eight alternatives are represented in this timeline. Alternatives that are generally more feasible for implementation in the near-term are to the left of the timeline, whereas alternatives that have a longer-term feasibility are on the right of the timeline. These are not recommendations for the implementation of specific alternatives but rather a planning tool for the identification and development of stormwater capture and use projects. This tool can also be used to consider adding these alternatives to planned projects to attract funding and other benefits.

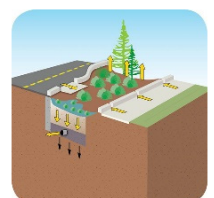
Alternative A - Injection to Designated Groundwater Basin for Water Supply

- Technology (dry wells for groundwater injection) increases feasible sites and total feasible volumes
- Groundwater injection requires treatment that increases cost
- Inter-agency agreements needed to increase storage and use



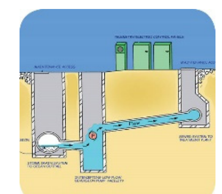
Alternative B - Infiltration to Groundwater to Restore Natural Hydrology (Low-Impact Development)

- Number of feasible sites is high
- Addition of dry-weather flows can increase volume and reduce unit costs
- Water quality benefit and potential cost "off-set" for compliance
- Multi-benefit that may attract grant funding
- Local soils limit infiltration and total volumes



Alternative F - Dry-Weather Flow Diversion to WWTP

- Addition of flows can improve solids management
- Flows occur when sewer lines have likely capacity
- Water quality benefit that may provide cost off-set for compliance
- Need for program level inter-agency agreements



Alternative C - Site or Nearby Irrigation Use

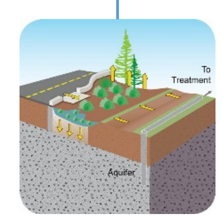
- Stormwater generated when demand is low requiring storage
- Greater and costlier storage needed to capture and use multiple storm events
- Pre-treatment required that can increase costs, but treatment costs can be lowered for drip irrigation
- Economies of scale are less viable for these individual site systems

Alternative E - Natural Treatment Systems

- Uses dry-weather flows that increase total annual volumes and lowers unit costs
- Multi-benefit
- Creation of habitat may impact long-term maintenance
- Vector issues need to be addressed

Alternative D - Private On-Site Use

- Rain barrels and downspout disconnects to landscaping are most cost effective alternative
- Larger scale storage and use on private lands provides a much larger potential volume
- Use of Alternative Compliance program provides opportunity for public/private partnerships and funding
- Total regional volume is low due to low storage capacity



Alternative A - Infiltration to Designated Groundwater Basin for Water Supply

- Low cost alternative where surface infiltration is high and site located above groundwater basin
- Regional geologic constraints limit sites and potential volumes

Alternative H - Controlled Discharge to WWTP for Recycled Water Use (H)

- Stormwater flows occur when sewer lines have lower capacity due to infiltration
- Higher unit costs due to greater storage need
- Treatment plant compatibility requires controlled discharge
- Stormwater flows occur when recycled water demand is lower

Alternative G - Controlled Discharge to WWTP for Indirect Potable Use (G)

- Stormwater flows occur when sewer lines have lower capacity due to infiltration
- Higher unit costs due to greater storage need
- Treatment plant compatibility requires controlled discharge
- Advanced treatment at existing facilities under development

How Do I Prioritize My Projects and Find Funding?

STEP 1

Quantify Capture and Use Volumes

- Gather data on the site/parcel:
  - Determine the potential drainage area to the site based on topography and MS4 drainages.
  - Identify land uses and soil types within the drainage area.
- Model runoff volume and timing of flow (e.g., using the San Diego Hydrology Model (SDHM3.0)).
- Using the flow time series from the SDHM3.0, calculate the possible volume that can be stored and used based on the desired stormwater use alternative or a hybrid of alternatives (or run multiple options and compare).
- See the Modeling Approach and Results Technical Memorandum (ESA 2018) for further details.

→ Quantified benefits = Higher ranking in Stormwater Resources Plan for Prop 1 and other grant funds.

STEP 2

Calculate Project Costs

- Gather data on unit costs that are appropriate to the specific project or area.
- Determine quantities for the project (e.g., volume of excavation, number/size of culverts, area of plantings).
- Develop cost table for project features, including line items for mobilization/demobilization, operations and maintenance, planning, engineering, and permitting, and contingency

→ Cost analysis required for grant funding.

