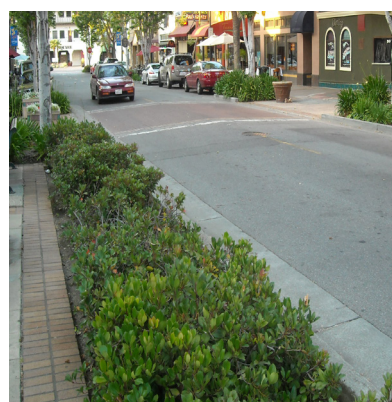
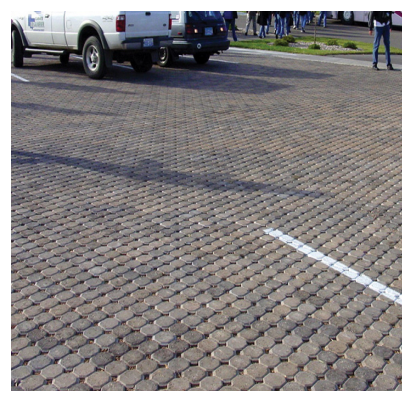
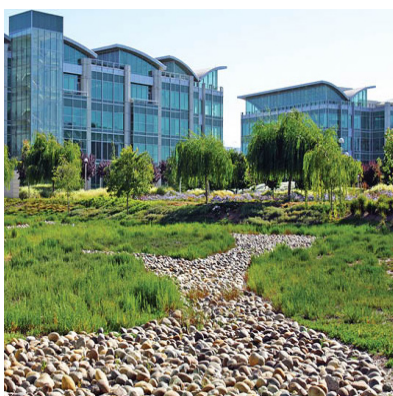


CITY OF SAN JOSE GREEN STORMWATER INFRASTRUCTURE PLAN DRAFT

April 2019



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Please print this plan double-sided.*

Cover Photographs first row: green street, subsurface infiltration and detention system, streetscape improvement, interlocking pavers, second row: regional green stormwater infrastructure project, roadside bioretention, bioretention and porous asphalt, schoolyard rain garden.

Credit first row: DaCosta Mermoz, City of Lakewood, Nevue Ngan Associates, National Resources Conservation Service, second row: DES Architects and Engineers, Harrison Design, Casey J Patterson, Kevin Robert Perry.

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EXECUTIVE SUMMARY

The City of San José envisions a thriving watershed with healthy creeks and rivers and a healthy San Francisco Bay. Green stormwater infrastructure (GSI) is a tool that can help achieve this vision. The multidisciplinary approach of GSI uses soil, plants, and pervious surfaces to capture, treat, infiltrate, and/or use stormwater runoff. GSI can provide multiple benefits such as improved water quality, reduced localized flooding, potable water conservation, increased groundwater recharge, reduced urban heat island effect, and public space beautification. GSI can be integrated with building and roadway design, complete streets, drainage infrastructure, urban forestry, soil conservation, and landscaping. As California's weather becomes increasingly unpredictable and extreme, GSI strategies can provide the City with enhanced climate resiliency, local water supplies, and energy savings, consistent with the City's sustainability goals.

The City of San José has developed this Green Stormwater Infrastructure Plan (GSI Plan) to lay out the approach, strategies, targets, and tasks needed to transition traditional "gray" infrastructure to include green stormwater infrastructure over the long term and to implement and institutionalize the concepts of GSI into standard municipal engineering, construction, and maintenance practices.

The GSI Plan is intended to serve as an implementation guide for reducing the adverse water quality impacts of urbanization and urban runoff on receiving waters over the long term, and a reporting tool to provide reasonable assurance that specific pollutant reductions from discharges to local creeks and San Francisco Bay will be met. The GSI Plan is required by the City's Municipal Regional Stormwater National Pollutant Discharge Elimination System (NPDES) Permit for the discharge of stormwater runoff from the City's storm drain system. The GSI Plan—along with the appended Reasonable Assurance Analysis (RAA) for bacteria—also describes how the City will reduce the storm drain system's contribution to bacteria loads entering the Guadalupe River, Coyote Creek, and other City watersheds per the Consent Decree with San Francisco Baykeeper.

The GSI Plan identifies methods to prioritize specific areas of the City and potential projects for GSI implementation, and generally maps out a GSI implementation plan through 2050. The GSI Plan describes guidance and standards for GSI project design and construction and how the City will track projects from construction through maintenance and monitoring. The GSI Plan also explains how GSI concepts and requirements are already addressed in current City policies and planning mechanisms and will be incorporated in future plan and policy updates.

Based on the prioritized opportunities for potential GSI projects, the RAA provided cost-benefit optimization to determine the most cost-effective combination of GSI projects needed throughout the city to address water quality improvement goals. The RAA included modeling to determine the needed GSI projects within each of the city's watersheds, and determined the citywide volume capture goals to reduce bacteria loads to the city's rivers and creeks. Results of the analysis informed the development of a GSI implementation strategy that outlines future goals for GSI project implementation and sets the stage for an adaptive management approach to GSI implementation that can adjust GSI strategies over time as further field investigations are performed, project concepts and cost estimates are developed, and lessons are learned through GSI project planning, design, construction, and assessment.



Green stormwater infrastructure (GSI) is a natural stormwater collection and treatment system that uses soil, plants, and pervious surfaces to capture and treat stormwater runoff. GSI facilities can also be designed to capture stormwater for uses such as irrigation and toilet flushing. The GSI Plan lays out the City’s approach, strategies, targets, and tasks to transition traditional “gray” infrastructure to include green stormwater infrastructure over the long term, in a manner consistent with the City’s planning and sustainability goals and regulatory requirements.

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1.1 AGENCY DESCRIPTION & BACKGROUND

Founded in 1777, the population of the City of San José (City) is approximately 1,051,316 (2018), making it the third most populous city in California. San José's position as a cultural, political, and economic center within a region that hosts a booming high-tech industry has earned the city the title "Capital of Silicon Valley." The city has grown tremendously since the 1950s when it began the transformation from a small community of farms and orchards to the residential and commercial center that it is today, resulting in challenges related to growth and density. However, as one of the most diverse cities in the United States, San José has talented, environmentally-active, and innovative residents who have committed their City to a leadership role on land use, housing and sustainability actions. San José has the advantages of a great climate with good access to natural amenities and community members who value outdoor-oriented lifestyles and sustainable living choices. The first capital of California and location of the first early sessions of the California State Legislature, San José has served as a center of cultural, political, and commercial life. The City is also a leader in environmental action.

In February of 2018, in line with the Paris Climate Agreement, the City approved Climate Smart San José, an initiative that includes the following goals:

1. Reducing carbon emissions to 40 percent below 1990 levels by 2030;
2. Becoming the first city in the world to produce 1 gigawatt of solar power by 2040 (enough power to serve 250,000 homes); and
3. Reducing per capita residential water consumption by 30 percent by 2030.

The City of San José goals for GSI dovetail with these and other environmental goals. The City is committed to working to advance GSI implementation and has taken a leadership role in early implementation of GSI facilities and coordinated closely with other agencies on regional efforts. One of the first steps of the GSI Plan development process was educating and informing department staff, managers, and City Council members on the purposes, goals, and benefits of GSI, the required elements of the GSI Plan, and steps needed to develop and implement the GSI Plan.



Hotel Valencia on Santana Row

1.2 NATURAL SETTING

San José has a jurisdictional area of 180 square miles, and is located in the Santa Clara Basin, a sub-watershed of the larger San Francisco Bay watershed (the Bay) and a part of Santa Clara County, as shown in Figure 1-1. The Santa Clara Basin is bounded by the Diablo Mountains to the east and the Santa Cruz Mountains to the south and west. The City's six major watersheds (Coyote, Guadalupe, Lower Penitencia, San Tomas Aquino, Calabazas, and Baylands), all drain to southern San Francisco Bay. Within these watersheds, approximately 32,000 storm drain inlets receive runoff from surrounding urban areas into the storm drain system where it is carried and discharged to a creek, river, or the Bay.

The Coyote Creek watershed is the largest in the Santa Clara Basin watershed, covering 320 square miles, and includes two dammed reservoirs. The Guadalupe River watershed is approximately 171 square miles and discharges to the Lower South San Francisco Bay via Alviso Slough. Lower Penitencia Creek watershed, part of the Coyote Creek watershed, covers about 30 square miles, San Tomas Aquino Creek watershed encompasses about 45 square miles, and Calabazas Creek watershed covers about 20 square miles.

The City maintains approximately 25 square miles of park land (including 0.8 square miles of regional park land) that will remain in perpetuity as open space and largely undeveloped natural areas in the watersheds. This includes the 1.1-square mile Alum Rock Park and part of the Don Edwards San Francisco Bay National Wildlife Refuge.

The GSI Plan will primarily focus on implementation of GSI and sustainable drainage practices within the City's urban core and growth areas to maximize the capture, treatment, infiltration, and/or use of stormwater runoff from impervious surfaces.



City of San José

Guadalupe River



Figure 1-1. Map of South Bay Area with Santa Clara Basin Boundary, Major Watershed Boundaries, and San José Jurisdiction Boundary

LEGEND

Santa Clara County	Streams
San José City Limit	Water Bodies
Watershed Boundaries	Bay & Ocean

1.3 REGULATORY CONTEXT

1.3.1 Federal & State Regulations & Initiatives

The U.S. Environmental Protection Agency (EPA) has authority under the Clean Water Act to promulgate and enforce stormwater related regulations. For the State of California, the EPA has delegated the regulatory authority to the State Water Resources Control Board (State Water Board), which, in turn, has delegated authority to the San Francisco Bay Regional Water Quality Control Board (Regional Water Board) to issue National Pollutant Discharge Elimination System (NPDES) permits in the San Francisco Bay Region. Stormwater NPDES permits allow stormwater discharges from municipal separate storm sewer systems (MS4s) to local creeks, San Francisco Bay, and other water bodies as long as they do not adversely affect the beneficial uses of or exceed any applicable water quality standards for those waters. Since the early 2000s, the EPA has recognized and promoted the benefits of using GSI in protecting drinking water supplies and public health, mitigating overflows from storm sewers, and reducing stormwater pollution. The EPA has encouraged the use of GSI by municipal agencies as a prominent component of their MS4 programs.¹

The State and Regional Water Boards have followed suit in recognizing not only the water quality benefits of GSI but the opportunity to augment local water supplies in response to the impacts of drought and climate change. The 2014 California Water Action Plan called for stormwater management solutions with multiple benefits and more efficient permitting programs. This directive created the State Water Board's "Strategy to Optimize Resource Management of Stormwater" (STORMS). STORMS' stated mission is to "lead the evolution of stormwater management in California by advancing the perspective that stormwater is a valuable resource, supporting policies for collaborative watershed-level stormwater management and pollution prevention, removing obstacles to funding, developing resources, and integrating regulatory and non-regulatory interests."²

These federal and state initiatives have influenced approaches in Bay Area municipal stormwater NPDES permits, as described in Section 1.3.2.

1.3.2 Municipal Regional Stormwater Permit

The City is subject to the requirements of the Municipal Regional Stormwater NPDES Permit (MRP) for Phase I municipalities and agencies in the San Francisco Bay Area (Order R2-2015-0049), which became effective on January 1, 2016. The MRP applies to 76 municipalities and flood control agencies that discharge stormwater to San Francisco Bay, collectively referred to as Permittees.

Over the last 16 years, under Provision C.3 of the MRP and previous permits, new development and redevelopment projects on private and public property that exceed certain size thresholds ("regulated projects") have been required to mitigate impacts on water quality by incorporating post-construction stormwater control measures, including site design, pollutant source control, stormwater treatment, and flow control measures, as appropriate. Low Impact Development (LID) treatment measures that use natural treatment processes, such as rainwater harvesting and use, infiltration, and biotreatment, have been required on most regulated projects since December 2011.

MRP Provision C.3.j requires Permittees to develop and implement long-term GSI Plans for the inclusion of LID drainage design into storm drain infrastructure on public and private lands, including streets, roads, storm drains, parking lots, building roofs, and other elements. Much of the incorporation of GSI is intended to be accomplished by retrofitting existing impervious areas in public right-of-ways and on public property, in addition to continuing to implement LID on regulated projects.

1. See: <https://www.epa.gov/green-infrastructure>

2. See: https://www.waterboards.ca.gov/water_issues/programs/stormwater/storms/

1.3.3 Consent Decree with San Francisco Baykeeper

A Consent Decree between the City and San Francisco Baykeeper, a conservation group, became effective on August 11, 2016. As a result, the City agreed to develop a plan (Comprehensive Load Reduction Plan) and pursue funding for the purposes of improving stormwater quality and reducing stormwater flows to its major waterways and tributaries. This GSI Plan has been developed in a manner that fulfills the City's obligation under the Consent Decree. Specifically, the quantitative analyses described in later sections of the GSI Plan and the Reasonable Assurance Analysis Appendix demonstrate how the City can meet flow reduction requirements to address the critical bacteria storm described in the Consent Decree.

1.4 PURPOSE & GOALS

The GSI Plan is a roadmap showing how the City of San José will transform its urban landscape and storm drainage systems from a singular reliance on traditional “gray” infrastructure, where stormwater runoff flows directly from impervious surfaces into storm drains and receiving waters, to an integrated approach that includes more resilient and sustainable “green” infrastructure systems. GSI systems disperse runoff to vegetated areas reducing and slowing flows, promote infiltration and evapotranspiration, collect runoff for non-potable uses, and treat runoff using biotreatment and other green stormwater infrastructure practices. The GSI Plan addresses GSI planning and implementation within the City of San José's jurisdiction. The GSI Plan also demonstrates the City's long-term commitment to implement GSI to reduce pollutants discharged to local waterways and meet regulatory requirements.

The GSI Plan achieves, assists, and aligns with the implementation of goals, policies, and actions from various City planning documents including the Envision San José 2040 General Plan - specifically, Action IN-3.17 to develop and implement a green streets plan. The GSI Plan is also consistent with the City's Climate Smart San José goals to be a sustainable city. Goals of the GSI Plan are shown in Figure 1-2.

Goals of the GSI Plan Include:

- 1** Protect beneficial uses of waterways within San José, including the Bay, and provide environmental and community benefits.
- 2** Capture, infiltrate, treat, and/or “repurpose” stormwater with multibenefit projects that can enhance public spaces, water supply, flood control, habitat, and green spaces.
- 3** Retrofit public right-of-ways to exhibit complete streets with GSI.
- 4** Reduce pollutants discharging to creeks from the MS4.
- 5** Demonstrate quantitatively the pollutant load reductions that can be achieved through implementation of GSI.

Figure 1-2. Goals of the GSI Plan

The GSI Plan serves as an implementation guide and reporting tool to provide reasonable assurance that pollutant reduction requirements in the City's stormwater discharge permit will be met. This is a major Citywide effort requiring close collaboration among City departments, especially those responsible for projects affecting future alignment, configuration, or design of impervious surfaces that produce stormwater runoff, as well as those responsible for operation and maintenance of existing and future GSI facilities.



Figure 1-3. GSI Plan Schedule

1.5 OVERVIEW OF THE GSI PLAN

1.5.1 GSI Plan Development Process

The process began with the preparation of the City's GSI Plan Framework (Framework), a work plan describing the goals, approach, tasks, and schedule needed to complete the GSI Plan. Development of the Framework was a regulatory requirement to demonstrate the City's commitment to completing the GSI Plan by September 30, 2019. The City Council adopted the completed Framework in May 2017. Figure 1-3 shows the schedule milestones for the development of the GSI Plan.

The overall approach to developing the GSI Plan consisted of three main components:

1. Identifying the type, location, and priority of potential GSI facilities to meet pollutant reduction goals;
2. Reviewing City planning, policy, and ordinance documents for adequacy and consistency with GSI language, and updating them if needed to facilitate implementation; and
3. Incorporating technical guidance and information on funding, tracking, and maintenance mechanisms to facilitate GSI implementation.

As described in Section 5.2, the Santa Clara Valley Water District (Valley Water) and the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP)³ recently completed a Stormwater Resource Plan (SWRP) for the Santa Clara Basin (the portion of Santa Clara County that drains to San Francisco Bay). The SWRP identified and prioritized potential multibenefit GSI opportunities on public parcels and street right-of-ways within San José and other cities in the Santa Clara Basin. The GSI Plan builds on the SWRP output to further identify, evaluate, and prioritize potential stormwater improvements, while developing the comprehensive long-term GSI implementation roadmap for the City. The goal is to identify cost-effective, multibenefit projects that provide additional water quality, community, and environmental benefits.

3. SCVURPPP is an association of thirteen cities and towns in Santa Clara Valley, the County and Valley Water that share resources toward stormwater permit compliance and collaborate on projects of mutual benefit.

To help select locations for GSI facilities, the City utilized a reasonable assurance analysis (RAA) model that was developed using hydrologic, hydraulic, pollutant loading, and cost data. The model was used to determine areas of the City with higher pollutant loading and the most cost-effective ways to implement GSI facilities to provide reasonable assurance of the reduction of pollutant loads. The model outputs were coordinated with the Storm Sewer Master Plan to identify projects that can provide both flood protection and water quality improvement. GSI was also considered for planned traffic safety improvement projects to ensure street designs meet complete street guidelines, including proper stormwater runoff management.

1.5.2 Reasonable Assurance Analysis

The City conducted a reasonable assurance analysis (RAA) to quantitatively demonstrate the amount of stormwater runoff within the City's jurisdiction and the GSI that is needed to capture, treat, and/or infiltrate stormwater to reduce fecal indicator bacteria (FIB) loads to the City's creeks and San Francisco Bay. The City performed the RAA to demonstrate how GSI can be implemented to support attainment of a FIB load reduction standard identified in the Consent Decree with San Francisco Baykeeper, which considers an allowable frequency of exceedance of FIB water quality objectives based on natural conditions. The City is also collaborating on a parallel effort led by SCVURPPP to perform a similar RAA to assess the GSI needed to reduce loads of polychlorinated biphenyls (PCBs) and mercury to San Francisco Bay to meet requirements of the MRP.

The RAA is based on modeling tools that (1) simulate the rainfall/runoff processes in City watersheds and the associated stormwater discharges to the City's waterways and (2) estimate the volume or pollutant load reductions based on GSI opportunities identified in the GSI Plan. The RAA is consistent with multiple guidance documents developed by the U.S. Environmental



Guadalupe River Trail

Protection Agency, State of California, and the Bay Area Stormwater Management Agencies Association (BASMAA) that inform the types of models used, expectations for model performance, and methods for documenting and presenting results to demonstrate with reasonable assurance that stormwater control measures (including GSI) will reduce stormwater flows or pollutant loads to meet water quality goals. The RAA models consider thousands of alternative scenarios that represent various combinations of GSI projects located throughout the City, and they identify the most cost-effective implementation strategy to attain the FIB load reduction standard and MRP requirements for PCBs and mercury.

A full description of the RAA addressing FIB is included in Appendix B. The stormwater volume capture goal for FIB is greater than the PCB and mercury (Hg) goals, therefore, attainment of the FIB goal means that PCB and Hg objectives will also likely be met. Results of the SCVURPPP RAA addressing PCBs and mercury will be completed at a later time.

PLAN DEVELOPMENT PROCESS

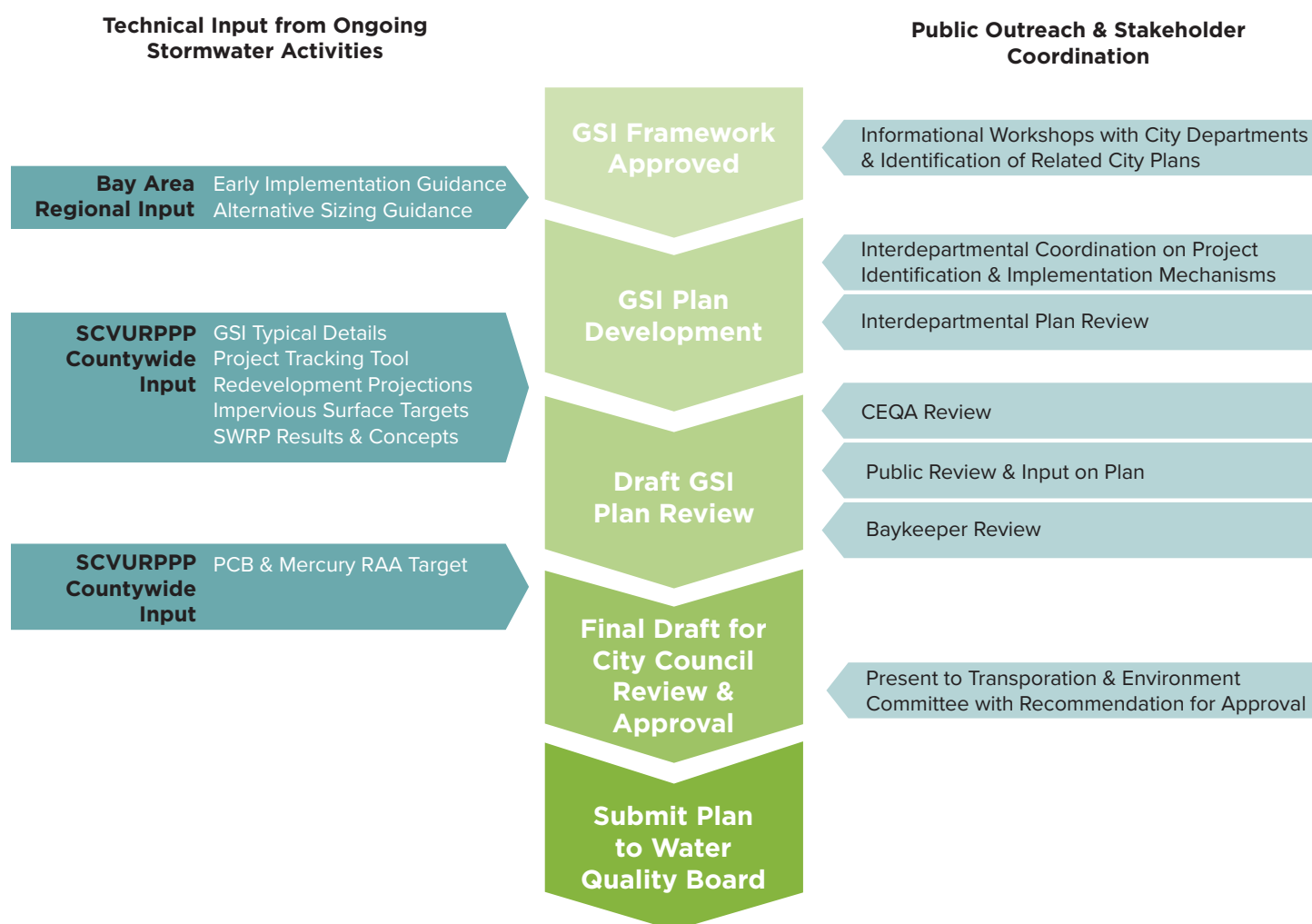


Figure 1-4. Plan Development Process

1.5.3 GSI Plan Sections & Appendices

The remainder of the GSI Plan contains the following information and appendices:

2 What is Green Stormwater Infrastructure?

Chapter 2 describes the impacts of urban development, the definition and purpose of GSI, the benefits of GSI, and types of GSI facilities, including bioretention, pervious pavement, infiltration, green roofs, and stormwater capture and use facilities. It also discusses the three GSI project type categories: green streets, LID retrofits, and regional projects.