STEP 3

Determine Additional Benefits

- Consider whether the project can be modified to provide more benefits, such as to provide water quality improvements, flood risk reduction, community involvement, or environmental enhancements.

→ Additional Benefits = Higher ranking in SWRP for Prop 1 and other funds.

STEP 4

Consider Constraints and Opportunities

- Identify whether the project has any constraints that will prevent it from being implemented.
- Evaluate whether there are any opportunities to overcome project constraints.

→ Opportunities may include access to other funding sources or partners.

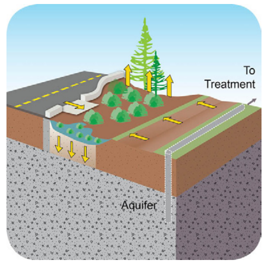
Prioritizing Projects within a Municipality

- Does your project provide water at a cost less than $2,500 per acre-foot? If so, the project price is competitive with alternative water supply sources = feasibile in the near-term. Note costs are in 2018 dollars.
- If your project is more expensive, does it provide other benefits that could be cost-shared? For example, if your project costs $3,000 per acre-foot of water supply, but also meets water quality compliance targets, the price of achieving regulatory compliance may make the project feasible = feasible in the near- or mid-term.
- If the project is very expensive and cannot be justified by off-setting the cost among multiple benefits, are there future opportunities that could make the project less expensive in the future? If so = feasible in the long-term.

Dry weather ponding

Alternatives' Constraints and Opportunities

Alternative A - Infiltration or Injection to Designated Groundwater Basin for Water Supply



Alternative A has near- to mid-term feasibility. The primary constraint for direct infiltration is the limited number of sites that possess higher permeability soils that would allow for sufficient infiltration and that are close enough to convey stormwater to a designated groundwater basin. A key to addressing the site constraint for direct infiltration is the use of dry well injection technology to penetrate through the lower permeability soil layers to reach the groundwater basin. This technological opportunity moves this alternative to shorter near-term feasibility. Another constraint to wider-spread use of this alternative is a lack of regulatory clarity on treatment requirements (see text box). These requirements increase the cost per volume. An additional constraint is the need for interagency agreements between municipalities and water authorities to facilitate the development of stormwater infiltration and injection projects that convey stormwater from the MS4 to groundwater basins under water agency management (see text box). These agreements may lead to cost sharing and cooperation on grant solicitations to overcome the cost constraints.

If the infrastructure for groundwater extraction, treatment, and distribution is not available at the designated groundwater basins, this may increase the cost of this alternative. These costs were not included in the analysis to be consistent with the alternatives that discharge to a sanitary sewer. For these alternatives, the conveyance, treatment, and distribution costs were also not included since it was assumed that this infrastructure already exists. Since parcels were filtered by proximity to designated groundwater basins, the existing extraction infrastructure was assumed to be in place.

Alternative A - Open and Closed Gates

Site Characteristics	
Production and Demand Timing	
Existing Infrastructure	
Partnerships	
Treatment Requirements	
Regulatory Clarity	
Costs and Funding	
Public/Agency Support	

Technology: increase feasibility by using injection wells to penetrate through low permeability soils

Partnerships: Locations where MS4 conveyance is in close proximity to groundwater basins.

Funding: Prop 1 and other grant funding opportunities

330-440 ac-ft/yr
Infiltration

480-5,700 ac-ft/yr
Injection

$240 - $89,400 ac-ft/yr
Infiltration

$200 - $31,000 ac-ft/yr
Injection

Regulatory clarity for Water Quality Standards for Injection Wells: Dry wells for use groundwater injection of stormwater are considered Class V injection wells and are subject to underground injection control (UIC) regulations. Dry wells are only allowed when registered with the US EPA and injection standards stem from the EPA-administered UIC Program. Any injection activity, as described in 40 CFR § 144.12(a), cannot allow the movement of fluid containing any contaminant into an underground source of drinking water, if the presence of that contaminant may cause a violation of the primary drinking water standards under 40 CFR part 141, other health-based standards, or may otherwise adversely affect the health of persons. Stormwater is a non-point source discharge that may contain constituents that are regulated under the drinking water standards, although the concentrations and presence may vary greatly depending on the land-use from which the runoff is generated. The regulations do not currently specify specific treatment requirements for stormwater. Regulatory clarity is needed to encourage stormwater capture and use, but under circumstances where there would be no health threat to the public.

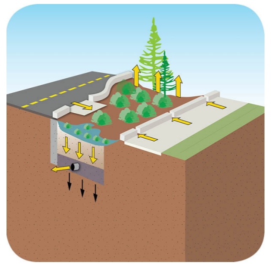
Inter-Agency Agreements: If authorized by their governing bodies, two or more public agencies may jointly exercise any power common to both through a Joint Powers Authority (JPA), Memorandum of Understanding (MOU), or contract. As part of overcoming the constraint of using stormwater for diversion to groundwater basins or wastewater treatment plants for the ultimate distribution as potable or recycled water, a JPA could be formed. Benefits of forming this JPA include:

- The creation of new avenues for stormwater capture;
- Organizing and coordinating stormwater capture and water supply activities across city boundaries;
- Receiving state and federal funding which may be more accessible through regional planning;
- Creating a more resilient water supply;
- Sharing information and identifying common needs and issues across jurisdictions; and,
- Uniting a single voice at the regional, state and federal levels

Watershed issues transcend jurisdictional boundaries. Alternative governmental structures like a JPA allows for a more rational model for conducting watershed planning and management that correspond to geographic boundaries. JPAs allow their partner agencies to collaboratively address issues of mutual concern and provide legal mechanisms for joint funding, financing, and planning the design and management of the shared water resources.

Alternatives' Constraints and Opportunities

Alternative B - Infiltration to Groundwater to Restore Natural Hydrology (Low-Impact Development)



Alternative B has near-term feasibility. This alternative has a high number of potential sites with planning for region-wide implementation already underway. Regional soil constraints reduce the volume that can be infiltrated to restore natural hydrology. However, biofiltration is used when soil permeability is low, allowing for greater retention and infiltration into these soils. This alternative would have a higher prioritization if the cost per volume were lower. However, these projects are often implemented to achieve water quality benefits and therefore the costs are offset by the regulatory compliance achieved. Cost per volume can be further reduced if diversion of dry-weather flows from the MS4 included in the project. These projects are strong candidates for grant funding, and project sponsors are encouraged to list their projects in the SWRP and apply for Prop 1 Round 2 grant funding in early 2019.

- **Technology:** Increase feasibility by increasing storage and volumes going to biofiltration
- **Funding:** Prop 1 and other grant funding opportunities
- **Multi-Benefit:** High cost is offset by multiple additional benefits

Infiltration and Biofiltration

Infiltration and Biofiltration

Alternative B - Open and Closed Gates

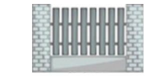
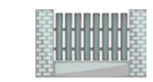
Site Characteristics	
Production and Demand Timing	
Existing Infrastructure	
Partnerships	
Treatment Requirements	
Regulatory Clarity	
Costs and Funding	
Public/Agency Support	

Alternative C - Site or Nearby Irrigation Use

Alternative C has long-term feasibility. This alternative has a lower priority due to the high cost per volume and regulatory ambiguity on water treatement standards. Although the high cost per volume may be off-set by the water quality compliance benefits these projects provide, there are other less costly alternatives that provide similar benefits. Treatment requirements under current regulation require above ground systems to meet Title 22, which drives up the cost for these small scale systems. Treatment costs can be lowered if drip irrigation is used. The cost per volume for this alternative is higher as the demand for irrigation is low during the wet season, requiring storage of collected stormwater. In order to collect multiple storm events, greater storage is needed which would increases costs. If in the future more cost effective treatment technologies are developed, this alternative may be more feasible for implementation. Alternative D, which includes using stormwater for onsite landscaping on private properties through down-spout disconnects and rain barrels, is more cost effective.