3 GSI Coordination with Related Planning Documents

Chapter 3 describes the relationship of the GSI Plan to other planning documents and efforts within the City and how those planning documents have been updated or modified, if needed, to support and incorporate GSI requirements. For documents whose desired updates and modifications have not been accomplished by the completion of the GSI Plan, a work plan and schedule are laid out to complete them.

4 GSI Design Guidelines, Standards, & Specifications

Chapter 4 outlines the materials developed by SCVURPPP and the City of San José to provide guidelines, typical details, specifications, and standards for municipal staff and others in the design, construction, and operation and maintenance of GSI facilities.

5 GSI Project Prioritization Methodology

Chapter 5 presents the methodology used to identify priority candidate sites for GSI projects. This starts at a countywide scale, as described in the Santa Clara Basin Storm Water Resource Plan (SWRP), and is then further refined based on the City's priorities.

6 GSI Citywide Strategy

Chapter 6 outlines the short-term and long-term strategies for implementing a mix of prioritized potential GSI projects within the next 10 years and through 2050.

7 Implementation Plan

Chapter 7 discusses the variety of mechanisms to be employed by the City in order to implement the GSI Plan, including future planning and outreach, performance assurance, tracking, and funding.

A List of Acronyms

Appendix A provides a list of acronyms of terms used in the GSI Plan.

B Reasonable Assurance Analysis

Appendix B describes the Reasonable Assurance Analysis (RAA) conducted for the City of San José to quantify the amount and type of GSI projects needed to achieve stormwater quality improvement goals related to the reduction of bacteria in local creeks.

C Project Concepts

Appendix C includes concept drawings and fact sheets for potential regional GSI projects within the City, including a description of potential benefits and planning-level cost estimates.

D Maintenance & Monitoring Plan

Appendix D contains the City's Maintenance and Monitoring Plan that describes how the City will ensure proper maintenance through monitoring of GSI condition. It also describes maintenance activities needed for each type of GSI facility.

E Green Streets Prioritization Maps

Appendix E includes maps developed for prioritizing green street opportunities.



City of San José

Green stormwater infrastructure can mitigate the impacts of urban development on natural systems while providing additional benefits. The City will employ GSI facilities including bioretention, permeable pavement, and infiltration facilities within the public right-of-way and in public spaces to meet water quality goals and provide community and economic benefits.

IN THIS CHAPTER

2.1	Definition & Purpose	14
2.2	Types of GSI Facilities	16
2.3	Types of GSI Projects	19

2.1 DEFINITION & PURPOSE

2.1.1 Impacts of Urban Development

In natural landscapes, most of the rainwater soaks into the soil or is taken up by plants and trees. However, in urban areas, building footprints and paved surfaces such as driveways, sidewalks, and streets prevent rain from soaking into the ground. As rainwater flows over and runs off impervious surfaces, this “urban runoff” or “stormwater runoff” can pick up pollutants such as motor oil, metals, pesticides, pet waste, and litter. It then carries these pollutants into the City’s storm drains, which flow directly to local creeks and San Francisco Bay, without any cleaning or filtering to remove pollutants.

As urban areas develop, the increase in impervious surface also results in increases in peak flows and volumes of stormwater runoff from rain events. Traditional “gray” stormwater infrastructure, like most of the City’s storm drain system, is designed to convey stormwater flows quickly away from urban areas. However, the increased peak flows and volumes can cause erosion and habitat degradation in downstream creeks to which stormwater is discharged.



Storm Drain Draining to Guadalupe River

2.1.2 Green Stormwater Infrastructure Approach

The City is working to create sustainable or green streets, buildings, and parking lots that mimic natural landscapes by incorporating green stormwater infrastructure features. These features allow stormwater runoff from buildings, streets, and parking lots to soak into the ground and be filtered by soil. This reduces the quantity of water and pollutants flowing into storm drains and local creeks.

GSI uses soil, plants and pervious surfaces to capture, treat, infiltrate, and slow urban runoff. GSI facilities can also be designed to capture stormwater for uses such as irrigation and toilet flushing. GSI integrates building and roadway design, complete streets, drainage infrastructure, urban forestry, soil conservation, and sustainable landscaping practices to achieve multiple benefits.

In this GSI Plan, GSI refers to specific natural drainage practices in urban environments that retain, treat, infiltrate, evapotranspire, and harvest and use rainwater and stormwater runoff as a valuable resource instead of directly piping and discharging it to the Bay as quickly as possible. The primary focus of the GSI Plan is the integration of these practices into public parcels and right-of-ways.

Examples of GSI practices include: landscape-based stormwater “biotreatment” using soil and plants; pervious pavement systems (e.g., interlocking concrete pavers, porous asphalt, and pervious concrete); rainwater harvesting systems (e.g., cisterns); infiltration facilities (e.g., infiltration trenches and subsurface infiltration systems); and other methods to capture and use stormwater as a resource. These practices, also known as Low Impact Development (LID) site design and treatment measures, are described in more detail in Section 2.2.

2.1.3 Benefits of GSI

The advantage of the GSI approach to stormwater management is that GSI can provide many benefits beyond stormwater runoff control. These benefits include environmental, economic, and community improvements.

Environmental Benefits

GSI facilities are designed to capture, treat, infiltrate (where possible), and slow stormwater runoff. They can mitigate localized flooding and reduce erosive flows and quantities of pollutants being discharged to local creeks and the Bay. However, there are many ancillary benefits, especially for the types of GSI that use vegetation and trees. Vegetated GSI systems can help improve air quality by filtering and removing airborne contaminants from vehicle and industrial sources and can reduce urban heat island effects by providing shade and cooling landscapes. Increasing vegetation can also provide an ecological benefit by improving the biodiversity of plant types in the urban environment and providing habitat for birds, butterflies, bees, and other local species. Vegetated green roofs can also help insulate buildings, shade building surfaces, and reduce energy use. Together, these benefits help build resilience to the impacts of climate change and support sustainability goals.

In addition, GSI helps to make better use of stormwater as a water resource, by increasing local water supplies or offsetting use of potable water. Depending on soil characteristics and strata, GSI may promote infiltration into shallow groundwater layers or even help recharge deeper aquifers. GSI facilities have the potential to support development or augmentation of alternative water supplies, such as recycled water. Also, when designed with extra storage GSI can capture stormwater for later use as irrigation water or non-potable uses such as toilet flushing and cooling tower supply, thus conserving potable water supplies.

Economic Benefits

Strategic implementation of GSI has the potential to defer or even eliminate the need for typical and expensive gray infrastructure projects. By providing more storage within the watershed, GSI could help reduce the costs of conveying and pumping stormwater. In some situations, when cost-benefit analyses are performed, GSI may be the preferred alternative due to the multiple benefits provided by GSI as compared to conventional infrastructure. Installation of GSI can also be a less expensive alternative to gray infrastructure.

Community Benefits

Implementing GSI provides opportunities to increase the quality of neighborhoods and add community amenities. These include greening and beautifying public spaces by planting additional trees, installing green roofs that provide park-like spaces (if accessible), providing unique design opportunities for the integration of public art, and enhancing parks and public right-of-ways for public gathering. When traffic calming improvements such as curb extensions and bulb-outs at intersections are used to promote active transportation and increased pedestrian bicycle safety, there is an opportunity to use the additional space created by the improvements to integrate GSI facilities. The trend toward development of GSI facilities is also creating the need for a new “green workforce” to perform installation and maintenance of the facilities, which helps create jobs.



Jackie Brookner Stormwater Artwork at the Roosevelt Community Center in San José

2.2 TYPES OF GSI FACILITIES

Integrating GSI into public spaces typically involves construction of stormwater capture and treatment measures in public streets, parks, and parking lots or as part of public buildings. Types of GSI measures that can be constructed in public spaces include: (1) bioretention; (2) pervious pavement, (3) infiltration facilities, (4) green roofs, and (5) rainwater harvesting and use facilities. Descriptions of these facility types are provided as follows.

2.2.1 Bioretention Areas

Bioretention areas are depressed landscaped areas that consist of a ponding area, a mulch layer, plants, and a special biotreatment soil media composed of sand and compost, underlain by drain rock and an underdrain, if required. Bioretention is designed to retain and filter stormwater runoff through biotreatment soil media and plant roots, and either infiltrate stormwater runoff to underlying soils as allowed by site conditions, release treated stormwater runoff to the storm drain system, or both. They can be of any shape and size and are adaptable for use on a building or parking lot site or in the street right-of-way.

Bioretention systems in the streetscape have specific names: stormwater planters or stormwater curb extensions. A stormwater planter is a linear bioretention facility in the public right-of-way along the edge of the street, often in the planter strip between the street and sidewalk. They are typically designed with vertical (concrete) sides; however, they can also have sloped sides depending on the amount of space that is available.

A stormwater curb extension (or bulb-out) is a bioretention system that extends into the roadway and involves modification of the curb line and gutter. Stormwater curb extensions may be installed midblock or at an intersection. Curb bulb-outs and curb extensions installed for pedestrian safety, traffic calming, and other transportation benefits can also provide opportunities for siting bioretention facilities. Parking lots can accommodate bioretention areas of any shape in medians, corners, and pockets of space unavailable for parking.



Bioretention Curb Extension on Chynoweth Avenue



Linear Bioretention Facilities on Autumn Parkway

2.2.2 Pervious Pavement

Pervious pavement is hardscape that allows water to pass through its surface into a storage area filled with gravel prior to infiltrating into underlying soils. Types of pervious pavement include permeable interlocking concrete pavers, pervious concrete, porous asphalt, and grid pavement. Pervious pavement is often used in parking areas or on streets where bioretention is not feasible due to space constraints. Pervious pavement does not require a dedicated surface area for treatment and allows a site to maintain its existing hardscape.

There are two types of pervious pavers: Permeable Interlocking Concrete Pavers (PICP) and Permeable Pavers (PP). PICP allow water to pass through the joint spacing between solid pavers, and PP allow water to pass through the paver itself and therefore can have tighter joints. Porous asphalt and pervious concrete are similar to traditional asphalt and concrete, but do not include fine aggregates in the mixture, allowing water to pass through the surface. All types are supported by several layers of different sizes of gravel to provide structural support and water storage.

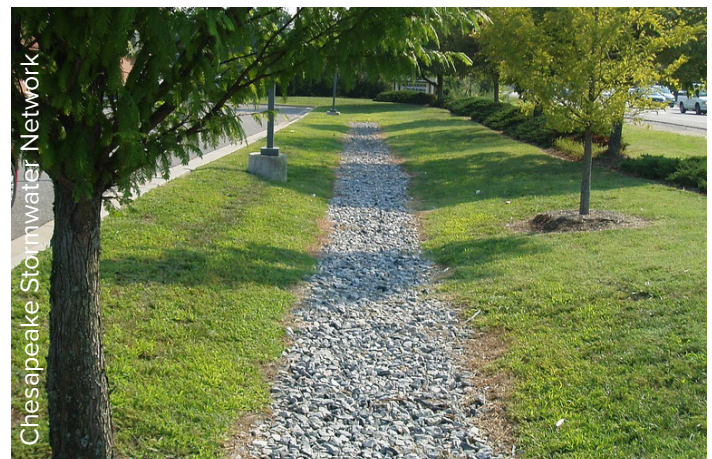


Permeable Pavement in Martha Gardens Alley Way

2.2.3 Infiltration Facilities

Where soil conditions permit, infiltration facilities can be used to capture stormwater and infiltrate it into native soils. The two primary types are infiltration trenches and subsurface infiltration systems. An infiltration trench is an excavated trench backfilled with a stone aggregate. Infiltration trenches collect and detain runoff, store it in the void spaces of the aggregate, and allow it to infiltrate into the underlying soil.

Subsurface infiltration systems are another type of GSI facility that may be used beneath parking lots or parks to infiltrate larger quantities of runoff. These systems, also known as infiltration galleries, are underground vaults or pipes that store and infiltrate stormwater while preserving the uses of the land surface above, such as parking lots, parks, and playing fields. Storage can take the form of large-diameter perforated metal or plastic pipe, concrete arches, concrete vaults, plastic chambers or crates with open bottoms.



Infiltration Trench



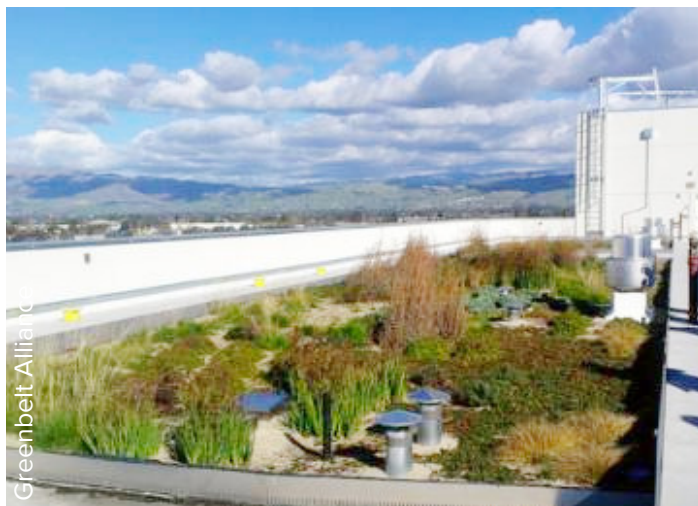
Subsurface Infiltration Gallery

2.2.4 Green Roofs

Green roofs are vegetated roof systems that filter, absorb, and retain or detain the rain that falls upon them. Green roof systems are comprised of a layer of planting media planted with vegetation, underlain by other structural components including waterproof membranes, synthetic insulation, geofabrics, and underdrains. A green roof can be either “extensive,” with 3 to 7 inches of lightweight planting media and low-profile, low-maintenance plants, or “intensive,” with a thicker (8 to 48 inches) of media, more varied plantings, and a more garden-like appearance. Green roofs can provide high rates of rainfall retention via plant uptake and evapotranspiration and can decrease peak flow rates in storm drain systems because of the storage that occurs in the planting media during rain events.



South San José Police Station Green Roof



Fourth Street Apartments Green Roof

2.2.5 Rainwater Harvest & Use Facilities

Rainwater harvesting is the process of collecting rainwater from impervious surfaces and storing it for later use. Storage facilities that can be used to harvest rainwater include rain barrels, blue roofs, aboveground or belowground cisterns, open storage reservoirs (e.g., ponds), and various underground storage devices (tanks, vaults, pipes, and proprietary storage systems). The harvested water is then fed into irrigation systems or non-potable water plumbing systems, either by pumping or by gravity flow. Uses of captured water may include irrigation, vehicle washing, and indoor non-potable use such as toilet flushing, heating and cooling, or industrial processing. The award winning public artwork Watershed designed by artist Peter Richards is a good example of a rainwater harvest system. This public artwork captures rainwater from the San José Environmental Innovation Center roof and channels it into a 6,600-gallon water storage tank which is then used to irrigate a grove of 100-year-old olive trees.

The two most common applications of rainwater harvesting systems are:

1. Collection of roof runoff from buildings; and
2. Collection of runoff from at-grade surfaces or diversion of water from storm drains into large underground storage facilities below parking lots or parks.

Rooftop runoff usually contains lower quantities of pollutants than at-grade surface runoff and can be collected via gravity flow. Underground storage systems typically include pretreatment facilities to remove pollutants from stormwater prior to storage and use.



San José Environmental Innovation Center

2.3 TYPES OF GSI PROJECTS

Applications for GSI facilities as part of GSI projects can be categorized as green streets, parcel-based LID retrofits, and regional projects as shown in Figure 2-1. The types of GSI projects described in this GSI Plan are typically constructed on publicly owned property or within public right-of-ways (e.g., along streets) and will often involve retrofitting an existing impervious area such that the area will drain to a pervious area and/or a GSI facility.

2.3.1 Green Streets

GSI roadway projects are typically called “green streets.” Green street projects are located in the public right-of-way and capture runoff from the street and adjacent parcels. Green streets are distributed, small-scale GSI projects spread throughout an urban area that provide localized treatment and flood reduction for relatively small drainage areas. For example, green streets can include facilities such as bioretention bulb-outs, stormwater planters, or permeable pavers along street right-of-ways.

There are often opportunities to combine GSI projects with another type of street design known as “complete streets.” This latter term refers to streets that incorporate all modes of travel equally and are designed to increase safety and access for cyclists and pedestrians regardless of age or ability. The integration of the goals of both complete streets and green streets has coined several new terms such as “living streets,” “better streets” and “sustainable streets.” This movement recognizes the multiple benefits that environmentally and holistically designed streets can achieve.

1 Green Streets

City of San José



2 LID Retrofits

City of San José



3 Regional Projects

Kitsap County Public Works



Figure 2-1. Green Streets, LID Retrofits, and Regional Projects

2.3.2 Parcel-Based Low Impact Development Retrofits

LID retrofit projects mitigate stormwater impacts by reducing runoff through capture and/or infiltration and treating stormwater on-site before it enters the storm drain system. LID retrofit projects may include bioretention facilities, infiltration trenches, detention and retention areas in landscaping, pervious pavement, green roofs, and systems for stormwater capture and use. These measures help to protect water quality by filtering stormwater through plants and soil and allowing stormwater to infiltrate into the ground, thus mimicking the pre-urbanized natural hydrology of the undeveloped site. For the purposes of this GSI Plan, LID retrofit projects are GSI facilities that are built on a parcel to treat runoff generated from impervious surfaces on that parcel. These projects may or may not be regulated projects (see Section 6.3).

2.3.3 Regional Projects

Regional GSI projects are large-scale stormwater capture and treatment measures that are intended to collect and treat runoff from a large drainage area, including runoff from on-site and off-site areas. Off-site surface runoff can come from diversions from storm drains, channels, culverts, and streams. These types of projects include aboveground or underground runoff capture facilities or subsurface infiltration galleries located in large open space areas or under existing uses (such as parking lots or parks) to which runoff from large areas of impervious surface can be directed. Benefits of regional stormwater capture projects include flood risk reduction, stormwater treatment and use, groundwater recharge, and the potential to augment alternative water supplies. They are often the most cost-effective projects due to the multiple benefits achieved and the economies of scale. The site characteristics and uses will determine what types of regional projects are feasible, e.g., how much flow the project can divert from the storm drain network, whether the project is aboveground or underground, and the size of the project. All projects proposed in City parks must conform to the City Charter Section 1700 Parks.



Permeable Pavement at Crescent Village Park in San José



3.0

GSI COORDINATION WITH RELATED PLANNING DOCUMENTS

City of San José

To enable its successful implementation, the GSI Plan has been developed to be consistent with existing City planning documents and will be integrated into planning documents currently under development.

IN THIS CHAPTER

3.1	GSI Support in Current City Plans	22
3.2	Work Plan for Future Integration of GSI Language into Related City Plans	25
3.3	Regional Plans	26

3.1 GSI SUPPORT IN CURRENT CITY PLANS

To ensure the success of the GSI Plan and its implementation, its goals, policies, and implementation strategies should align with Envision San José 2040 and other related planning documents. The MRP requires that municipal agencies review such documents and include in their GSI Plans a summary of any planning documents updated or modified to appropriately incorporate GSI requirements.

The City completed a review of its existing planning documents to determine the extent to which GSI-related language, concepts, and policies have been incorporated, starting with those that were identified in the City's Green Infrastructure Plan Framework (Framework). Additional documents were identified after the Framework was completed. In the future, new plans and updates to existing plans will contain appropriate language to further support the GSI Plan as needed.

The City of San José develops and has developed several planning documents that address different elements of City operations related to GSI including land use, transportation, sustainability, conservation, urban forestry, environmental leadership, infrastructure, employment, and housing.

3.1.1 Envision San José 2040 General Plan

The General Plan is the overarching document used to govern the City's goals, policies, and actions. The General Plan is updated in intervals with some sections, such as the Housing Element, being updated more frequently. The GSI Plan implements many General Plan goals, policies, and actions within various sections of the General Plan, including Measurable Sustainability (MS), Environmental Resources (ER), Community Design (CD), Transportation (TR), and Infrastructure (IN):

- » Promote, require, and practice the use of GSI facilities, such as pervious pavement, bioretention and rainwater harvesting, on public and private land. (MS-3.4, MS-18.12, MS-18.14, ER-8.1, ER-8.2, ER-8.3, ER-8.5, ER-8.6, ER-8.7, CD-2.5, TR-2.12)
- » Protect and enhance groundwater as a water supply, improve local watersheds, and reduce flood risk. (MS-20.3, ER-8.4, and ER-8.8)
- » Promote, partner with, and educate the public and key stakeholders on the importance of responsible stormwater management. (ER-8.9 and ER-8.10)
- » Provide and maintain adequate infrastructure to support the City's residents and businesses. (IN-1 and IN-3.16)
- » Develop and implement a Green Street Plan consistent with the MRP. (IN-3.17)

The General Plan may be updated to include further policies to facilitate GSI during annual or four-year major reviews, as needed, to further support the GSI Plan. Specific plans are incorporated in the General Plan and updated through General Plan text amendments. Discretionary planning permits allowing new development must be consistent with the General Plan, regardless of its location within or outside of a Specific Plan area.

3.1.2 Urban Village Plans

Urban Village Plans are prepared by the City and community to provide a policy framework to guide new job and housing growth within each Urban Village boundary. Each plan describes the desired characteristics of future development, including buildings, parks, plazas and public art, streetscape and circulation, and financing for improvements or maintenance.

Urban Village Plans include discussion relevant to GSI and sustainability. A good example is the following language from The Alameda Urban Village Plan, Chapter 5 - Urban Design (UD) and Historic Preservation, Section 1 – Urban Design, Urban Design Goal #5 - Sustainability:

- » Goal UD-5: Ensure that new development in The Alameda Urban Village maintains and improves quality of life and protects the environment.
- » Policy UD-5-1: All projects shall be consistent with or exceed the City's Green Building, renewable energy, stormwater, and trash management policies, Ordinance and City Council Policies, and 2040 General Plan Environmental Leadership section as well as State and/or regional policies.
- » Policy UD-5-2: Manage stormwater runoff in compliance with the City's Post-Construction Urban Runoff (6-29) and Hydromodification Management (8-14) Policies.
- » Guidelines: Stormwater Management:
 - Require the use of native or drought tolerant plant species that require low water usage and maintenance.
 - Design and use natural drainage such as bioretention in on-site pocket parks and other landscaped areas to filter surface water runoff.
 - Use water permeable paving surfaces in parking lots and other paved areas to increase natural percolation and on-site drainage of stormwater.

The Alameda Urban Village Plan Chapter 6 – Circulation and Streetscape (CS) also includes important goals and policies such as:

- » Goal CS-4: Contribute to greenhouse gas reduction and sustainability goals of the Envision San José 2040 General Plan by planning for green streets.
- » Policy CS-4.2: Require the incorporation of stormwater runoff treatment (green infrastructure) into the public right-of-way (such as along sidewalks, in medians, bulb-outs, parks, and plazas) as part of public improvements to the maximum extent practicable. Allow centralized/regional stormwater treatment facilities as an alternative approach.

Other examples of GSI policy language in Urban Village Plans include:

- » This plan should address the potential for treating stormwater runoff in vegetative treatment systems integral with the parks and open spaces. While each specific project within the area should develop their own stormwater quality plan to treat stormwater at the point source, the backbone infrastructure that supports the entire plan may need regional areas to treat stormwater runoff from the streets and other public areas. (Diridon Station Area Plan)
- » Different types of green infrastructure elements, such as rain gardens, vegetated swales, infiltration and flow-through planters, and stormwater tree wells should be employed as appropriate to local conditions. (East Santa Clara Urban Village Plan)
- » Installation of rain gardens as part of protected bike lanes should be considered to take advantage of grade and drainage patterns. (East Santa Clara Urban Village Plan)

The General Plan governs these documents so they are not required to have GSI-related language; however, the City will continue to incorporate GSI-related language with future updates consistent with goals and policies to support sustainability as outlined in the General Plan.

The following Urban Village Plans are under development and will include GSI-related goals and/or policies:

- » North 1st Street
- » Alum Rock Avenue (east of 680)
- » Southwest Expressway/Race Street Light Rail
- » Berryessa BART

The following Urban Village Plans include GSI-related language:

- | | |
|---------------------------|-----------------------------|
| » West San Carlos | » Diridon Station Area Plan |
| » South Bascom | |
| » East Santa Clara | » Roosevelt Park |
| » The Alameda | » Little Portugal |
| » Stevens Creek | » Five Wounds |
| » Winchester Blvd | » 24th and Williams |
| » Santana Row/Valley Fair | |

3.1.3 San José Complete Streets Design Standards & Guidelines

The Complete Streets Design Standards and Guidelines document was developed to provide a comprehensive set of street design guidelines for the building and retrofitting of City of San José roadways. The guidelines, completed in 2018, “describe a comprehensive approach to the practice of mobility planning that recognizes that transportation corridors have multiple users with different abilities and travel mode preferences (such as walking, biking, taking transit and driving).”

The guidelines also recognize the need for integration of GSI in street design. Stormwater management policies are included in Section 3 of the guidelines (“Key Elements of Complete Streets”) and recommended for inclusion in the design and scoping of complete street projects, as appropriate. Another section, “Stormwater Management through Green Street Design,” provides an overview of various GSI elements and their applicability and function.

3.1.4 Climate Smart San José

Climate Smart San José is the community's Climate Action Plan. It articulates how every facet of the City—from buildings, to mobility, to growth of the city needs to transform to minimize climate impacts. It articulates how every facet of the City—from buildings, to mobility, to growth of the workforce—needs to transform to minimize climate impacts. The GSI Plan is consistent with the City’s goals to be a sustainable, climate smart city.

Strategy 1.2 of Climate Smart San José includes embracing the Californian climate by “creating an urban landscape, in our homes and public places that is not just low water use, but attractive and enjoyable.” Potential actions to support this strategy include:

- » Convene to advance regional conversation to understand potential contribution of stormwater capture and reuse to region’s water supply portfolio. (1.2-J)
- » Run program to include green stormwater infrastructure (e.g., rain gardens) as part of complete streets requirements. (1.2-L)

3.1.5 Storm Sewer Master Plan

The City is developing a Storm Sewer Master Plan (Master Plan) that is intended to describe how the City will meet future demands for stormwater conveyance. Currently, the City is conducting a study to evaluate the storm sewer system capacity based on a 10-year storm event that will identify deficiencies in the system and recommend projects to address existing or potential flood issues. As part of the study, existing GSI installations and potential project concepts will be evaluated. The Master Plan will describe, to the extent feasible, the synergies and benefits that could be realized by implementing GSI projects in conjunction with storm sewer capacity improvement projects. The GSI Plan and Master Plan efforts will continue to be coordinated to ensure the goals of each plan are considered during preliminary planning and design phases of projects.

3.2 WORK PLAN FOR FUTURE INTEGRATION OF GSI LANGUAGE INTO RELATED CITY PLANS

Although current City plans are generally aligned with and support the GSI Plan, several City plans could benefit from additional GSI-related language. The following plans will be updated as needed in accordance with each document's scheduled update

in Table 3-1. The City will review GSI Plan requirements when revising or updating existing planning documents or when developing new planning documents to ensure that GSI requirements and policies are incorporated. Examples of GSI-related language can be found in existing City plans, as described in Section 3.1 above, and in references such as SCVURPPP's Model Green Infrastructure Language for Incorporation into Municipal Plans (2016).

Table 3-1. GSI Language Integration Schedule

Name of Plan to be Completed / Updated	Anticipated Date of Completion / Update
San José Downtown Design Guidelines	FY 2019-20
General Plan / Specific Plans ¹	FY 2019-20
Community Forest Management Plan	FY 2019-20
Storm Sewer Master Plan	FY 2019-20
Berryessa BART Urban Village Plan	FY 2019-20
North 1st Street Urban Village Plan	FY 2020-21
Southwest Expressway/ Race Street Light Rail Urban Village Plan	FY 2020-21
Alum Rock Avenue (east of 680) Urban Village Plan	FY 2021-22

1. Specific plans are incorporated in the General Plan and updated through General Plan text amendments.



Alviso Marina Park Along San Francisco Bay

3.3 REGIONAL PLANS

The City of San José participates in the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP), an association of 13 cities, the County of Santa Clara, and the Santa Clara Valley Water District (Valley Water) that are permittees under the MRP. This partnership allows sharing of resources toward permit compliance and collaboration on projects of mutual benefit.

The City is working with SCVURPPP, Valley Water, and other agencies to integrate and coordinate several large-scale planning efforts including the following:

- » Santa Clara Basin Stormwater Resource Plan (SWRP) – A collaboration between SCVURPPP and Valley Water during 2017-2018, the SWRP supports municipal GSI Plans by identifying and prioritizing potential multibenefit GSI opportunities on public parcels and street right-of-ways throughout the Basin and allows them to be eligible for state bond-funded implementation grants. The SWRP includes a list of prioritized GSI opportunity locations for each SCVURPPP agency, including San José.
- » SCVURPPP's Reasonable Assurance Analysis (RAA) – To meet Municipal Regional Stormwater Permit (MRP) requirements, SCVURPPP has initiated a countywide effort to develop an RAA to estimate baseline PCB and mercury loads in stormwater discharges to the Bay from its

member agencies' jurisdictions, determine load reductions to meet assigned load allocations, and set goals for the amount of GSI needed to meet the portion of PCB and mercury load reduction the MRP assigns to GSI. The RAA is planned for completion by September 2020, and some results from the efforts to date have informed this GSI Plan.

- » The Bay Area's Integrated Regional Water Management Plan (IRWMP) -- The Bay Area IRWMP is a comprehensive water resources plan for the Bay region that addresses four functional areas: 1) water supply and water quality; 2) wastewater and recycled water; 3) flood protection and stormwater management; and 4) watershed management and habitat protection and restoration. It provides a venue for regional collaboration and serves as a platform to secure state and federal funding. The IRWMP includes a list of more than 300 project proposals and a methodology for ranking those projects for the purpose of submitting a compilation of high priority projects for grant funding. The Santa Clara Basin SWRP was submitted to the Bay Area IRWMP Coordinating Committee and incorporated into the IRWMP as an addendum. As SWRP projects are proposed for grant funding, they will be added to the IRWMP list using established procedures.



Guadalupe River Trail



Don Ramey Logan

The City worked with the Santa Clara Valley Urban Runoff Pollution Prevention Program and its member agencies to create a Green Stormwater Infrastructure Handbook that will provide guidance for public and private GSI designers, contractors, operation and maintenance staff and inspectors. The Handbook includes typical design details and specifications that will be referenced by and incorporated into City standards as needed.

IN THIS CHAPTER

4.1	Development Process	28
4.2	Guidelines for GSI Design	28
4.3	Typical Details & Specifications for GSI	29

4.1 DEVELOPMENT PROCESS

The MRP requires that the GSI Plan include general design and construction guidelines, standard specifications, and details (or references to those documents) for incorporating GSI components into projects within the City of San José. These guidelines, details, and specifications should address the different street and project types within the City, as defined by its land use and transportation characteristics, and allow projects to provide a range of functions and benefits, such as stormwater management, bicycle and pedestrian mobility and safety, public green space, and urban forestry.

In 2018, the City finalized its Complete Streets Design Standards and Guidelines, which provide direction on how San José streetscapes should be designed for multimodal use depending on the street type, street dimensions, intersections, and mobility types. As mentioned in Chapter 3, this guidance document describes a wide range of functions associated with streets such as safe pedestrian travel, use as a public space, multiple modes of transit, urban forestry, and stormwater management through green street design. Specifically, as it relates to stormwater management, the document describes GSI elements that “should be considered and incorporated into the complete street design process.”

In addition, the City of San José worked with the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP) and its member agencies to create a green stormwater infrastructure handbook⁴ that provides guidance for public and private GSI designers, contractors, operation and maintenance staff, and inspectors. Part 1 of the GSI Handbook provides general design guidelines for GSI facilities within public right-of-ways and on public parcels. Part 2 of the Handbook includes typical design details and specifications compiled from a variety of sources within California and nationally modified for use in Santa Clara County. The City intends to use the GSI Handbook as a primary resource for GSI guidelines, details, and specifications. The contents of the GSI Handbook are described further in the next subsections, 4.2 and 4.3.

4.2 GUIDELINES FOR GSI DESIGN

The GSI Handbook highlights the different design approaches to GSI facilities that are retrofitted into different locations in the public sphere such as roadways, parks, and parking lots. Part 1 of the Handbook provides guidance on selection, integration, prioritization, sizing, construction, and maintenance of GSI facilities. It includes sections describing the various types of GSI, their benefits, and design considerations; how to incorporate GSI with other uses of the public right-of-way, such as bicycle and pedestrian infrastructure and parking; and guidelines on utility coordination and landscape design for GSI. In addition, the Handbook provides guidance on post-construction maintenance practices and design of GSI to facilitate maintenance.

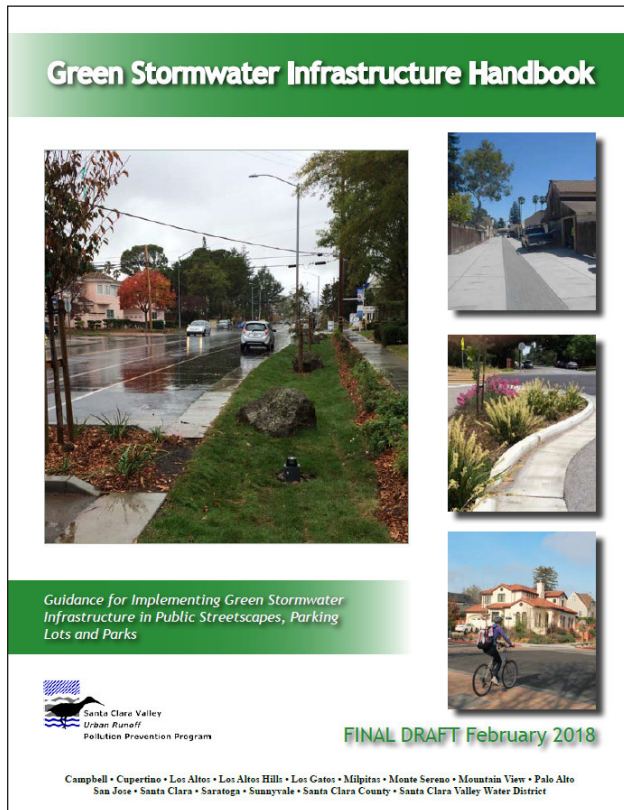
Part 1 of the Handbook also contains a section on proper sizing of GSI facilities. GSI facilities should be designed to meet the same sizing requirements as regulated projects, which are specified in Provision C.3.d of the MRP. In general, the treatment measure design standard is the capture and treatment of 80 percent of annual runoff (i.e., capture and treatment of stormwater from small, frequent storm events). Infiltration of the captured stormwater to the extent feasible is the goal of GSI facility design where site conditions allow. GSI facilities should be located and sized to treat the C.3.d volume and/or flow of runoff from all contributing impervious surface areas including private property and the public right-of-way (street and sidewalk). Similarly, for parking lots and public parks, GSI facilities should treat the C.3.d amount of runoff from all contributing impervious surface areas.

If a green street project cannot be designed to treat the C.3.d amount of runoff due to constraints in the public right-of-way or other factors, the City may still wish to construct the measure to provide some runoff reduction and water quality benefit and achieve other benefits (e.g., traffic calming, pedestrian safety). For these situations, the GSI Handbook describes regional guidance on alternative design approaches developed by BASMAA for use by MRP permittees.⁵

4. The SCVURPPP GSI Handbook is available online at [LINK TBD].

5. BASMAA, 2018. Guidance for Sizing Green Infrastructure Facilities in Street Projects.

Together with the San José Complete Streets Design Standards and Guidelines, the SCVURPPP GSI Handbook will be used during planning and implementation of GSI projects. When designing new streets or retrofitting existing streets, the Complete Streets Design Standards and Guidelines will be referenced for guidance on how and where to incorporate San José-desired street functions, including GSI. In coordination with these guidelines, project planners can reference Part 1 of the SCVURPPP GSI Handbook guidance on how to address common design approaches and site constraints, and provide design tools that can be customized based on the project-specific goals. Over time, these practices will become routine and innovation will improve the best practices, producing streets and spaces that are even more resilient, regenerative, and appealing.



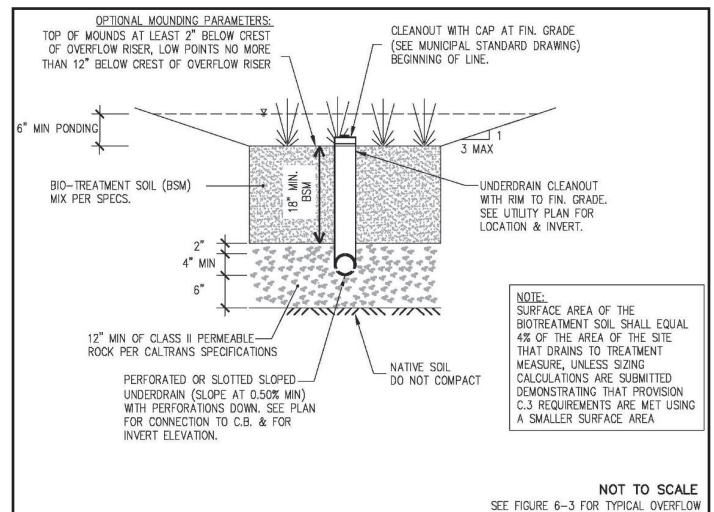
SCVURPPP's Green Stormwater Infrastructure Handbook

4.3 TYPICAL DETAILS & SPECIFICATIONS FOR GSI

Part 2 of the GSI Handbook consists of a compilation of typical details and specifications for the GSI facility types described in Section 2.2. Typical GSI design details were compiled from several sources including the San Francisco Public Utilities Commission, the California Stormwater Quality Association, the California Low Impact Development Initiative, the Bay Area Stormwater Management Agencies Association, the Cities of Philadelphia and Washington D.C., and several other exemplary programs. Several workshops were held by SCVURPPP in 2017 and 2018 to present and receive input from local agencies on various sections of and details in the draft GSI Handbook.

Based on this input, a revised draft GSI Handbook was developed containing a reduced set of details from primarily California sources, and distributed for SCVURPPP member agency comment. The final GSI Handbook contains typical details and specifications that have been modified for use in Santa Clara County, based on the comments received from SCVURPPP agencies, including San José. These details and specifications will be referenced by and incorporated into City standards, as needed.

The GSI Handbook details and specifications are flexible to allow for creativity and customization for specific locations. The City plans to use these typical details and specifications, in addition to details and specifications used on past GSI projects, for the design of future GSI projects and GSI components of capital projects.



Cross Section of a Bioretention Area (with Maximized Infiltration)

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This chapter describes the process followed to identify and prioritize GSI project opportunities in San José. This process not only considers stormwater performance but also evaluates project constructability constraints, community and environmental benefits, and synergies with other planned City projects and goals.

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5.1 INTRODUCTION & BACKGROUND

Integral to the GSI Plan was the development of a standardized process to identify and prioritize GSI project opportunities in the City. This process focused on prioritizing capital project opportunities, which include green streets to manage right-of-way runoff, LID retrofits to manage public parcel runoff on-site, and regional projects to capture large drainage areas that span both streets and parcels. A two-phase prioritization process was conducted by the City to develop a ranked list of GSI project candidates. The list serves as the basis for generating the capital project recommendations presented in the GSI citywide strategy described in Chapter 6. Moreover, the criteria and mapping output from the prioritization process provides the tools needed to understand the costs and benefits of the identified opportunities and to assess future candidate projects as they arise. The two-step prioritization process included:

1. Countywide GSI Prioritization – SCVURPPP collaborated with the City and other permittees to develop the multibenefit scoring criteria used to prioritize street, parcel, and regional GSI opportunities throughout the County.
2. San José-Specific GSI Prioritization – The City refined the prioritization output from the countywide SCVURPPP process by applying more localized criteria, including stormwater performance effectiveness using runoff volume analyses from preliminary RAA modeling output, interdepartmental feedback, and site-level construction constraints.

5.1.1 Project Types

Green stormwater infrastructure project types employed in San José fall into the following categories: green streets, LID retrofits, and regional projects. These are the types of GSI capital projects that the City will implement to meet the water quality goals and multibenefit objectives defined in the GSI Plan.

GREEN STREETS



LID RETROFITS



REGIONAL PROJECTS



5.2 COUNTYWIDE GSI PRIORITIZATION

The first step in San José's GSI project prioritization process was to participate in the evaluation of opportunities at the countywide level. This step was led by SCVURPPP and followed the State of California's guidance for developing a Stormwater Resource Plan (SWRP).

Water Code section 10563, subdivision (c)(1), requires a SWRP as a condition of receiving State grants for stormwater and dry weather runoff capture projects from any State bond approved by voters after January 2014. This requirement applies to Proposition 1, the water bond measure approved by voters in November 2014, which authorized \$200 million in grants for multibenefit stormwater management projects. Funds provided for the purpose of developing a stormwater resource plan are exempt from this requirement. As a result, in conjunction with Valley Water, SCVURPP applied for, and received a Proposition 1 planning grant from the State Board to develop a SWRP for the Santa Clara Basin.

The Santa Clara Basin SWRP (completed December 2018) provided an ideal opportunity for the SCVURPPP member agencies, including the City of San José, to proactively plan for future requirements of the MRP while providing essential information needed to explore funding needs, GSI opportunities, and Prop 1 grants for project implementation. Following the SWRP guidelines developed by the California State Water Resources Control Board (SWRCB) ensures that stormwater and dry weather runoff capture projects included within the SWRP are eligible for bond funds. These guidelines specify that the SWRP must employ quantitative methods to identify and prioritize stormwater and dry weather runoff capture projects, including the quantification of stormwater capture volumes and pollutant load reduction. The results of the Santa Clara Basin SWRP multibenefit prioritization process for green streets, LID retrofits, and regional projects is provided in the following subsections. Ultimately, as described in Section 5.3, these results served as input to the GSI Plan, which built upon the SWRP effort and refined the prioritized project list to cater it to the City's specific local conditions and goals.

5.2.1 Key Data Sources

The process used to analyze the Santa Clara watersheds and identify and prioritize GSI projects included the landscape elements that most affect hydrology and pollutant transport. Natural hydrology is influenced by physical characteristics such as impervious cover, soil type, and land segment slope. Percent imperviousness is the predominant factor in determining the quantity of runoff generated from a given area. Hydrologic Soil Group (HSG) categorizes soils based on drainage characteristics, with Group A consisting of well drained soils and Group D consisting of poorly drained soils. Slope is a factor in determining both the peak rate of runoff and the feasibility of implementing GSI projects to capture and infiltrate runoff. Additional datasets used to identify potential projects include ownership and public right-of-way data, as well as other special considerations. This data is summarized in Table 5-1.

The first step in countywide prioritization was to identify public parcels and streets that can support GSI projects. The screening process for parcels and streets is outlined in Table 5-2.