- **Technology:** Future technologies may reduce costs
- **Regulatory Clarity:** Stormwater must meet current recycled water requirements
- **Funding:** Prop 1 and other grant funding opportunities
- **Small-Scale Implementation:** Projects can be scaled

Alternative C - Open and Closed Gates

Site Characteristics	
Production and Demand Timing	
Existing Infrastructure	
Partnerships	
Treatment Requirements	
Regulatory Clarity	
Costs and Funding	
Public/Agency Support	

Irrigation

Alternatives’ Constraints and Opportunities

Alternative D - Private On-Site Use

Alternative D has a near-term feasibility since small-scale residential stormwater capture and use (rain barrels and down-spout disconnects) are successfully being implemented. Although these projects use a small amount of runoff, there is the potential for large-scale implementation in the region. For these smaller-scale projects, partial funding or rebates will likely increase support and implementation as evidenced from the programs that have been implemented by the County and City of San Diego.

Public/Private Partnerships - Opportunities for larger- scale private use of stormwater could be realized on large, private residential developments, commercial sites, and industrial sites. For these larger-scale projects, public/ private partnerships are needed to use private funding to build the needed infrastructure. Projects would become more feasible through greater regulatory clarity and flexibility under the stormwater alternative compliance program to allow private developers to purchase water quality credits to meet onsite stormwater regulatory requirements. The raised money would then fund public infrastructure to convey and treat captured stormwater from these sites. For more information on public/private partnerships from the industrial business and developer perspectives, please refer to the Water Reliability Coalition (WRC) white paper entitled, “Assessing the Potential for Stormwater Capture and Reuse” (WRC, 2017).

Alternative D - Open and Closed Gates

Site Characteristics	
Production and Demand Timing	
Existing Infrastructure	
Partnerships	
Treatment Requirements	
Regulatory Clarity	
Costs and Funding	
Public/Agency Support	

Partnerships: Public/Private partnerships could help fund public

Regulatory Clarity: Alternative Compliance program would provide greater flexibility to Alternative D Projects

Small-Scale Implementation: Scaled to meet
on-site demands

Funding: Prop 1 and other grant funding opportunities

Rain Barrels

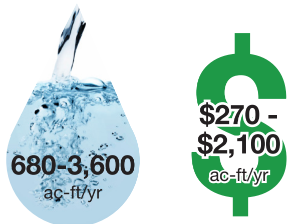
Alternative E - Natural Treatment Systems

Alternative E has near-term feasibility, due to its cost effectiveness, potential regional volume, and benefits, including water quality compliance, environmental, and community benefits. A lower cost per volume is associated with this alternative due to the use of dry-weather flows from the MS4, which significantly increase the total annual volume captured and used. Dry-weather flows from the MS4 are routed through the treatment wetland to sustain the wetland vegetation while also removing pollutants such as sediment and nutrients. Constraints associated with this alternative include long-term operation and maintenance costs and permitting that allows for continued maintenance, which could require mitigation for established habitat. Consideration is needed in preparing the permits for these projects to negotiate up-front mitigation to allow for continued maintenance and performance of the wetland. Persistent non-storm flows, including those from over-irrigation are prohibited under the current MS4 Stormwater Permit. Dry weather flows may also consist of permitted discharges from water supply infrastructure maintenance and groundwater infiltration into the MS4. The use of dry weather flows for this and other use alternatives is suggested in the Senate Bill 985 and included in the San Diego Regional SWRP.

Reduced Cost Per Volume: Dry-weather flows significantly increase annual volume used

Regulatory Clarity and Flexibility: Permits can be negotiated

Funding: Prop 1 and other grant funding opportunities



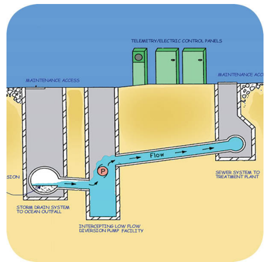
Treatment Wetlands

Alternative E - Open and Closed Gates

Site Characteristics	
Production and Demand Timing	
Existing Infrastructure	
Partnerships	
Treatment Requirements	
Regulatory Clarity	
Costs and Funding	
Public/Agency Support	

Alternatives' Constraints and Opportunities

Alternative F - Dry-Weather Flow Diversion to WWTP

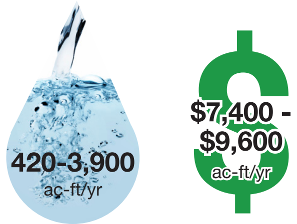


Alternative F has mid-term feasibility. This alternative has a higher priority than the other alternatives that treat stormwater at an existing wastewater facility because it uses dry-weather flows, which lower cost per volume and better matches supply to demand. Existing capacity in sanitary sewers is available during dry-weather periods. Addition of dry-weather flows helps move solids through the system, which has become a greater issue as water use has decreased due to conservation efforts. The constraints for implementing this alternative include the need for agreements between wastewater authorities and stormwater departments to provide a program-level approach to dry-weather diversion discharge permits. Diversion of dry-weather flows from MS4 may reduce flows in receiving waters that have established habitats from these perennial flows. Although the current MS4 permit prohibits non-storm flows from MS4, diversion of these flows may be restricted due to the establishment of habitat downstream of these outfalls. Regulatory clarity is needed to address these conflicting goals.