Bioretention in Commercial Parking Lot in San José

Table 5-1. SWRP Data Sources

Characteristic	Data Source	Source Date
HYDROLOGY & POLLUTANT TRANSPORT		
Land Use	Association of Bay Area Governments Data Catalog	2005
Impervious Cover	National Land Cover Dataset (NLCD) - 30 meter resolution	2011
Hydrologic Soil Group	National Resource Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO)	2016
Percent Slope	Derived from National Elevation Dataset (NED) - 10 meter resolution	2014
OWNERSHIP & PUBLIC RIGHT-OF-WAY		
Parcels	Santa Clara County Information Services Department	2017
Streets & ROW	Santa Clara County Information Services Department	2017
SPECIAL CONSIDERATIONS		
Flood Prone Streams	Santa Clara County One Water Plan: An Integrated Approach to Water Resource Management	2017
PCB Areas	SCVURPP (land use pre-1980, SWRCB Industrial Permit Facilities, pavement conditions, and site violations)	2017

Table 5-2. SWRP Parcel and Right-of-way Screening Methodology

Screening factor	Characteristic	Criteria	Reason
PARCEL			
Public Parcels	Ownership	County, City, Town, Valley Water, State, Open Space Agencies	Identify all public parcels for regional storm and dry weather runoff capture projects or on-site LID retrofits
	Land Use	Park, Public Building, Others (e.g. golf course)	
Suitability	Parcel Size	≥ 0.25 acres	Opportunity for regional stormwater and dry weather runoff capture project
		< 0.25 acres	Opportunity for on-site LID retrofit
	Site Slope	< 10%	Steeper grades present additional design challenges
RIGHT-OF-WAY			
Selection	Ownership	Public	Potential projects are focused on public and right-of-way opportunities
Suitability	Surface	Paved	Only roads with paved surfaces will be considered suitable. Dirt roads will be removed.
	Slope	< 5%	Steep grades present additional design challenges; reduced capture opportunity due to increased runoff velocity
	Speed	≤ 45mph	Excludes higher speed roads such as major arterials and highways

5.2.2 Prioritization Criteria

After the identification of feasible project locations, screened streets and parcels were prioritized to aid in the selection of potential project locations that would be most effective and provide the greatest number of benefits. In addition to physical characteristics, several special considerations were included in the prioritization methodology to consider high opportunity projects and currently planned projects provided by agencies, as well as consideration of multiple benefit projects. Specifically, projects were prioritized through the lens of the following seven categories:

1 Physical Characteristics

Physical conditions include land use, impervious area, parcel size, hydrologic soil group, and/or slope. Characteristics for a suitable project differ between project type, and a separate scoring system was developed for regional projects, green streets, and LID retrofit projects, as shown in Table 5-3.

2 Proximity to Storm Drains

The proximity to a storm drain is an important consideration in ensuring that a regional project can divert from large drainage areas upstream of that storm drain. Additionally, projects that are sited close to a storm drain benefit from lower diversion and pumping requirements.

3 Flood-prone Streams & Areas

Projects placed within the subwatersheds of flood-prone streams and areas affected by flooding can help to mitigate flood risks and reduce flood and hydromodification impacts by limiting the volume of runoff that reaches the impacted streams.

4 PCB Interest Areas

PCBs are one of the primary pollutants of concern within the Bay Area; therefore, siting stormwater capture projects in PCB interest areas can potentially address water quality issues.

5 Priority Development Areas

The Association of Bay Area Governments describes PDAs as places identified by Bay Area communities as areas for investment, new homes, and job growth. Projects that are within a PDA can coincide with redevelopment and revitalization projects, potentially taking advantage of opportunities for coordinated efforts.

6 Co-located Planned Projects

Consideration of other potential or planned City projects opens opportunities for cost-sharing and maximizes multiple benefits achieved by a single project.

7 Multiple Benefits

While the reduction of pollutant loads is one of the primary objectives of green stormwater infrastructure, several other benefits can be achieved to improve cost effectiveness and increase buy-in. Potential benefits include but are not limited to: augmentation of local/alternative water supply; source control of pollutants and runoff volume; re-establishment of natural water drainage treatment and infiltration; restoration of pre-development drainage; creation, enhancement, or restoration of habitat; and community enhancement.

5.2.3 Prioritization Method

Through the City's input and input from the other SCVURPPP member agencies, the prioritization criteria were weighted to arrive at the final project prioritization methodology. The process resulted in assigned prioritization scores for each identified GSI opportunity within each of the three project categories (green streets, LID retrofits, and regional projects). These scores could then be further filtered or sorted to support ongoing prioritization of projects within a member agency's jurisdiction. The criteria and weighting are summarized for each project type in Table 5-3.

Table 5-3. Regional, LID, and Street Project Prioritization Methodology

Metric	Points						W
	0	1	2	3	4	5	
REGIONAL PROJECTS							
Parcel Land Use			School/Golf Course	Public Building	Parking Lot	Park/Open Space	
Impervious Area (%)	X < 40	40 ≤ X < 50	50 ≤ X < 60	60 ≤ X < 70	70 ≤ X < 80	80 ≤ X < 100	2
Parcel Size (acres)	.25 ≤ X < .5	.5 ≤ X < 1	1 ≤ X < 2	2 ≤ X < 3	3 ≤ X < 4	4 ≤ X	
Hydrologic Soil Group		C/D		B		A	
Slope (%)		10 > X > 5	5 ≥ X > 3	3 ≥ X > 2	2 ≥ X > 1	1 ≥ X	
Proximity to Storm Drain (ft)	X < 1,000	1,000 ≥ X > 500		500 ≥ X > 200		200 ≥ X	
LID RETROFIT PROJECTS							
Parcel Land Use			School/Golf Course	Park/Open Space	Public Building	Parking Lot	
Impervious Area (%)	X < 40	40 ≤ X < 50	50 ≤ X < 60	60 ≤ X < 70	70 ≤ X < 80	80 ≤ X < 100	
Hydrologic Soil Group		C/D		B		A	
Slope (%)		10 > X > 5	5 ≥ X > 3	3 ≥ X > 2	2 ≥ X > 1	1 ≥ X	
GREEN STREET PROJECTS							
Impervious Area (%)	X < 40	40 ≤ X < 50	50 ≤ X < 60	60 ≤ X < 70	70 ≤ X < 80	80 ≤ X < 100	
Hydrologic Soil Group		C/D		B		A	
Slope (%)		5 > X > 4	4 ≥ X > 3	3 ≥ X > 2	2 ≥ X > 1	1 ≥ X	
ALL PROJECTS							
Within Flood-Prone Storm Drain Catchments	No					Yes	
Contains PCB Interest Areas	None			Moderate		High	2
Within Priority Development Area	No					Yes	
Co-located With Another Agency Project	No					Yes	
Augments Water Supply	No	Opportunity for capture & reuse				Above groundwater recharge area & not above groundwater contamination area	2
Water Quality Source Control	No	Yes					
Reestablishes Natural Hydrology	No	Yes					
Creates or Enhances Habitat	No	Yes					
Community Enhancement	No	Opportunity for other enrichment				Within DAC or MTC Community of Concern	

Notes: W = weighting factor

Source: Prioritization metrics for green streets, LID retrofit projects, and regional projects from Santa Clara Basin Stormwater Resource Plan (2018)

5.2.4 Green Streets

Based on results of the SWRP screening, approximately 5,000 street segments within the county were identified as high priority, i.e., scoring in the 90th percentile of screening. These street segments represent a single block or around a 300-foot segment of a continuous roadway. Of the high priority segments, more than 2,000 are in San José. These streets segments are characterized by well-draining soils, higher potential for capturing PCBs, and the other criteria listed in Table 5-3. The locations of these high priority streets are shown in Figure 5-1.

5.2.5 LID Retrofits on Public Parcels

Public, parcel-based low impact development projects within Santa Clara watersheds were additionally evaluated and prioritized for the SWRP. LID retrofit projects are designed to mitigate stormwater impacts by reducing runoff through capture and treatment of stormwater on-site before it enters the storm drain system. To prioritize LID retrofit sites, the SWRP analysis employed the same method described above to screen for public parcels, flood prone areas, PCB interest areas, and the other criteria listed in Table 5-3. More than 2,500 public parcels opportunities were evaluated in Santa Clara County for the SWRP, and more than 250 were identified as high priority, i.e., the 90th percentile of eligible parcels. Of these, almost 200 high priority LID parcel projects were identified

in San José. The location and prioritization score (i.e., high, medium, or low) of the identified LID retrofit opportunities in San José are shown in Figure 5-2.

5.2.6 Regional Projects

Regional stormwater capture projects were also evaluated and prioritized within the Santa Clara watersheds. As with LID Retrofits, these projects were screened from public parcels. However, regional projects include opportunities to manage stormwater and dry weather runoff from other off-parcel sources, such as off-site surface runoff and diversions from storm drains, channels, culverts, and streams. Regional stormwater capture projects can provide flood protection, stormwater treatment and use, and groundwater recharge. The prioritization of regional projects followed the same method described above to screen public parcels and score project feasibility based on the criteria listed in Table 5-3. However, project sites less than 0.25 acres were considered unsuitable for regional projects, and therefore regional projects represent a subset of the full parcel list analyzed for LID Retrofits. The SWRP analysis evaluated more than 1,900 public parcels in Santa Clara County and identified more than 100 potential regional project opportunities within San José as high priority. The location and prioritization score (i.e., high, medium, or low) of the identified regional project opportunities in San José are shown in Figure 5-3.



Bioretention at Village Oaks Shopping Center in San José

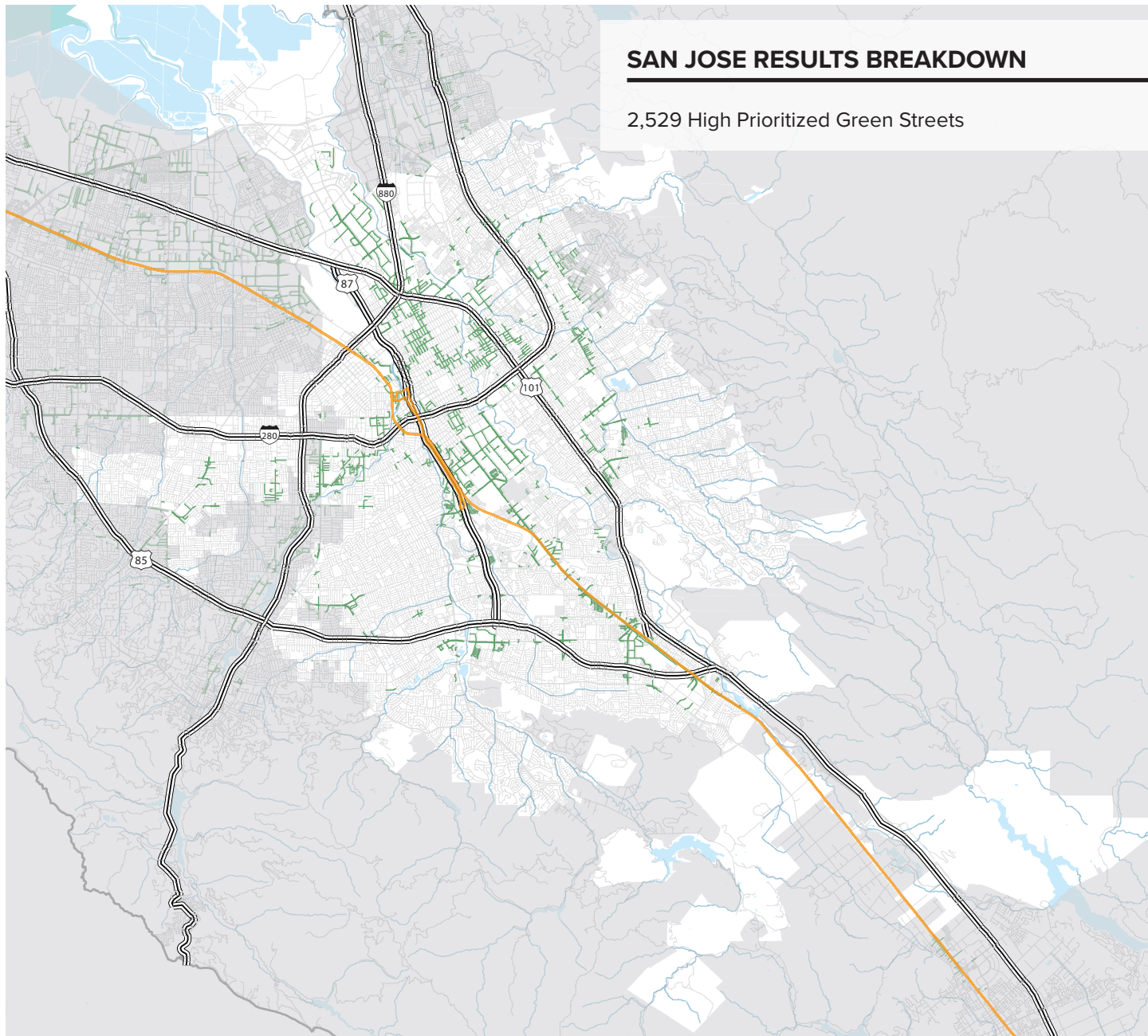


Figure 5-1. Prioritized Green Street Project Potential Locations

LEGEND

- Bay
- Water Bodies
- Streams
- Streets
- Major Throughway
- Caltrain

**SWRP Countywide Prioritized
Green Street Project Opportunities**

- 90th Percentile Candidates



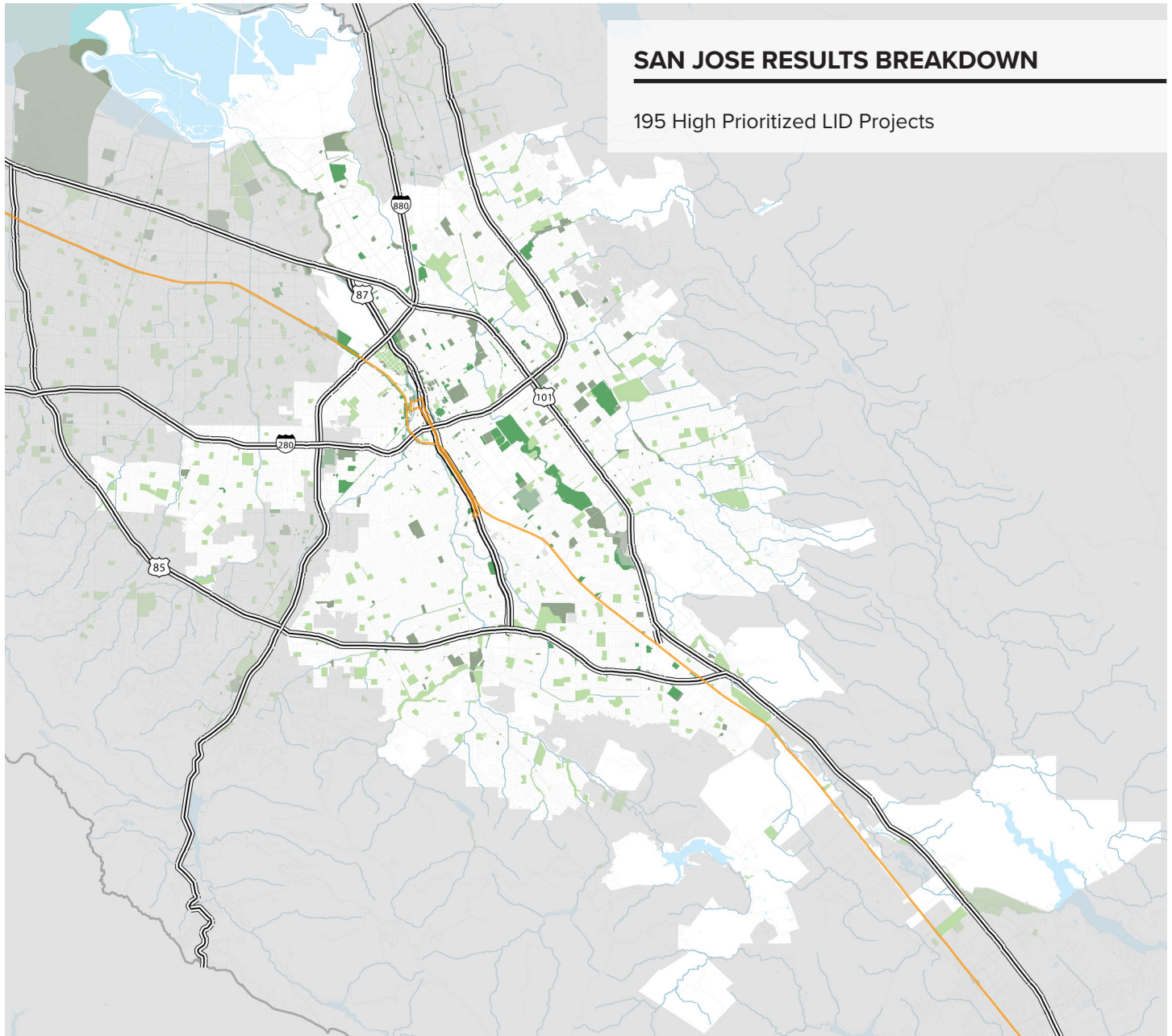


Figure 5-2. Prioritized LID Public Parcel Retrofit Project Potential Locations

LEGEND

- Bay
- Water Bodies
- Streams
- Streets
- Major Throughway
- Caltrain

**SWRP Countywide Prioritized
LID Project Opportunities**

- High
- Medium
- Low



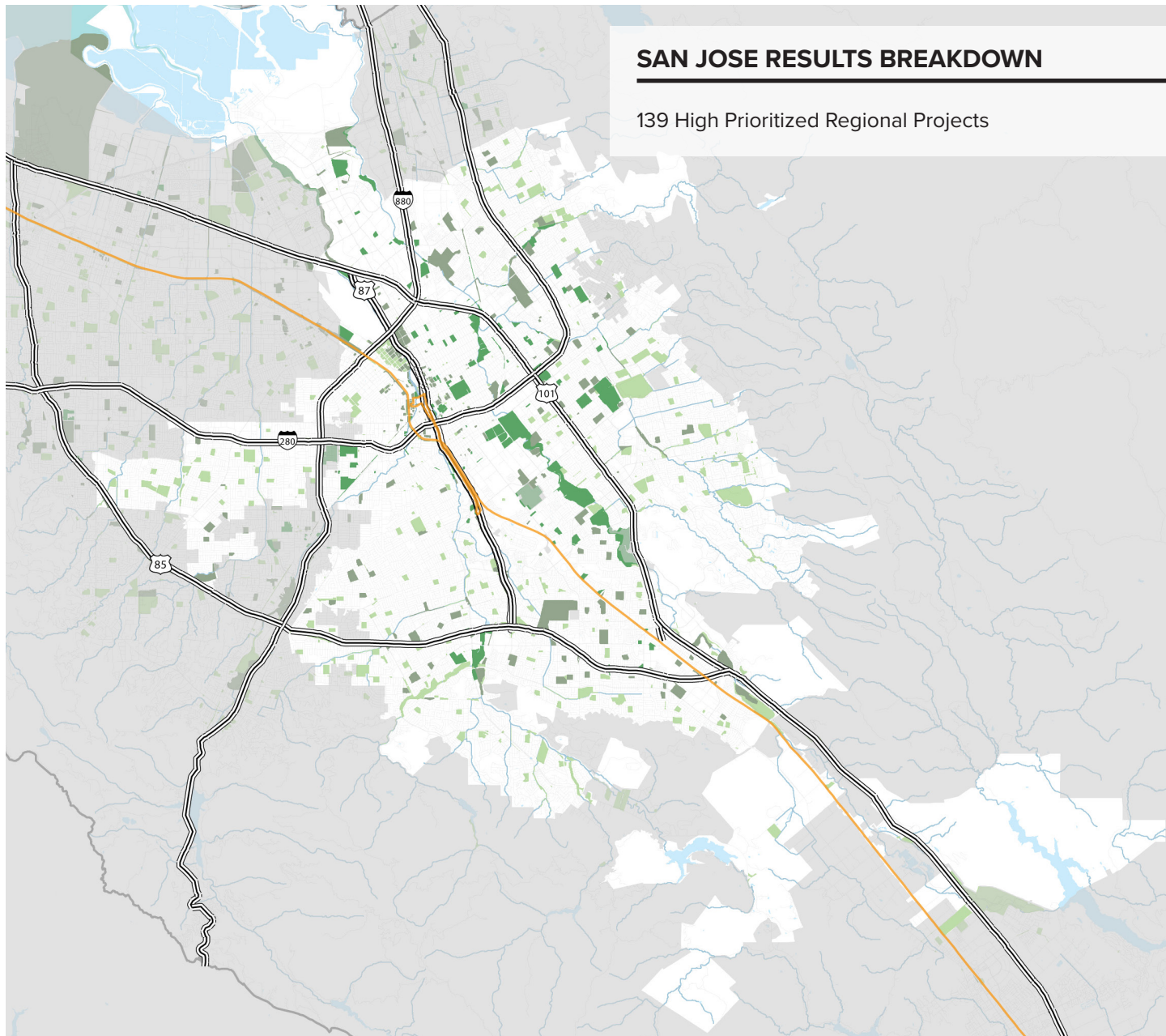


Figure 5-3. Prioritized Regional Project Potential Locations

LEGEND

- Bay
- Water Bodies
- Streams
- Streets
- Major Throughway
- Caltrain

SWRP Countywide Prioritized Regional Project Opportunities

- High
- Medium
- Low



5.3 SAN JOSE-SPECIFIC GSI PRIORITIZATION

The San José-specific prioritization developed for the GSI Plan builds on the SWRP effort to refine, identify, evaluate, and prioritize potential GSI improvements. This city-specific prioritization process will continue to be refined over time as the City moves forward with implementing the GSI Plan to 2050. The goal of presenting the methodology herein is to document the criteria that led to the ranked GSI project opportunity list along with the tools needed to assess and prioritize future GSI opportunities. As with the SWRP, the prioritization is broken out between green street projects, LID retrofit projects, and regional projects. To properly weigh the criteria most critical to these project types, a slightly different prioritization process was developed for each. However, the process follows a similar format of first evaluating stormwater benefits, then assessing constructability through interdepartmental coordination and refined utility constraint data, and finally overlaying co-benefit and project synergies to arrive at a refined prioritization ranking. An overview of the criteria and process that resulted in an updated prioritization is shown in Figure 5-4.



Bioretention at Brokaw Commons in San José

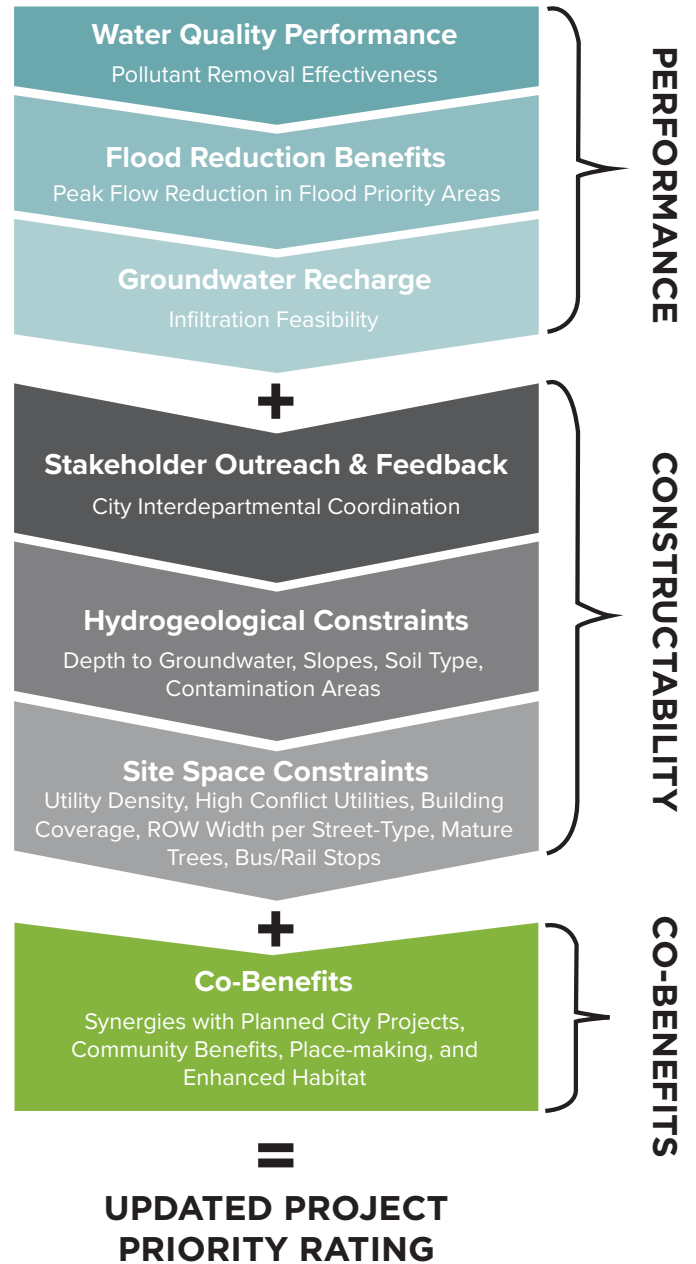


Figure 5-4. San José GSI Project Prioritization Considerations

5.3.1 Green Street Projects

The objective of the San José-specific green street prioritization process was to provide better granularity to the more than 29,000 street segments that were evaluated for green street opportunities in the SWRP prioritization, with each street segment representing a single block or approximately 300-feet of continuous roadway. Key new datasets, such as water quality spatial effectiveness results from preliminary RAA modeling output and expanded utility information to assess site space constraints, were leveraged to refine the scoring of the SWRP green street opportunities. The methodology is described herein and the results of the prioritization are presented within Chapter 6 GSI Citywide Strategy.



City of San José Green Streets Medallion
Installed for Education and Outreach

A secondary objective of the prioritization was to create tools that visually convey the street rating results and can be used to support assessment of future green street opportunities as they arise. For this purpose, a series of maps were developed that demonstrate how performance, constructability, and co-benefit criteria combine to produce green street suitability ratings. First, separate maps of stormwater performance, geotechnical constraints, and site space constraints were developed by compiling numerous data layers that summarize overall technical suitability per street segment. The results of these maps were then overlaid with co-benefit and co-located project data to arrive at an updated opportunity rating map that reprioritizes the green street opportunities assessed in the SWRP. A summary of the methodology is presented in Figure 5-5 for green streets.

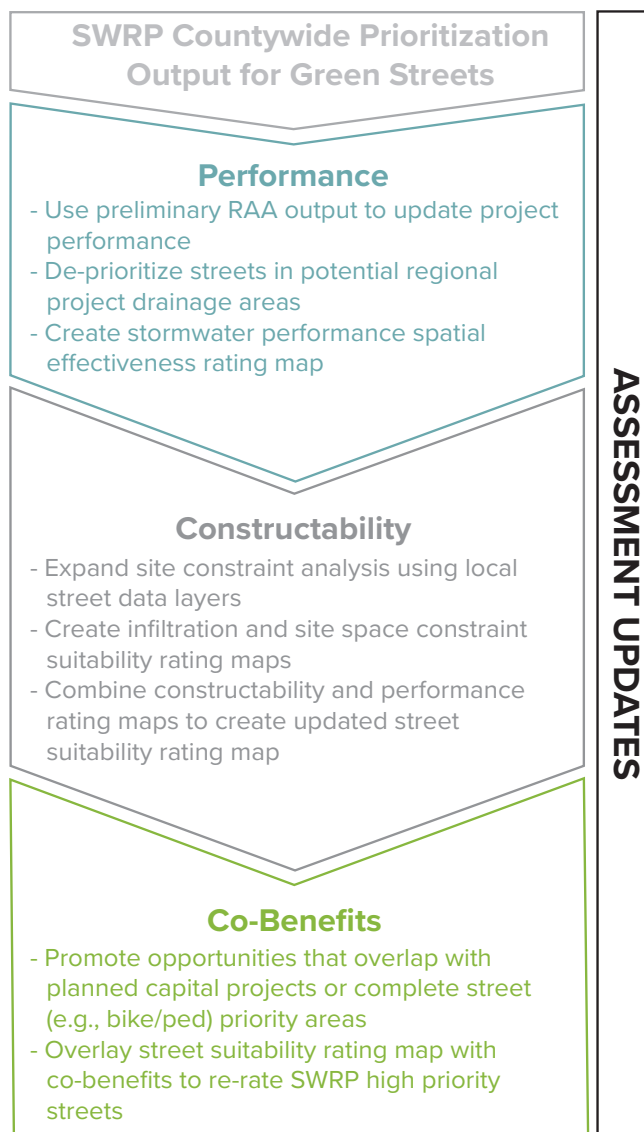


Figure 5-5. San José-specific Green Street Prioritization Process

The refined prioritization output enables the City to assess the potential impervious acres managed and resulting stormwater volume captured if a certain percentage of highly rated streets are retrofit as green streets. This potential is discussed further as part of the long-term citywide GSI strategy discussed in Chapter 6. Moreover, the suitability maps created for the prioritization can be used as a tool to assess street retrofits as collaboration opportunities arise. The prioritization criteria, as refined from the countywide prioritization, are presented in Table 5-4, and the rating maps, are shown in Figure 5-6 through Figure 5-8. These maps, including the small inset maps, are provided in Appendix E with more resolution.

Table 5-4. Updated Green Street Prioritization Methodology

Metric	Points						W
	0	1	2	3	4	5	
STORMWATER PERFORMANCE							
Water Quality Effectiveness							
Impervious Area (%)	X < 40	40 ≤ X < 50	50 ≤ X < 60	60 ≤ X < 70	70 ≤ X < 80	80 ≤ X < 100	2
Contains PCB Interest Areas	None			Moderate		High	2
Pollutant Removal per Acre Managed ¹	None	Low	Moderately Low	Moderate	Moderately High	High	2
Located Outside of Potential Regional Project Drainage Areas	No					Yes	
Groundwater Recharge Area							
Augments Water Supply	No	Opportunity for Capture & Reuse				Above Groundwater Recharge Area ³	
Flood Reduction Effectiveness							
Within Flood-Prone Storm Drain Catchments	No			Yes		Yes	
Upstream of 10-yr Storm Flood Project Priority Areas ²	No					Yes	
HYDROGEOLOGIC CONSTRAINTS (INFILTRATION FEASIBILITY)							
Hydrologic Soil Group		C/D		B		A	2
Groundwater Constraints	In Contamination Area AND Depth to Groundwater < 10 ft	In Contamination Area OR Depth to Groundwater < 10 ft		Depth to First Groundwater 10 - 20 ft		Depth to First Groundwater > 20 ft	
Slope (%)	> 5	5 ≥ X > 4	4 ≥ X > 3	3 ≥ X > 2	2 ≥ X > 1	1 ≥ X > 0	
SITE SPACE CONSTRAINTS (CONSTRUCTION FEASIBILITY)							
ROW Width by Street Class ⁴		Skinniest 33% by Class		Middle 33% by Class		Widest 33% by Class	
Length Constraints per Block ⁵		Length Lost > 300 ft per 1,000 ft		Length Lost 200-300 ft per 1,000 ft		Length Lost < 200 ft per 1,000 ft	
Utility Constraints ⁶		Multiple High Conflict Utilities	One High Conflict Utility or Water Main Length > 1,000 ft per 1,000 LF	Water Main Length 500 - 1,000 ft per 1,000 LF	Water Main Length 100 - 500 ft per 1,000 LF	Water Main Length < 100 ft per 1,000 LF	
CO-BENEFITS & PROJECT SYNERGIES							
Co-Located With Another Planned Project ⁷	No			Priority Street for Condition Improvements	Priority Street for Safety or Bike/Ped Improvements	Overlaps Near-Term Streetscape Capital Project	2

Notes: W = weighting factor, **Bold** = added criteria relative to SWRP. Gray text = SWRP criteria removed from San José-specific analysis. ft = feet, LF = linear feet

- Percent imperviousness is superseded by pollutant loading per impervious acre managed. Pollutant removal effectiveness is estimated by the runoff depth per subwatershed during the critical bacteria storm.
- Draft priority areas based on Storm Sewer Master Plan planned conveyance projects for 10-year Storm. Note, however, the Storm Sewer Master Plan model is being refined and updated and it is possible that some conveyance project locations/areas may change.
- In recharge area and not above groundwater contamination area.
- Right-of-way width of all streets divided into thirds by street class. The average (middle third) right-of-way width for separated secondary streets (A35) is 125'-133', for separated local neighborhood streets (A41) is 89'-105', and for major local neighborhood streets (A40) is 60'-88'.
- Length constraints evaluated: laterals based on parcel density (2' per building), transit stops (10' per stop), curb ramps (4' per ramp), 24" diameter trees (2' buffer around tree), local bridge or overpass (60' per bridge), fire hydrants (4' per hydrant).
- High conflict utilities included: major gas transmission mains, rail lines, and tunnels. If multiple water mains are located on a street, length equals total aggregate length.
- Three-Year Pavement Plan used as indicator of priority streets for condition improvement needs. Vision Zero San José and San José Bike Plan 2020 used as indicators of priority safety, bike, and pedestrian needs. Near-term capital projects are based on the list provided for SWRP plus additional near-term streetscape projects, including Better Bikeways for Central San José.

Stormwater Performance

Stormwater performance effectiveness, shown in figure 5-6, was evaluated to prioritize projects in strategic locations that have the potential to improve water quality most cost-effectively, while also contributing to other stormwater capture benefits, such as flood mitigation and groundwater recharge.

Water Quality Effectiveness - Using model output from the RAA, areas were identified that are more effective for meeting water quality goals. Green street projects in these subwatersheds are therefore prioritized. Whereas, streets that are within the drainage area of potential regional stormwater management projects were given lower priority as the stormwater runoff from these streets will be captured and managed downstream. The water quality effectiveness submap shows the RAA results and PCB interest areas. It also indicates the drainage area of the potential regional projects.

Groundwater Recharge Area - Streets within groundwater recharge areas were given priority over streets outside of these areas since green street projects can provide infiltration to groundwater.

Flood Reduction Effectiveness - Streets within flood prone areas and within the watershed identified in the Storm Sewer Master Plan as priorities for conveyance improvements during the 10-year storm event were given additional prioritization points. Green street projects in these watersheds can provide flood reduction benefits.

Hydrogeologic Constraints (Infiltration Feasibility)

Shown in Figure 5-7, available hydrogeology information was used to give lower priority to streets with a high probability of constraints that would make infiltration infeasible. This includes poor draining soils, bedrock, high groundwater levels, and contaminated soils.

Hydrologic Soil Group - HSG soil types were used to identify and prioritize locations with well draining soils with the assumption that GSI projects in these areas provide better performance and are more cost effective than projects in areas with poor draining soils.

Groundwater Constraints - Depth to first groundwater was used to identify streets likely to have shallow groundwater that would make grading and infiltration for green streets infeasible. Additionally, any streets that fall within a GeoTracker site were given lower priority due to the risks associated with infiltrating at these sites. GeoTracker sites are areas with hazardous substances or waste discharges from underground storage tanks that the State Water Board tracks.

Slope - Slopes exceeding 5 percent make designing green stormwater infrastructure along streets less cost effective due to the need to excavate deeper to account for grade and the need to install check dams and energy dissipation systems for managing flow. Thus, streets that fall within steeper slopes were given a lower priority.



Green Street with Bioretention and Permeable Pavement on Park Avenue

Site Space Constraints (Construction Feasibility)

Constructability, as shown in Figure 5-8, was evaluated to identify streets that have adequate space available for a green street project. Lack of suitable space for GSI is a common constraint with green street implementation. Therefore, the prioritization process included additional analyses relative to the SWRP prioritization to refine this assessment. The constructability criteria accounts for width constraints, length constraints, and utility constraints within the right-of-way.

Width Constraints - The width of the right-of-way was calculated for each eligible street segment. These widths were assessed by street typology (e.g., primary, secondary/collector, or local) to identify streets that have a wide right-of-way relative to their typology. The widest third of streets in each street typology were given a higher priority and the skinniest third of streets in each street typology were given a lower priority. This identifies street segments that likely have adequate space between the driving lane edge and the edge of the right-of-way, where green stormwater infrastructure can be located.

Length Constraints - Right-of-way length constraints and utility constraints were also used to assess likely conflicts for green stormwater infrastructure implementation. Length constraints included trees per block, fire hydrants, and transit stops.

Utility Constraints - Utility conflicts were focused on shallow, large utilities that are more challenging to relocate as part of GSI implementation, such as water mains and major gas transmission mains. This data, where available, was coupled with other major utility constraints such as rail lines, tunnels, and major gas transmission lines to arrive at an overall utility constraint rating. The costs associated with designing around these utility conflicts is often prohibitive. Streets with these conflicts are therefore given a lower priority.

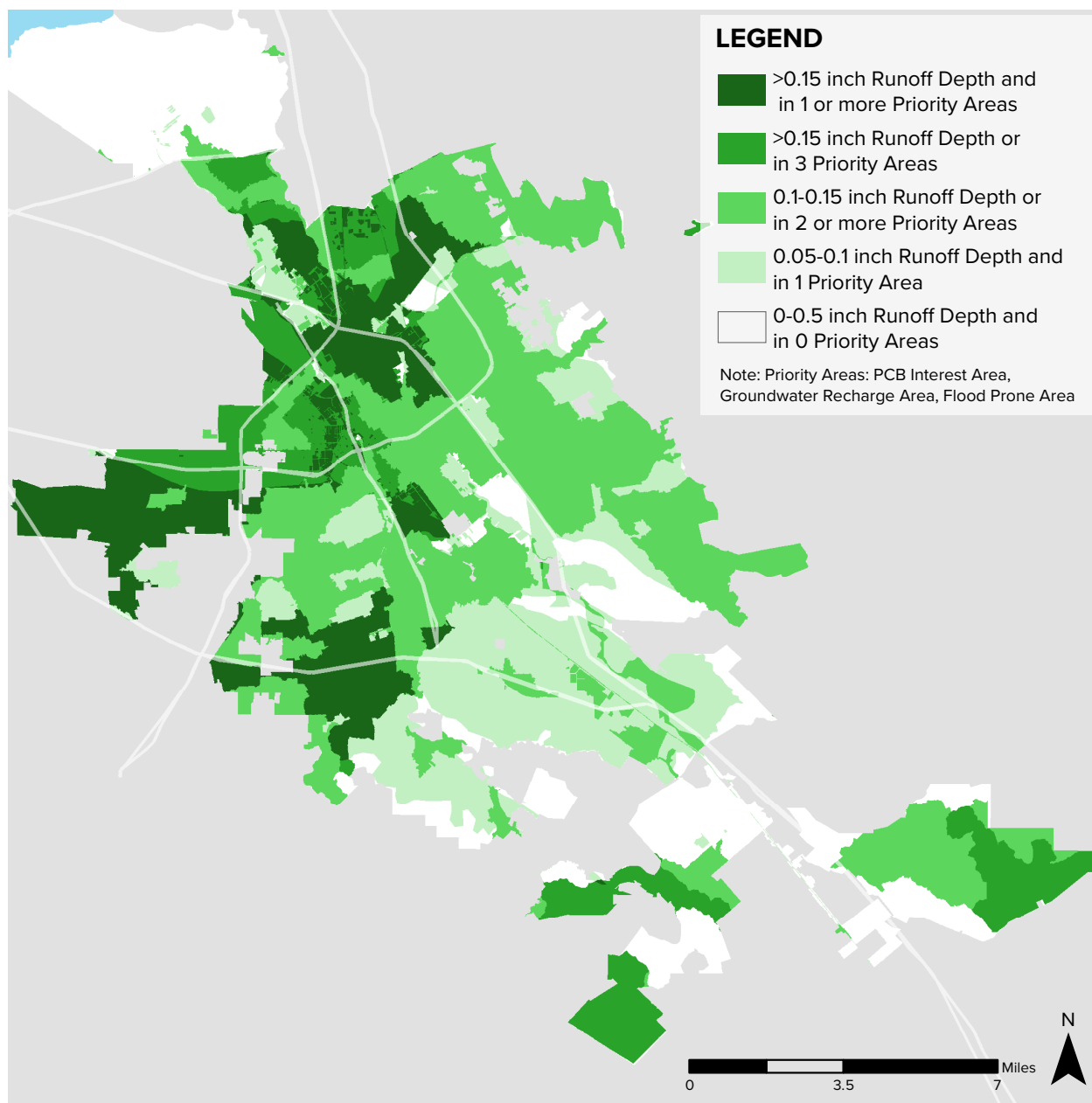
Technical Street Suitability

Each street segment was given a technical suitability score by combining the output from the three above categories: stormwater performance, hydrogeologic constraints, and site space constraints. Points and weighting were applied to each street segment as defined in Table 5-4. Street segments with a score of 35 or above were given a high or medium-high technical suitability rating. Street segments with a score below 25 were given a low technical suitability rating. These projects may be infeasible due to constructability constraints; however, due to the uncertainty and coarseness of the available hydrogeologic and space constraint data these streets may be found to be feasible upon a more detailed investigation of site soils and utilities. As future street improvement projects are proposed, the green street technical suitability map can be referenced as a planning level tool to assess the potential for GSI integration. A map showing the street technical suitability results is presented in Figure 5-9.

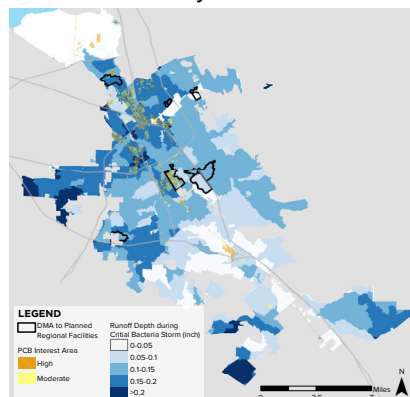


Green Street with Bioretention

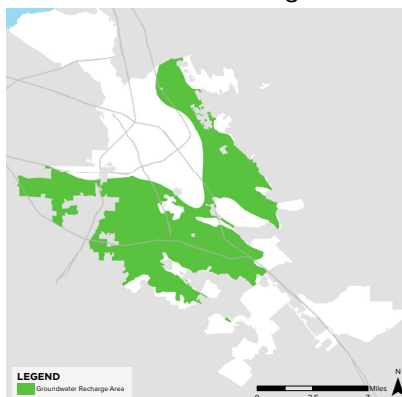
Stormwater Performance - Spatial Effectiveness Rating