Alternative F - Open and Closed Gates

Site Characteristics	
Production and Demand Timing	
Existing Infrastructure	
Partnerships	
Treatment Requirements	
Regulatory Clarity	
Costs and Funding	
Public/Agency Support	

- **Match Supply/Need:** Existing systems generally have capacity
- **Partnerships:** Example projects show partnerships are developing
- **Reduced Cost per Volume:** Alternative has a lower cost per volume due to dry-weather flows, which significantly augments annual volume used
- **Funding:** Prop 1 and other grant funding opportunities

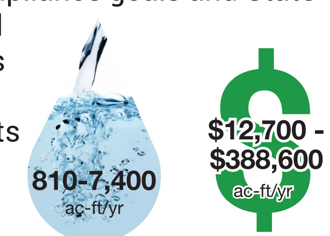


Dry-Weather Diversion

Alternatives' Constraints and Opportunities

Alternatives G + H - Controlled Discharge to WWTP for Indirect Potable Use (G) and Recycled Water Use (H)

Alternatives G and H have long-term feasibility. These alternatives have a longer-term timeline for regional implementation due to a greater number of constraints including high cost per volume and limits to the current capacity of sanitary sewers and treatment facilities during storms. In addition, incompatibility of stormwater quality to the sewer treatment systems also limits discharge rates (see text box). These contraints can be addressed through the use of temporary storage and controlled discharge. Restricted discharge rates from stormwater storage facilities limit the storage facilities capacity to capture and store multiple storm events. This constraint may be overcome by larger regional storage facilities. However, the availability of large-enough public areas for these facilities will limit the overall regional application of these alternatives. There is a long-term opportunity for larger scale storage at private sites (Alternative D), but conveyance and treatment capacity would be needed. Recycled water has a slightly higher priority than potable water use as there is greater support and interest in this alternative from public utilities. Another constraint is the need for agreements between MS4 managers and public utilities. These alternatives may move up in priority and timeline as stormwater quality compliance goals and State-level policies for increased use of local water supplies provide regional drivers that off-set the higher costs of these alternatives and incentivize inter-agency agreements.



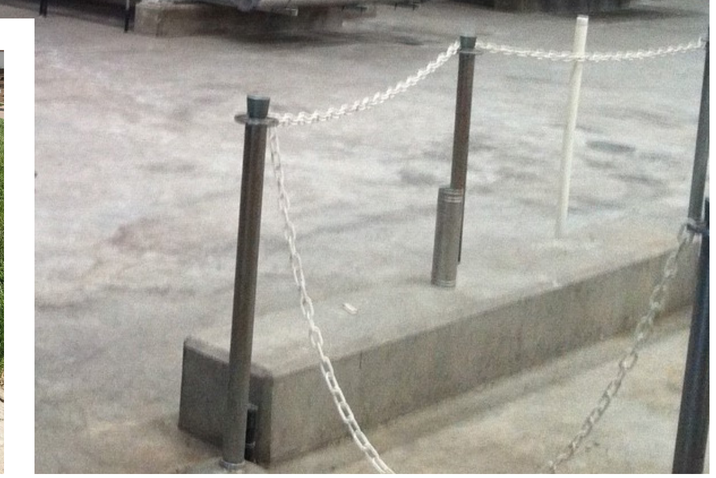
Wastewater Diversion

Alternatives G + H - Open and Closed Gates

Site Characteristics	Open gate	Open gate
Production and Demand Timing	Closed gate	Closed gate
Existing Infrastructure	Closed gate	Closed gate
Partnerships	Closed gate	Open gate
Treatment Requirements	Open gate	Open gate
Regulatory Clarity	Closed gate	Closed gate
Costs and Funding	Closed gate	Closed gate
Public/Support	Closed gate	Closed gate