Water Quality Effectiveness



Groundwater Recharge Area



Flood Reduction Effectiveness

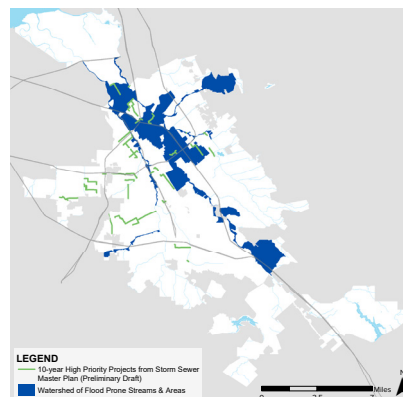


Figure 5-6. Stormwater Performance: Spatial Effectiveness Rating Map

Refer to Appendix E for enlarged maps

Hydrogeological Constraints - Desktop Suitability Rating

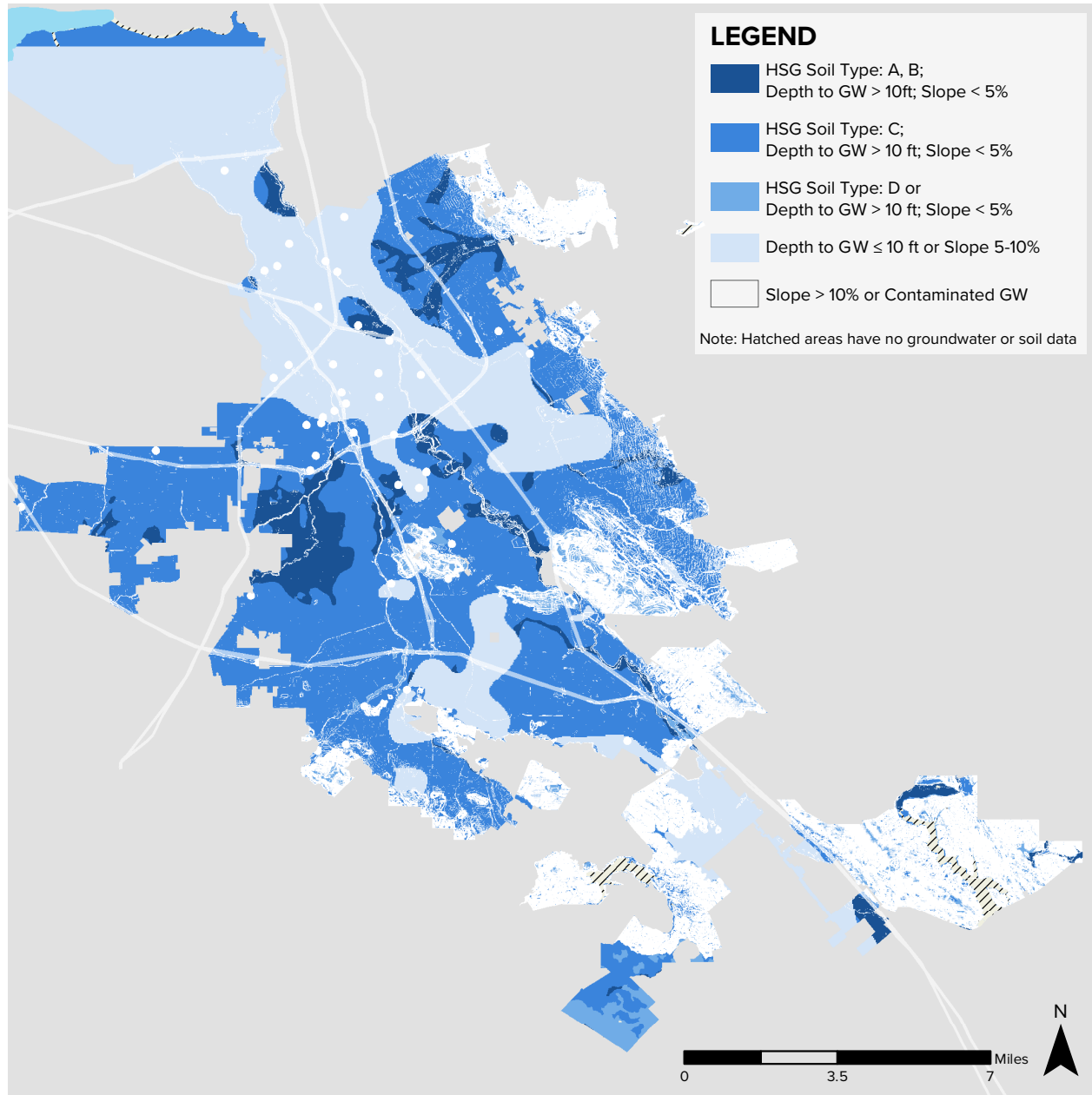
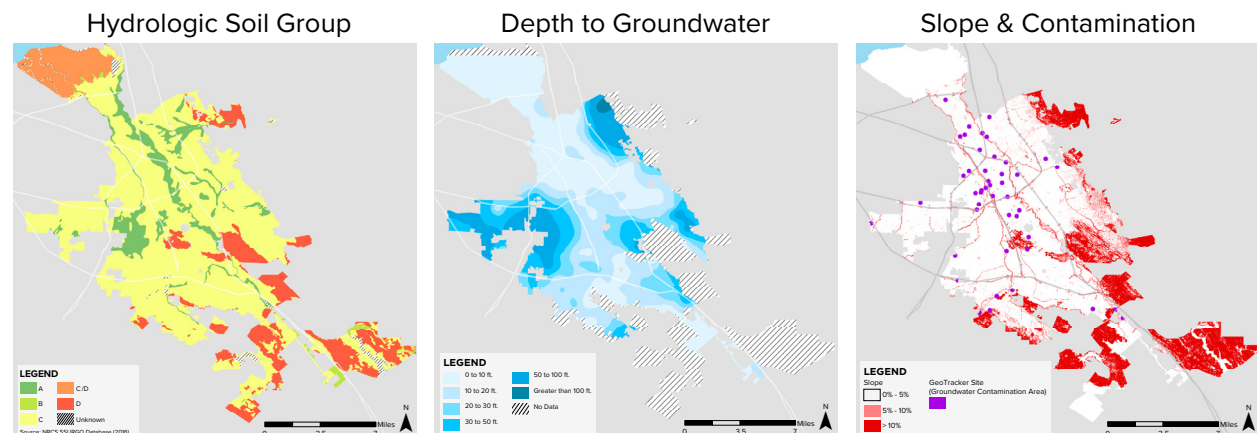


Figure 5-7. Hydrogeological Constraints: Desktop Suitability Rating Map

Refer to Appendix E for enlarged maps

Site Space Constraints - Desktop Suitability Rating

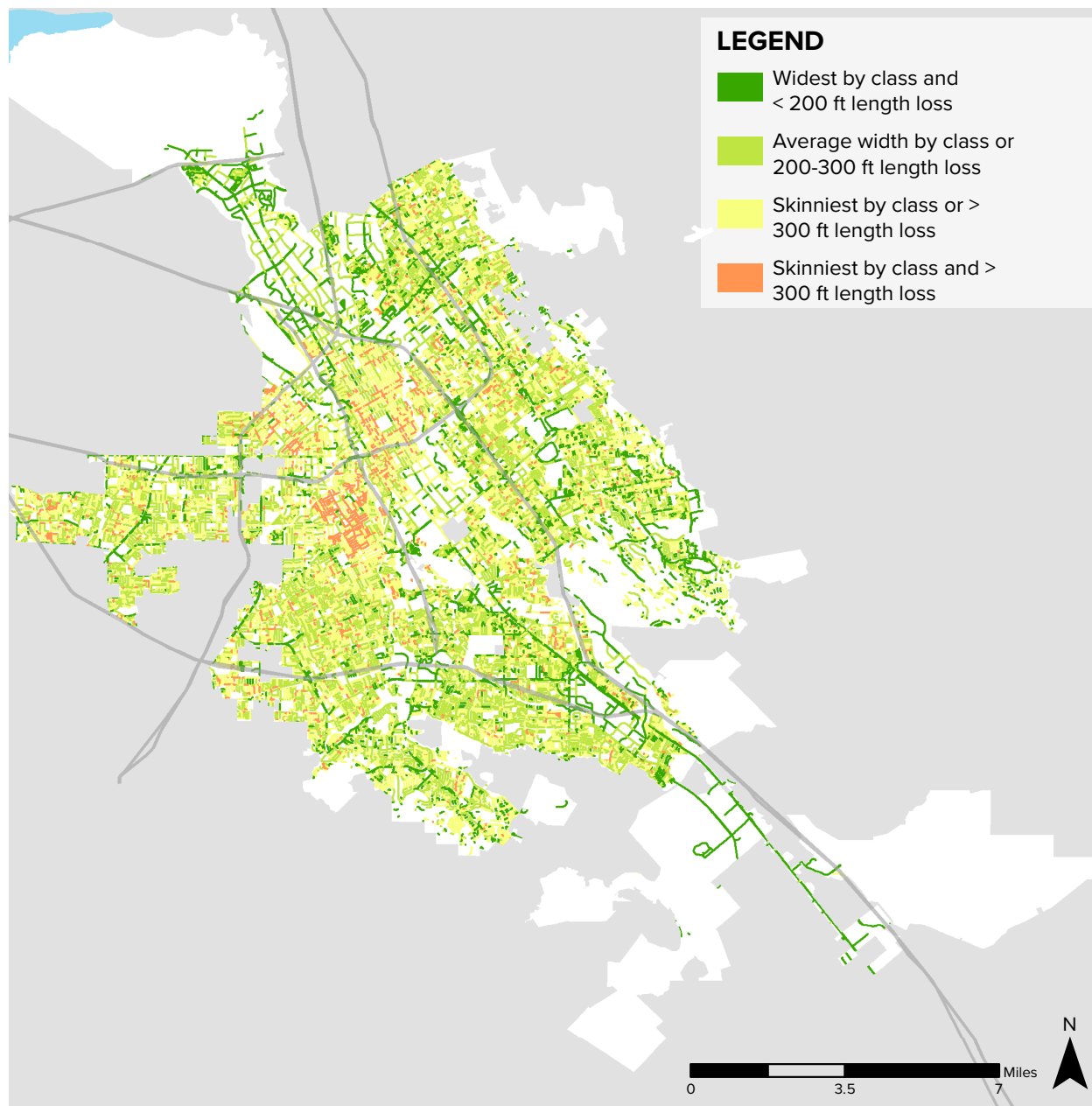
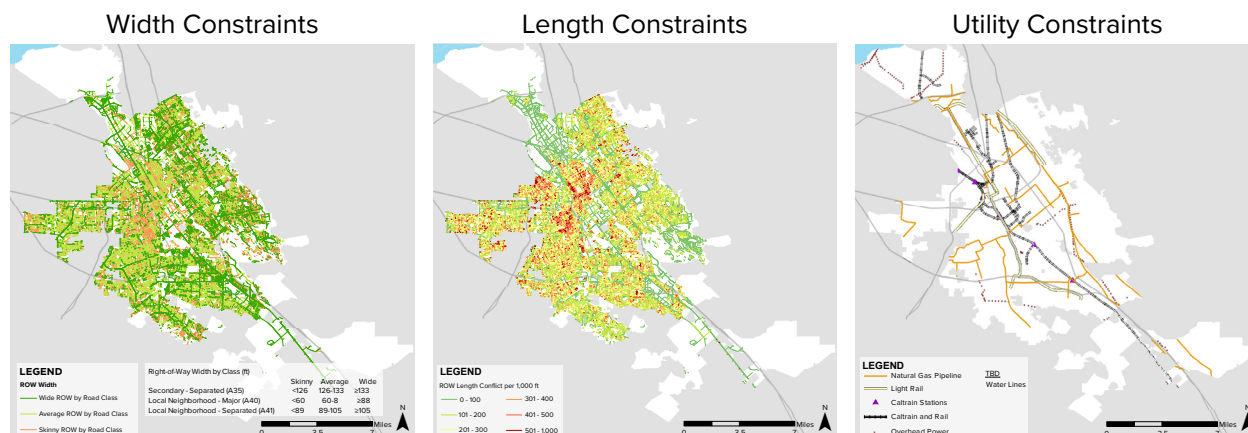
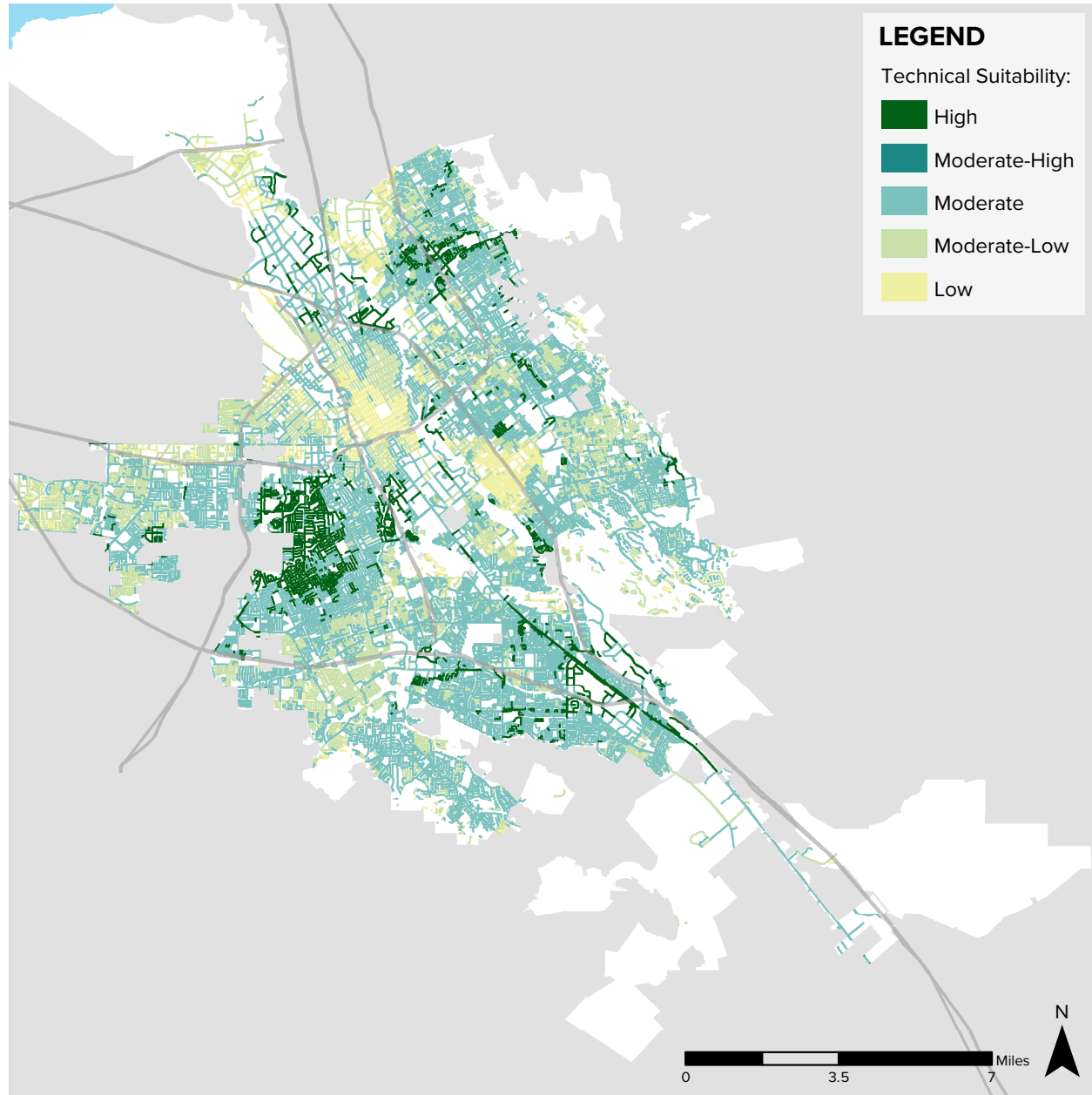


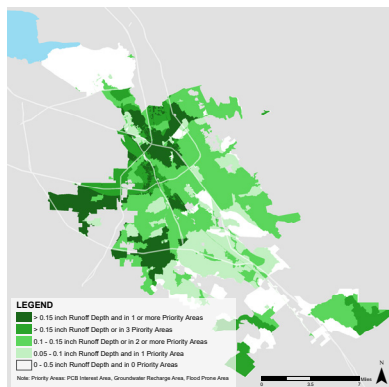
Figure 5-8. Site Space Constraints: Desktop Suitability Rating Map

Refer to Appendix E for enlarged maps

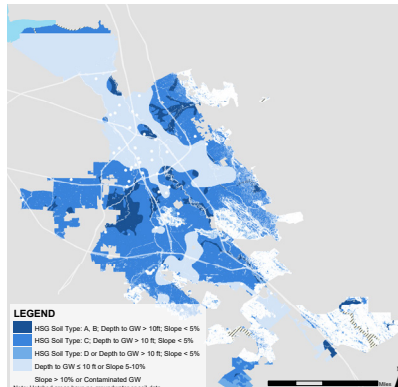
Technical Suitability



Stormwater Performance



Hydrogeological Opportunity



Site Space Constraints

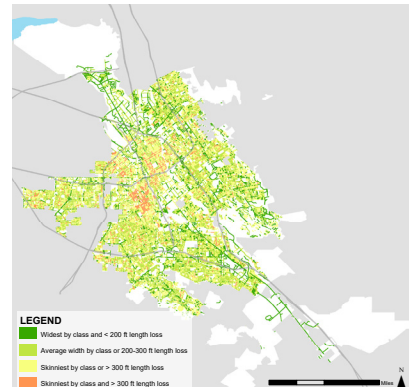


Figure 5-9. Technical Suitability Rating Map

Refer to Appendix E for enlarged maps

Project Synergies and Co-Benefits

Green street improvements are often co-located with other planned street improvement projects to provide synergistic benefits such as bike lanes, pedestrian improvements, traffic calming, and green corridors. The current project synergy and co-benefit data layers are presented in Figure 5-10. Although this map will

continue to be updated throughout the life of the GSI Plan, for the purpose of creating an initial prioritization ranking of all street segments, the technical street suitability results were overlaid with the co-benefits and co-located project data to arrive at final updated project opportunity scores. These updated prioritization results are presented in Chapter 6 as part of establishing the citywide GSI strategy.

Synergies & Co-Benefits

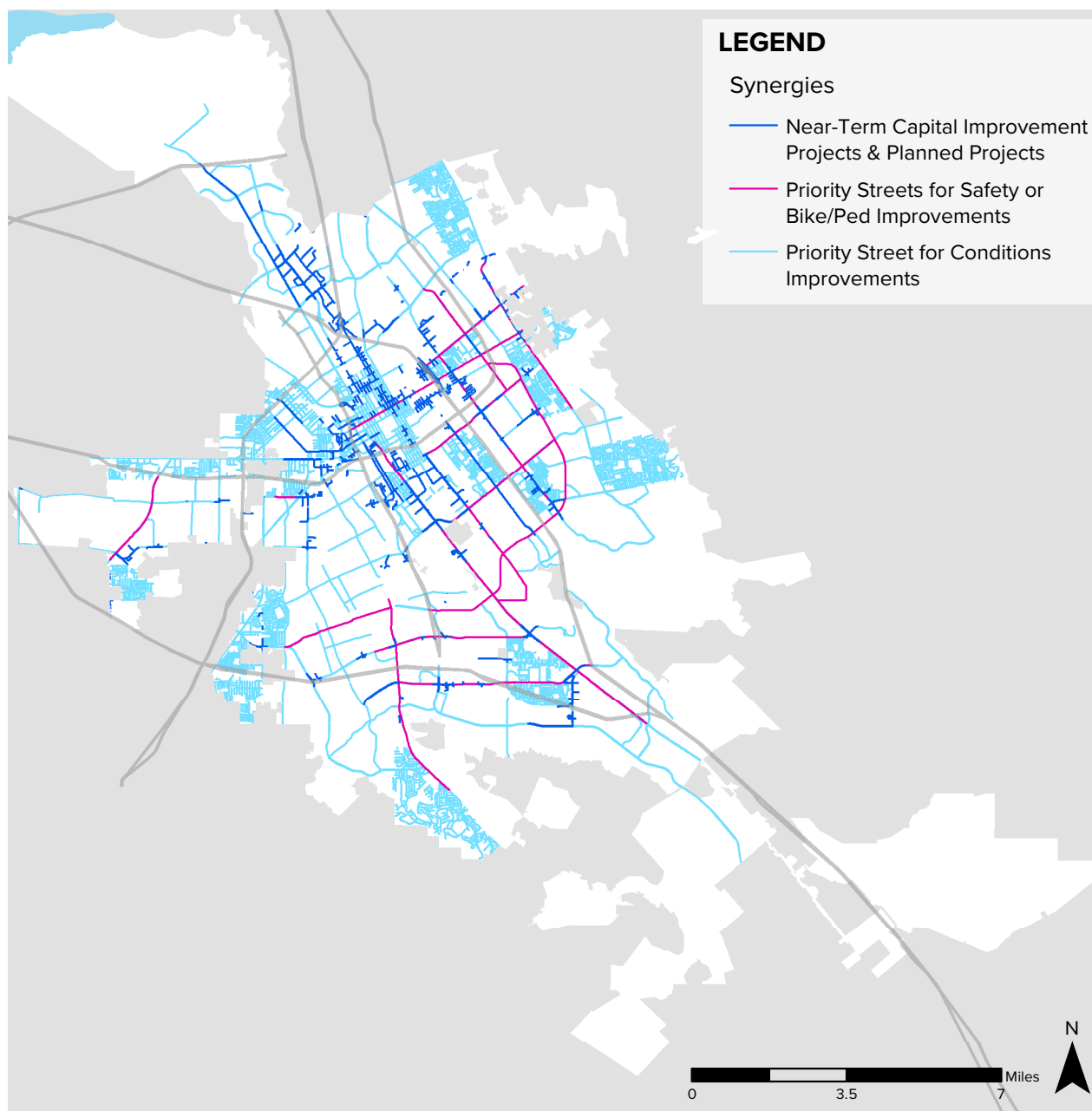


Figure 5-10. Project Synergies and Co-Benefits

5.3.2 LID Retrofit Projects on Public Parcels

The prioritization results from the SWRP process identified close to 200 high priority LID retrofit opportunities within San José which cover more than 1,800 acres of public parcel land and approximately 950 acres of impervious cover. These parcels mainly include public buildings, schools, parks, parking lots, and open spaces. These parcels include land owned by City of San José, Santa Clara Valley Transportation Authority, Santa Clara County, State of California, and others.

This SWRP prioritization output will support the City's current annual process of reviewing planned capital projects to assess LID retrofit opportunities. During this process, the Stormwater Performance and Hydrogeological Constraint rating maps described above for evaluating green streets can be used to further inform potential opportunities and constraints for LID retrofit opportunities.



Bioretention in Park Parking Lot

5.3.3 Regional Projects

The prioritization results from the SWRP process produced 139 high priority potential regional project retrofit opportunities within San José. Using SCVURPPP's Santa Clara Basin SWRP online map and accompanying database, potential regional project locations were identified within San José and further evaluated using spatial information for each site. An initial set of potential project locations from the 139 high priority sites identified in the SWRP were evaluated using the methods described in this section. When SWRP-identified high priority locations were determined to be infeasible based on the initial analysis, the City used the same process to evaluate medium- and low-priority locations identified by the SWRP. A critical parameter within this re-evaluation of regional project opportunities was the estimated drainage area that could be routed to the site. An overview of the process used to select the preferred regional project locations is shown in Figure 5-11.

From the top prioritized regional project locations identified in the SWRP, each site was evaluated further to account for stormwater performance, constructability, and co-benefits. These sites were individually evaluated to estimate the potential drainage area based on the storm drain network found in the City's Utility Viewer. Sites with a drainage area exceeding 100 acres were promoted as potential candidates for regional projects. Of the candidate regional project sites, those that have predominately A or B-type soils were identified. These candidate sites were further prioritized based on space available. Sites that could accommodate a regional stormwater facility without impacting existing park use were prioritized. Sites that were constrained but had adequate groundwater separation were also prioritized as potential subsurface storage sites.

To verify the availability of space and ensure current use was not impacted, several criteria were evaluated including estimated driplines of mature trees, surrounding land use, park size, recreational use types, and current understanding of community needs. The Park Condition Assessment (PCA) score was used to identify parks that could benefit from a project that could provide an amenity or that could be coupled with additional park improvements. Sites that were recently

improved or are scheduled for improvements were deprioritized, i.e., if more than \$500,000 was spent on improvements as part of capital improvements in the last five years or future planned improvements cannot align with a stormwater project. These prioritized candidate sites were further refined based on feasibility as determined by land management and status of contracts and lease agreements.

The candidate regional project sites that were selected and prioritized as a result of this evaluation are included in the citywide GSI strategy presented in Chapter 6.

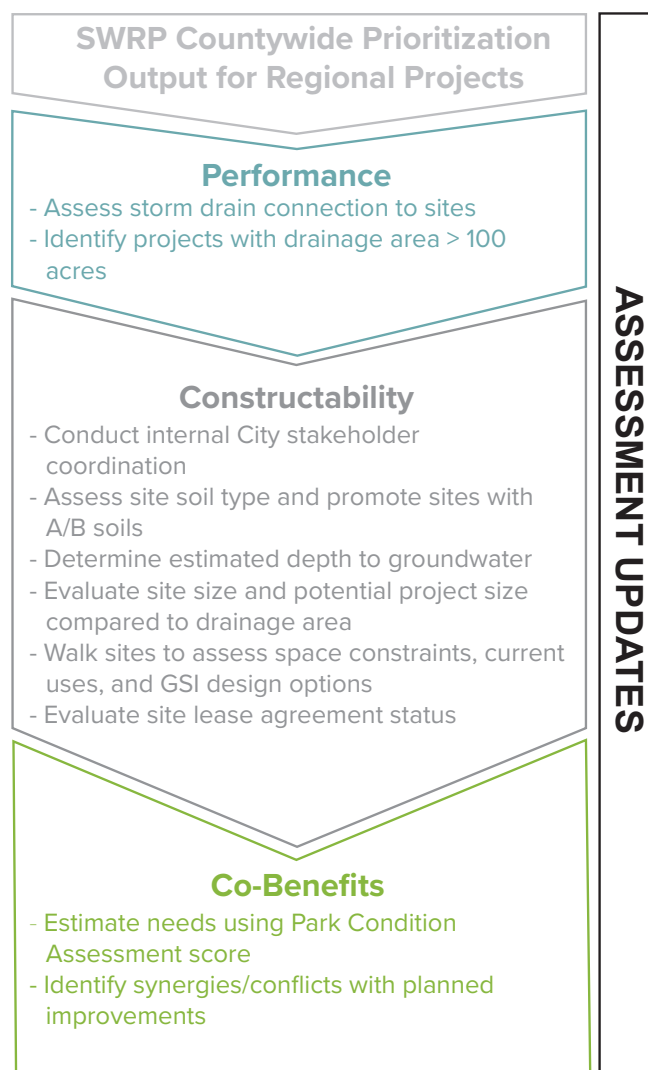


Figure 5-11. San José-specific Regional Project Prioritization Process



6.0

GSI CITYWIDE STRATEGY

City of San José

This chapter defines water quality goals based on the results of the RAA and presents the results of city-specific prioritization to demonstrate how GSI project types (i.e., existing GSI projects, C.3 regulated projects, regional projects, green streets, and public-parcel LID retrofits) can combine to meet these goals by 2040 and 2050.

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6.1 GSI STRATEGY OVERVIEW

The GSI Plan represents a long-term City vision to transition from a gray stormwater collection network to an integrated system that includes green and gray infrastructure. The goal of the integrated green-gray system is to achieve water quality goals cost-effectively, while maximizing overall City benefits. Once completed, the City's Storm Sewer Master Plan will lay out the planned gray projects and objectives. The gray improvements—such as pipe upsizing and pump station improvements—increase overall system capacity and ensure structural reliability of the collection network. In complement, the GSI Plan lays out the strategy for green improvements. The green—or GSI—reduces or treats runoff prior to it entering the gray system. In this way, the gray and green work together to ensure the best possible stormwater management system that minimizes flooding and reduces pollutants to receiving waters.

Meeting San Francisco Bay MRP water quality goals for PCBs and mercury by 2040 and Consent Decree goals for Fecal Indicator Bacteria (FIB) reduction to streams by 2050 requires a multifaceted GSI strategy. The appended RAA evaluates the costs and benefits of many different potential GSI strategies. Based on the results of this analysis, a long-term GSI implementation strategy is presented in this chapter that identifies a recommended mix of projects to meet the 2040 and 2050 water quality goals. The GSI project types used in the strategy include those prioritized in Chapter 5—regional projects, green streets, and public-parcel LID retrofits—as well as early implementation GSI projects and C.3 new and redevelopment regulated projects. Early implementation projects are GSI projects that have already been implemented by the City or were already scheduled for implementation prior to development of the GSI Plan. C.3 regulated projects are those implemented as part of new development and redevelopment to meet the post-construction stormwater treatment requirements of the MRP and City Council Policy 6-29. An example of how these GSI project types build on each other within the strategy to achieve stormwater capture goals is displayed in the graph of Figure 6-1 and the example maps shown in Figure 6-2 and 6-3.

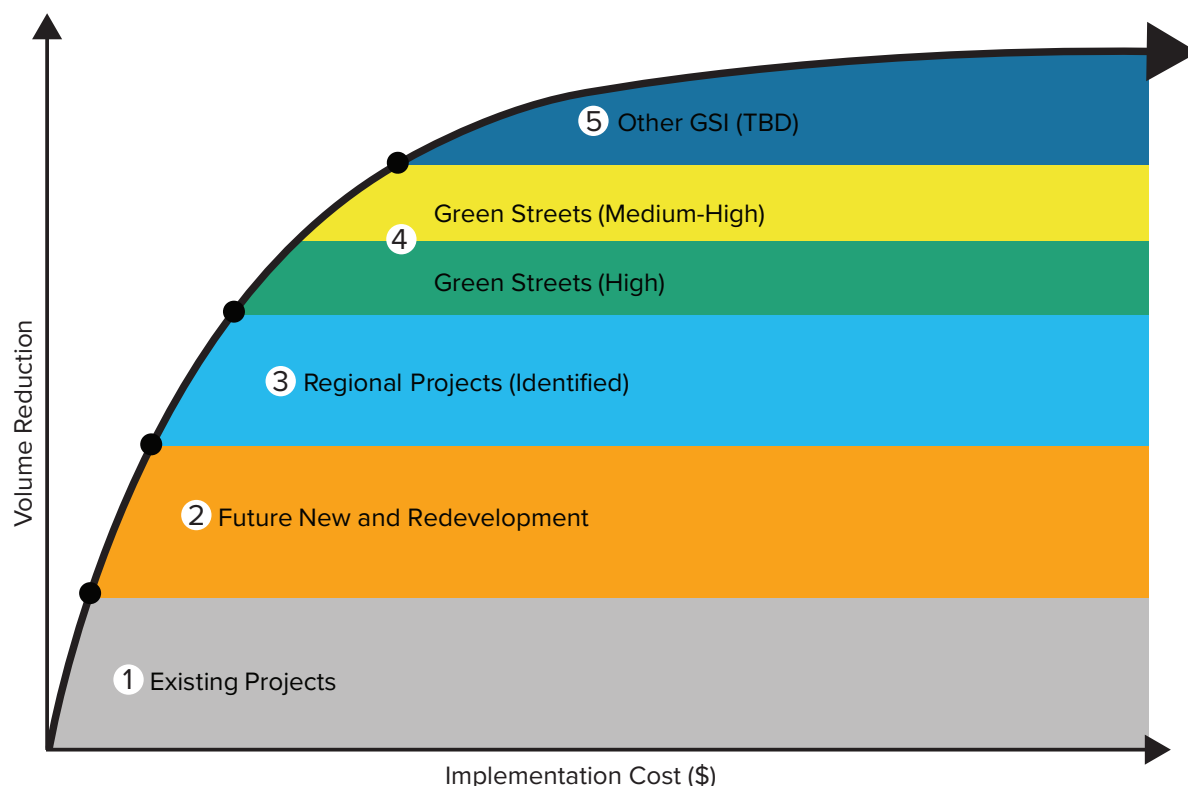


Figure 6-1. Multifaceted GSI Strategy

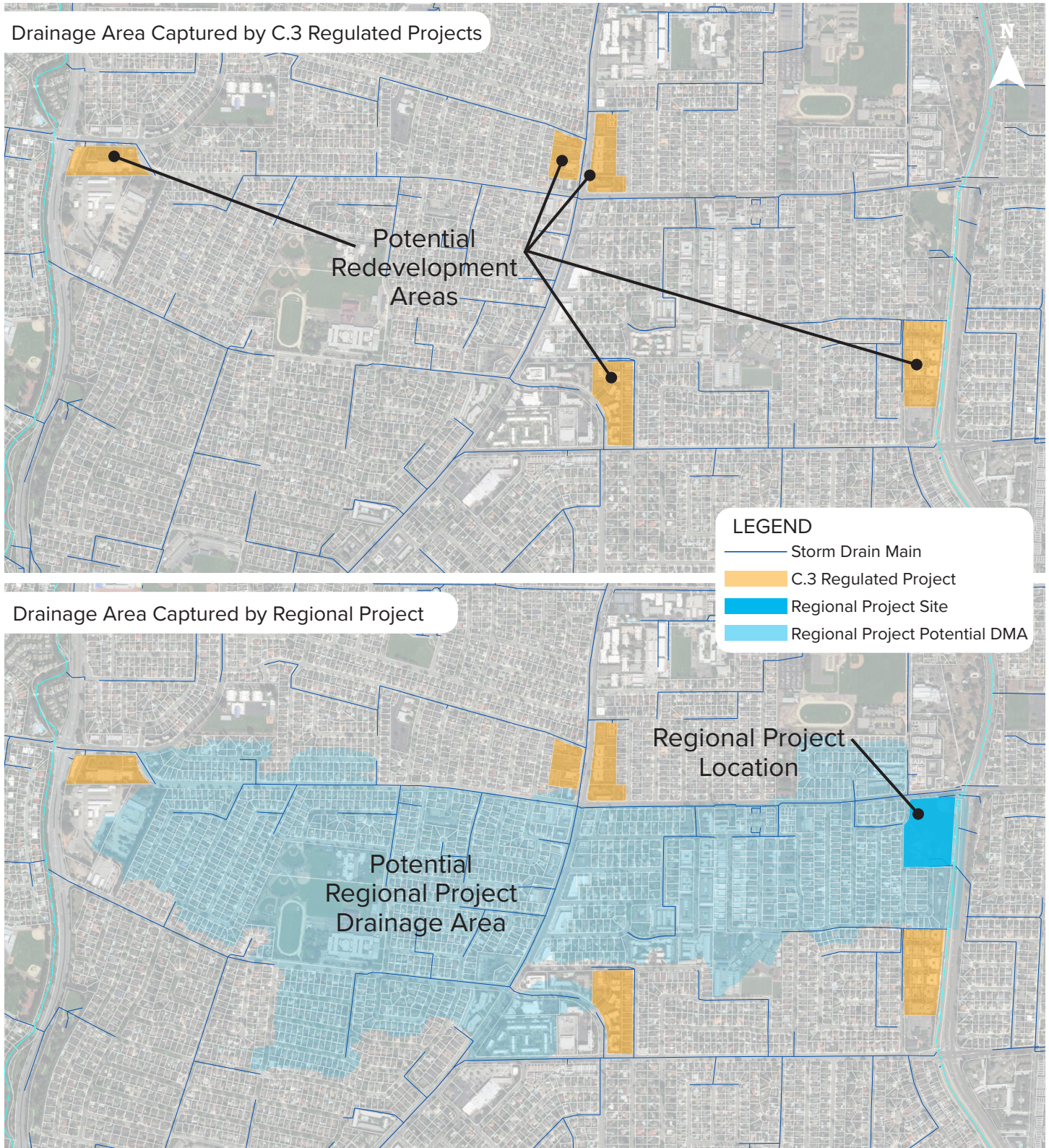


Figure 6-2. Graphical Representation of Example Drainage Areas Captured by GSI Project Types

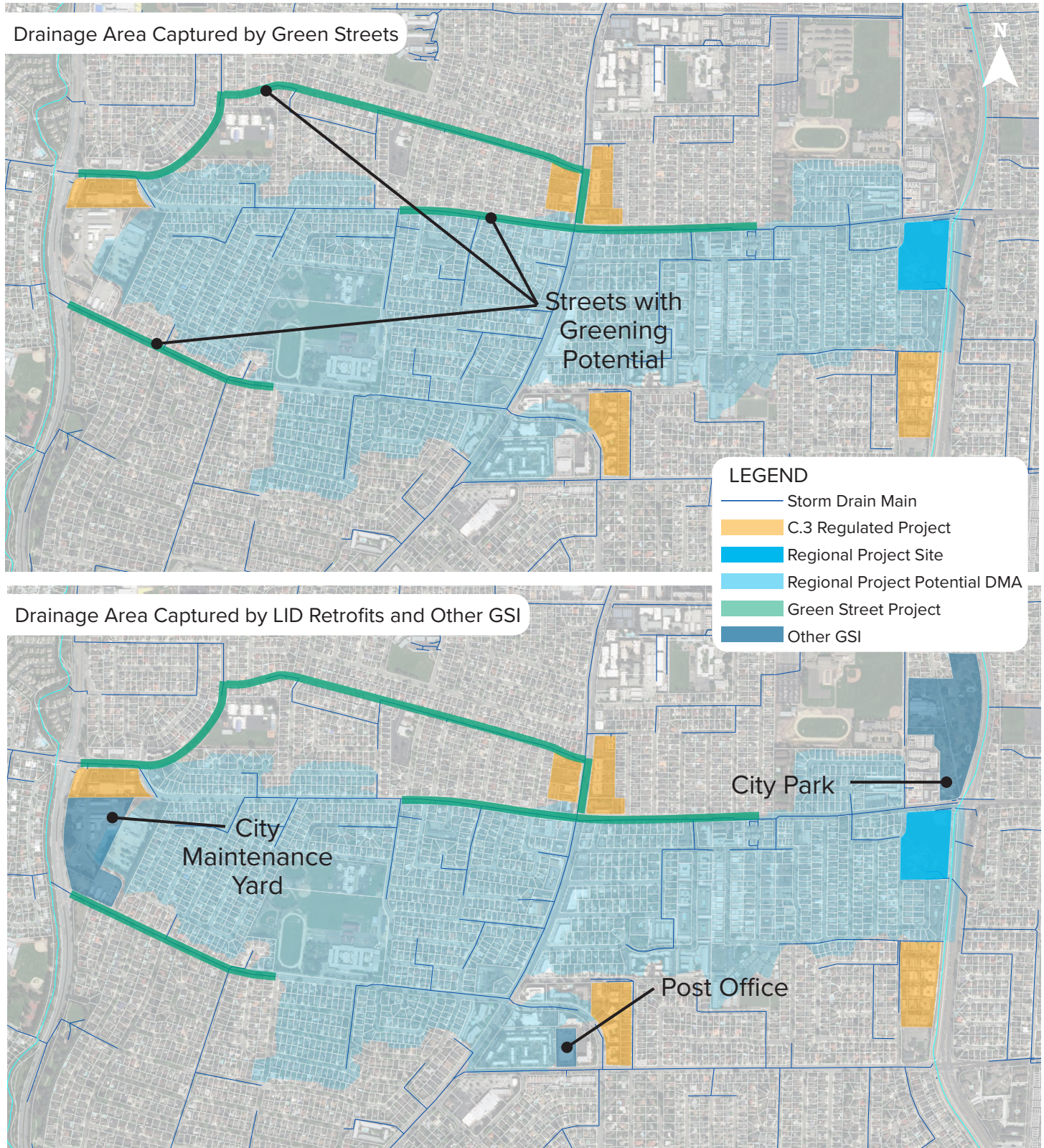


Figure 6-3. Graphical Representation of Example Drainage Areas Captured by GSI Project Types

The ultimate objective of the selected project mix is to address the citywide stormwater volume capture goal, which was established through the RAA to represent 833 acre-feet of volume associated with the 24-hour critical bacteria storm (see Appendix B). As the stormwater volume capture goal for FIB is greater than the PCB and mercury (Hg) goals, attainment of the FIB goal means that PCB and Hg objectives will also likely be met. Each subsequent section in this chapter presents the potential stormwater capture by each of the GSI project types. These sections define the results of project prioritization—or in the case of private projects, the results of long-term projections of new and redevelopment—to quantify the potential impervious area managed by GSI and the progress over time toward reaching the capture goals.

The citywide strategy presented in this chapter forms the core of the GSI Plan and enables the City to establish the near-term steps for GSI Plan implementation, as defined in Chapter 7. The recommended strategy was selected based on achieving the stormwater capture goals as cost-effectively as possible, while maximizing multiple benefits. For a more detailed cost-benefit analysis of the various project combinations evaluated, refer to the RAA in Appendix B. Note, as the GSI Plan is a living document that forecasts over a 30-year horizon, this initial strategy to achieve water quality objectives can and likely will be refined through an adaptive management process.

6.2 EXISTING & EARLY IMPLEMENTATION PROJECTS

Since the issuance of the MRP, several GSI projects have already been implemented and contribute towards the FIB reduction goal. Existing and early implementation projects include both private development projects regulated under Provision C.3 of the MRP (implemented through City Council Policy 6-29) and several City projects where GSI has either been implemented or scheduled for construction in the near term.

6.2.1 Existing C.3 Regulated Projects

Provision C.3 requires new development and redevelopment projects that create and/or replace defined amounts of impervious surface to implement post-construction control measures to address stormwater runoff generated on-site and comply with other applicable elements of the provision. These projects are known as “C.3 Regulated Projects” or “regulated projects.” Regulated projects include private development or redevelopment projects, such as multi-family residential buildings, commercial office buildings, or shopping plazas, as well as public projects, such as libraries, police stations, and parking lots, exceeding the impervious surface thresholds identified in the MRP. For most regulated projects, post-construction control measures must include LID site design, source control, and treatment measures, such as bioretention, pervious pavement, and infiltration trenches. These are the same types of facilities described in the GSI Plan for implementation on nonregulated projects on public parcels and right-of-ways. GSI facilities on regulated projects help achieve multiple benefits within city watersheds and are considered part of the City’s total inventory of GSI facilities.

Over the last 10 years, approximately 2,000 acres of development in the City have been subject to the Provision C.3 regulations, resulting in more than 2,000 installations of bioretention areas, pervious pavement, and other GSI facilities. The City tracks the locations of these facilities and conducts an operation and maintenance verification inspection program to ensure that they are maintained properly. The City will continue to require future regulated projects to incorporate appropriate GSI facilities, as part of the City’s long-term GSI implementation strategy.

6.2.2 Existing & Early implementation City Projects

Some street improvement projects already planned for design and construction can be modified to incorporate GSI in addition to or in lieu of traditional drainage infrastructure to achieve multiple benefits while helping reach water quality goals. The City actively looks for these types of opportunities, which has resulted in several green street projects being constructed and more scheduled for implementation. These existing and early implementation green street projects shown in Figure 6-5 include:

- » Martha Gardens Green Alleys (Completed)
- » Park Avenue Green Avenue Pilot Project (Completed)
- » Chynoweth Avenue Green Street (Completed)
- » Horace Mann and Washington Neighborhood Green Alleyways Improvements (In Construction)
- » San Carlos Safety Improvement Project (Scheduled for design)

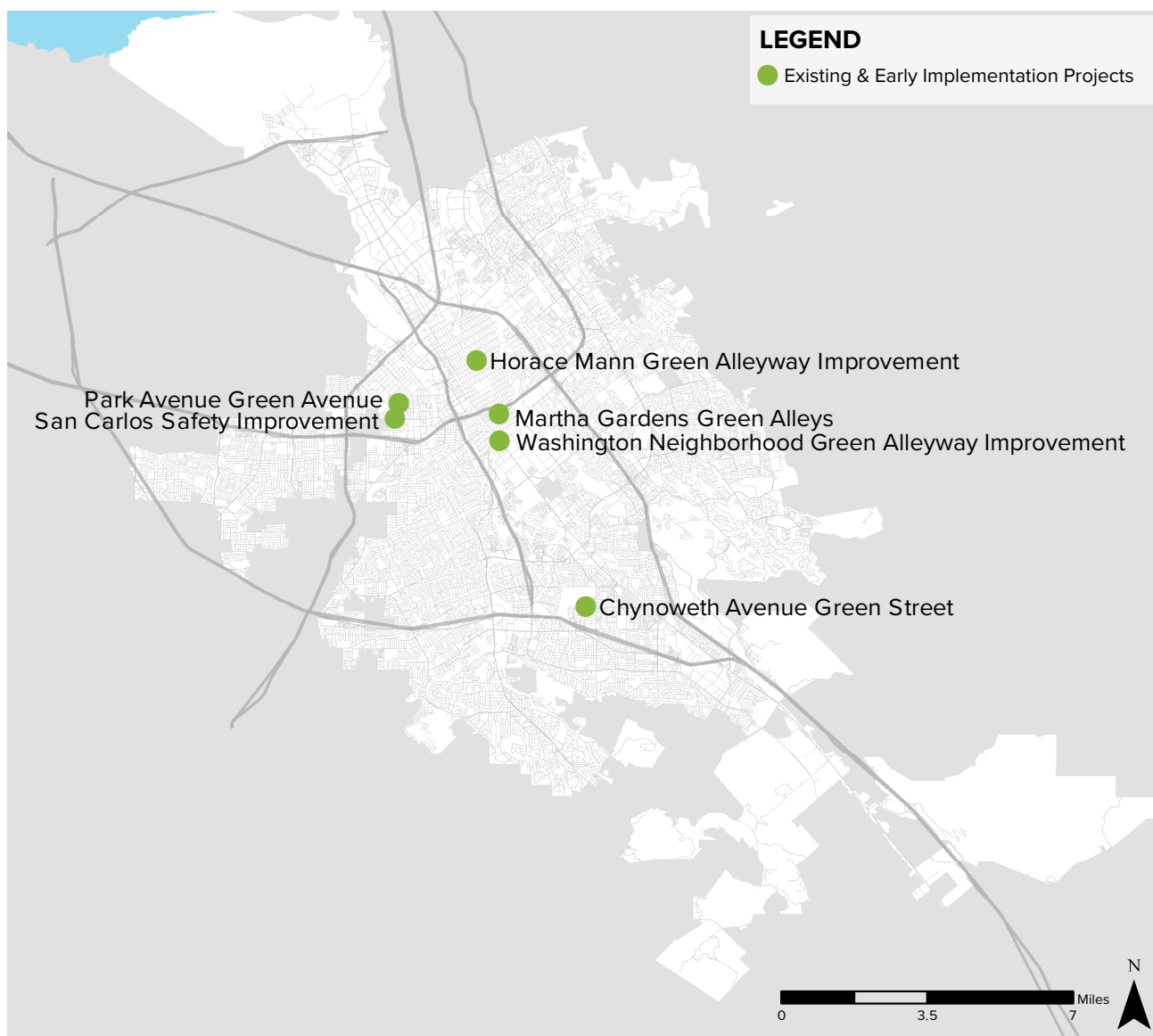


Figure 6-4. Map of Existing and Early Implementation Projects

6.2.3 Martha Gardens Green Alleys

The Martha Gardens Green Alleys Pilot Project is located immediately south of downtown and Interstate 280 in the Spartan-Keyes neighborhood and includes three blocks of alleys running from the project area terminus at Interstate 280 to Martha Street between Second and Third streets. The Martha Gardens Green Alleys are situated in a residential neighborhood that is characterized by single-family Victorian homes, many of which have intact carriage houses along the rear alleyway.