- **Production and Demand Timing:** Economies of Scale: Large projects may overcome capture
- **Partnerships:** Example projects indicate future partnerships are developing
- **Funding:** Prop 1 and other grant funding opportunities
- **Public/Agency Support:** Public/private partnerships for larger-scale projects could help provide funding

Stormwater Compatibility with Treatment Processes: In the San Diego region, existing wastewater treatment/water reclamation facilities receive only sanitary sewer flows and are not combined systems (sanitary sewage and stormwater). These facilities are therefore designed and operated for high biological oxygen demand (BOD) sanitary flows. The introduction of lower BOD and highly variable storm flows into these facilities would result in an impact to the operations unless flows are controlled to address system compatibility. The impacts to wastewater treatment processes caused by flow augmentation to the Water Resource Recovery Facilities (WRRF) must be considered for Alternatives G & H. Stormwater impacts on wastewater treatment process have been tested from the perspective of wet-weather flows, where stormwater is added to WRRFs in the form of Infiltration and Inflow (I/I). However, the concept of low, sustained flows of stormwater that are captured and stored prior to sewer discharge has not been tested operationally. Chemical and physical treatment processes at a WRRF may need a re-evaluation of chemical dosing and operational set points (primary treatment, disinfection), while biological treatment processes may require a higher Solids Retention Time to buffer against the input of unexpected toxic or recalcitrant contaminants.

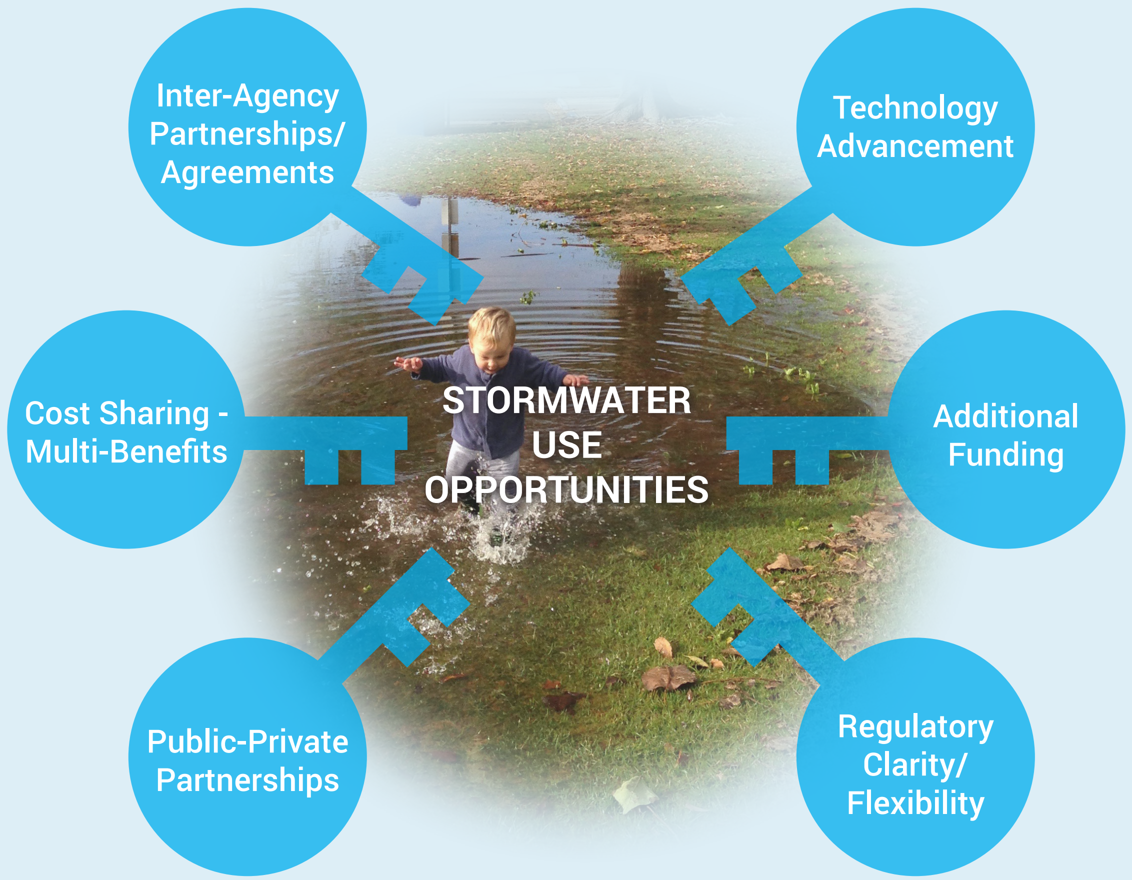


Conclusions

San Diego region is different – Local hydro-geological conditions, that include predominantly low permeability soils and limited groundwater basins that are generally located along the larger river corridors, provide limited opportunities for direct groundwater infiltration in the coastal urban areas. While stormwater capture and infiltration to recharge local groundwater basins is often the less costly alternative, San Diego region's hydro-geological constraints (limited groundwater basins located within urban areas and lack of soils that promote recharge) limits the total volume of stormwater that can be feasibility captured and used.

Capture and use alternatives already implemented – Several stormwater capture and use alternatives are already being implemented in the region. These include green streets (Alternative B), dry weather diversions (Alternative F), underground vault stormwater capture for groundwater infiltration (Alternative A), capture and use for irrigation (Alternative C), and rain barrels (Alternative D). These example projects provide opportunities to inform the planning and implementation of stormwater capture and use projects.

Water quality & other co-benefits offset costs – Cost analysis results indicate that the many of the alternatives have costs above that of local water supply sources (i.e., desalination). Stormwater capture and use needs to consider the additional benefits of these projects that include meeting water quality compliance targets. Additional benefits like meeting MS4 permit compliance, provide cost offsets that go beyond providing augmentation to local water supplies.



These regional opportunity "keys" open the gate to additional stormwater collection and use

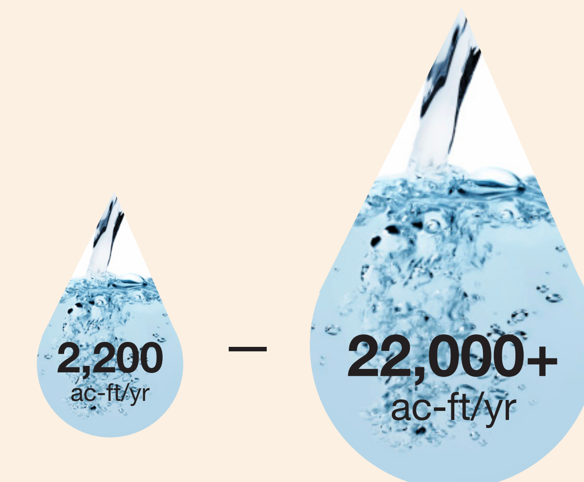
Funding opportunities – The addition of stormwater capture and use to green infrastructure projects provides for potential funding opportunities through State grants and other water resource funding.

Dry-weather flows: more volume reduces unit costs – Implementing systems or policies that allow more use alternatives to utilize dry-weather flows would allow them to capture and use water year round, increasing annual capture and use volume and reducing unit cost. These changes would improve the overall feasibility scores for these use alternatives and could make them feasible in a shorter term than they are now. Dry weather flows from the MS4 include non-storm flows that are prohibited, but also include permitted discharges and groundwater infiltration that can be a source of water use.

Opportunities to move alternatives forward – Alternatives may move up the feasible timeline as stormwater quality compliance goals and State level policies for increased use of local water supplies provide greater regional drivers that "off-set" the higher costs of these alternatives and incentivize inter-agency agreements. New technologies can also move alternatives up the timeline with reduced costs and greater volumes such as the use of injection wells. Regulatory clarity can also overcome current constraints with defining stormwater use specifically in regulations regarding use opportunities such a groundwater injection, irrigation and recycled and indirect potable use supply augmentation. Providing operational flexibility to treatment facilities that use stormwater to augment supplies for recycled water may also provide a "key" to opening up currently closed gates to greater regional use of stormwater. Additional opportunities or "keys" to open gates (overcome constraints) are shown in the graphic to the left.

Stormwater Capture and Use Regional Opportunity

Total potable water use in the San Diego region in 2017 based on data from the Water Authority



Estimated lower and upper end of the range of regional total annual volume of stormwater capture and use. See the Modeling Approach and Results Technical Memorandum for further details.

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