Prior to the project, the three blocks of alleys had deteriorating pavement or were unpaved, creating hazards for pedestrians and cyclists and generating dust and sediment. They lacked standard drainage infrastructure, and during the rainy season, stormwater collected sediments which flowed or tracked onto adjoining streets where the water drained to the storm sewer and discharged to the Guadalupe River.

By retrofitting three blocks of existing alleyways with green stormwater infrastructure features, the Martha Gardens Green Alleys Pilot Project eliminated sediment sources and reduced stormwater runoff by infiltrating stormwater from urban hardscape through porous pavers into underground infiltration trenches. Stormwater from approximately 2 acres of urban development drains through approximately 5,000 square feet of porous pavers into underground infiltration trenches and dry wells, thereby reducing the volume and rate of runoff discharged to the local storm drain system and ultimately the Guadalupe River. The project eliminated approximately 35,000 square feet of sediment sources by replacing deteriorated asphalt in the alleys with a durable surface of high albedo “green concrete” that drains to the infiltration devices.

Project construction took place from April through August in 2015. The \$1.4 million project was funded through a combination of Proposition 84 Stormwater Grant funds and a funding match provided by the City of San José.



Figure 6-5. Martha Gardens Green Alley – Before and After

6.2.4 Park Avenue Green Avenue Pilot Project

The Park Avenue Green Avenue Pilot Project is located west of downtown San José, in the Shasta-Hanchett Neighborhood, and spans from University Avenue to Sunol Street along Park Avenue. The project was planned and constructed in conjunction with the City's Park Avenue Multimodal Improvements Project to install new bicycle lanes, improve sidewalk access, and narrow traffic lanes.

The Park Avenue Green Avenue Pilot Project retrofitted the street to capture, store, and infiltrate runoff at its source. This project demonstrates how stormwater management facilities can be integrated with pedestrian and cyclist safety improvements. The project installed bioretention areas and permeable pavement at four intersections, spanning approximately 1.4 miles. Stormwater from approximately 1 acre of urban development drains through approximately 5,500 square feet of bioretention divided into seven different cells. Permeable pavers at three of the intersections reduce the amount of impervious surface by approximately 2,800 square feet and provide rainwater storage and filtration. The project replaced 8,300 square feet of impervious surfaces along this main thoroughfare.

The \$1.3 million project was funded through a combination of Proposition 84 Stormwater Grant funds and a funding match provided by the City of San José. The Proposition 84 Stormwater Grant Program awarded \$857,551 in grant funds and the City of San José provided \$459,973 in match funds. Project construction began in January 2017 and was completed in October 2017.



Figure 6-6. One of the Bioretention Areas Along Park Ave – Before and After

6.2.5 Chynoweth Avenue Green Street

The Chynoweth Avenue Green Street Project is located along a neighborhood street in South San José bordered by Martial Cottle Park to the north and residential single-family homes to the south. The project area runs along Chynoweth Avenue, spanning from immediately east of Canoas Creek to Snell Avenue. The goal of this green stormwater infrastructure project was to provide treatment to previously untreated flows conveyed on City streets by integrating green stormwater infrastructure methods into traffic and safety improvements. The project installed stormwater bioretention area bulb-outs between newly installed street parking for the adjacent county park and constructed a median separating two lanes of travel.

The project involved the reconstruction of a residential street to eliminate excess lane width while constructing seven new bioretention areas on the northern side of the street to treat stormwater runoff from approximately two acres of urban development. The project created approximately 5,600 square feet of bioretention areas, installed approximately 19,500 square feet of porous asphalt sidewalk, planted 17 broad-leaf evergreen trees, and eliminated approximately 40,000 square feet of existing impervious pavement and a barren dirt median that previously contributed sediment to the storm drain system.

The \$2.2 million project was funded through a combination of Proposition 84 Round 2 Integrated Regional Water Management (IRWM) Implementation Grant funds and a funding match provided by the City of San José. The Proposition 84 Round 2 IRWM Implementation Grant Program provided approximately \$1,977,881 in grant funds and the City of San José provided approximately \$235,426 in match funds. Project construction began in May 2017 and was completed in February 2018.



Figure 6-7. Chynoweth Avenue Bioretention

6.2.4 Horace Mann & Washington Neighborhood Green Alleyways Improvements

The Horace Mann and Washington Neighborhood Green Alleyways Improvements project is near the intersection of Julian and North 9th streets (Horace Mann Neighborhood) and Humboldt and Sherman streets (Washington Neighborhood), within the Guadalupe River watershed. The alleyways do not have standard drainage infrastructure. They consist of deteriorated asphalt that creates hazards to residents, bicyclists, and pedestrians and generates dust, sediment, localized flooding, and ponding. In lieu of traditional storm drain infrastructure, the project installed green stormwater infrastructure to resolve these problems. The project scope included the installation of permeable pavers with underground infiltration trenches and new asphalt. The new asphalt and impervious surfaces from surrounding areas drain to the permeable pavers and infiltration trenches that will remove pollutants and reduce urban runoff flow. The project provides long-term water quality benefits and improves roadway and pedestrian safety.

The project is estimated to cost \$1.6 million and will be funded by the Community Development Block Grant Fund, which supports improvements in low- and moderate-income residential neighborhoods. Construction began in October 2018 and is scheduled to be completed in 2019.

6.2.6 San Carlos Safety Improvement Project

The San Carlos Safety Improvement Project is located on West San Carlos Street between Highway 880 and McEvoy Street, within the Guadalupe River watershed. The goal of the project is to enhance safety by slowing traffic, improving pedestrian crossings, and retrofitting the streetscape design to appropriately reduce vehicle lane widths. The project will remove and modify right-turn slip lanes to slow turning traffic and increase pedestrian bicycle safety.

Green stormwater infrastructure is planned to be incorporated into the safety elements such as mid-block and intersection bioretention bulb-outs. The type and location of each GSI facility is yet to be finalized but is likely to consist of bioretention facilities. Street trees and landscaping will also be planted as part of the site improvements.

The project is estimated to cost \$10 million and will be funded through a combination of City match funds and two federal grants: the Surface Transportation Program and the Congestion Mitigation and Air Quality Improvement Program. Project design is scheduled to begin in 2020 and construction is slated to begin in 2022 with an estimated project completion in 2024.

6.2.7 Existing & Early Implementation Project Performance

In total, the existing and early implementation projects manage 1,244 acres of impervious area as shown in Figure 6-8. These projects capture and treat 34 acre-feet of runoff during the critical bacteria storm. These existing projects represent a small fraction of progress toward the stormwater capture goal of 833 acre-feet.

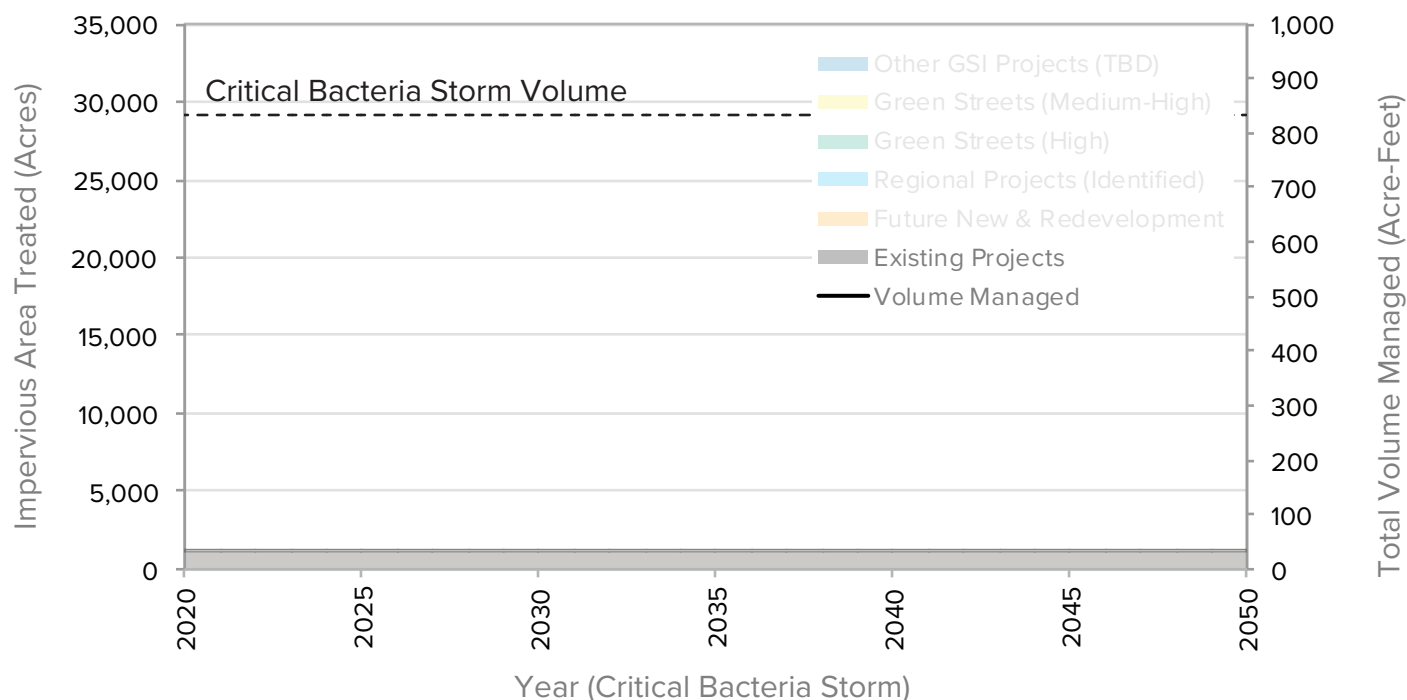


Figure 6-8. Projected Volume Managed by GSI: Existing GSI + C.3 Regulated Projects

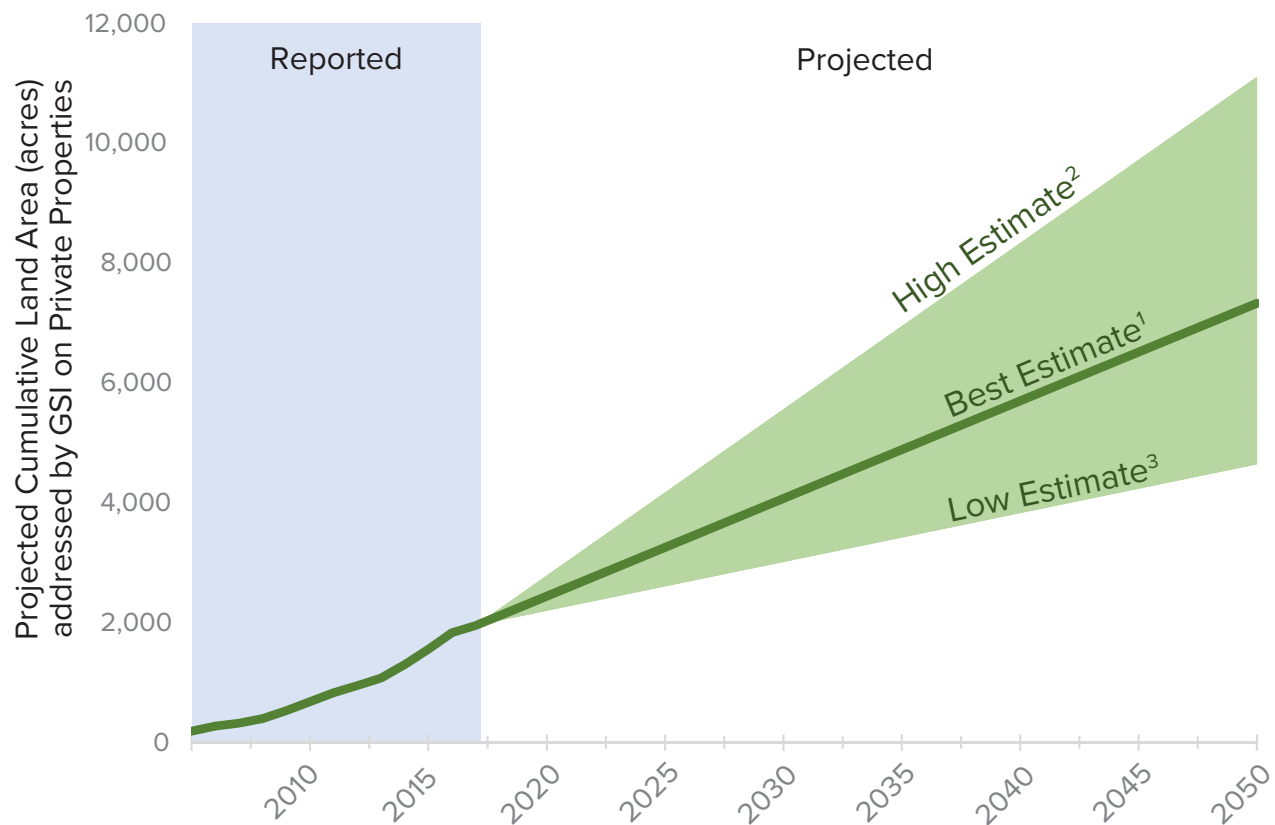
6.3 FUTURE NEW DEVELOPMENT & REDEVELOPMENT

While Provision C.3 has already resulted in the development of existing GSI projects, new and redevelopment from now until 2050 is expected to spur additional implementation of GSI projects. The City worked with SCVURPPP to develop and apply a methodology, based on historic development trends and the City's General Plan, to predict the amount of land area that will be redeveloped in the City and for which stormwater runoff will be addressed via GSI installed on privately owned parcels from 2018 to 2050.

To develop impervious surface retrofit targets, the first step in the process was to estimate the acres of redevelopment and the associated GSI implementation that will occur in the City by 2020, 2030, 2040, and

2050. The City worked with SCVURPPP to develop and apply a methodology, based on historic development trends and the City's General Plan, to predict the amount of land area that will be redeveloped in the City and for which stormwater runoff will be addressed via GSI facilities installed on privately owned parcels over these time horizons.

Figure 6-9 displays the projected amounts of regulated project areas treated with GSI facilities over the required time frames, based on this methodology. Given the uncertainty of development rates in the future, with the expected boom and bust cycles that have historically occurred, the graph displays a best estimate with low and high ranges below and above the target. The resulting projections, also presented in Table 6-1, indicate that the amount of private redevelopment in San José treated by GSI is likely to increase by 3 to 4 times the current (2017) amount by 2050.



1. Best estimate – rate of redevelopment based on 10-year average (2008-2017)
2. High estimate – rate of redevelopment from General Plan build-out projections
3. Low estimate – projected from 50% of “Best Estimate”

Figure 6-9. Existing and Projected Cumulative Land Area Anticipated to be Addressed via GSI Facilities Installed on Private Property in the City of San José by 2020, 2030, 2040, and 2050

Table 6-1. Projected Cumulative Land Area (acres) Anticipated to be Addressed via GSI Facilities Installed on Private Property in the City of San José by 2020, 2030, 2040 and 2050

Year	Low ¹	Best ²	High ³
Current (2017)	-	1,956	-
2020	2,200	2,445	2,788
2030	3,014	4,073	5,560
2040	3,828	5,701	8,333
2050	4,642	7,329	11,105

1. Low estimate – projected from 50% of “Best Estimate”

2. Best estimate – rate of redevelopment based on 10-year average (2008-2017)

3. High estimate – rate of redevelopment from General Plan build-out projections.



Bioretention at Montecito Vista Urban Village

The second step was to estimate the acres of impervious surface associated with future redevelopment. To do this, it was necessary to predict the likely locations, extent, and land uses of the redeveloped areas. Growth patterns and time horizons for development in San José's growth areas, as identified in the General Plan, along with algorithms to identify which parcels were likely to redevelop, resulted in estimates of the location and extent of land area that is predicted to be addressed by GSI facilities by 2030, 2040, and 2050. Then, using the 2011 National Land Cover Database (NLCD) imperviousness dataset and the predicted locations of GSI implementation, estimates of the amount of impervious surface that would be retrofitted with GSI on privately-owned parcels were developed.

Table 6-2 lists the total and impervious area predicted to be retrofitted by 2030, 2040, and 2050 in the City of San José via new GSI implementation on private parcels. The impervious area captured by projected C.3 regulated projects and how this contributes to the City's overall GSI strategy is shown in Figure 6-10.

Table 6-2. Predicted (2020-2050) Extent of Impervious Surface Retrofits via GSI Implementation on Privately Owned Parcels in the City of San José by 2030, 2040, and 2050

Period	2020-30	2030-40	2040-50	Total (2020-50)
Total Area (acres)	1,447	1,628	1,628	4,703
Impervious Area (acres)	890	822	942	2,654

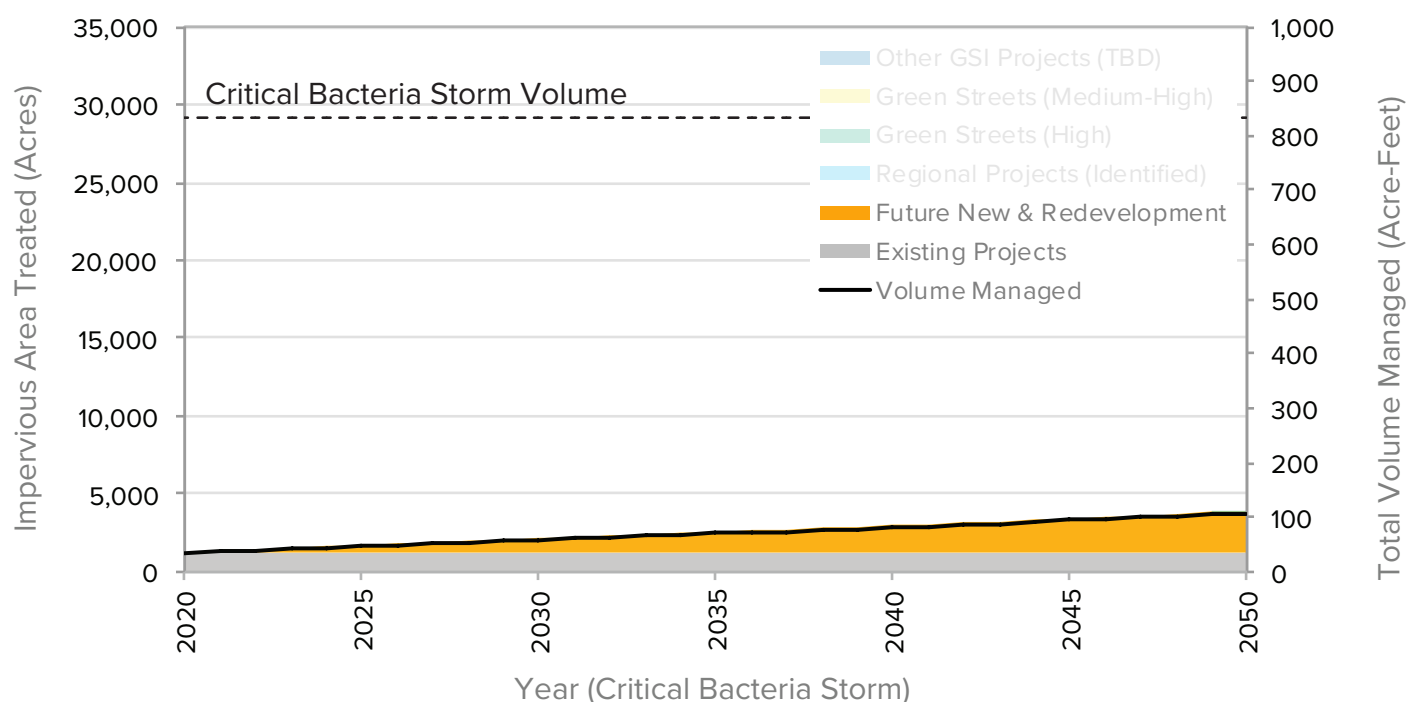


Figure 6-10. Projected Volume Managed by GSI: Existing GSI + C.3 Regulated Projects

6.4 REGIONAL GSi PROJECTS

Based on the prioritization described in Section 5.3, six potential regional projects were identified and advanced through concept design. While these represent the top identified sites, the City is continuing to evaluate additional regional project locations and eliminate infeasible regional project locations. Future identified sites may be added to the current list. These additions would offset green street and LID retrofit needs, resulting in a refinement of the City's overall GSi strategy.

The regional project prioritization process included identifying the sites with best technical suitability for regional stormwater capture and consideration of park uses, community priorities, and other capital project schedules. Then, site visits were conducted to assess design options and evaluate the site's multibenefit potential. Concept designs were developed for the top

sites based on available information. The concepts, listed below, are described in detail in Appendix C.⁶

- » Tully Community Ballfields Regional Stormwater Capture Project
- » Kelley Park Stables Regional Stormwater Project
- » Roy M Butcher Park Regional Stormwater Project
- » Vinci Park Regional Stormwater Capture Project
- » River Oaks Pump Station Regional Stormwater Capture Project
- » Kelley Park Disc Course Regional Stormwater Capture Project

A map of the potential project locations and drainage area is shown in Figure 6-11.

Drainage Area of Regional Project Candidates

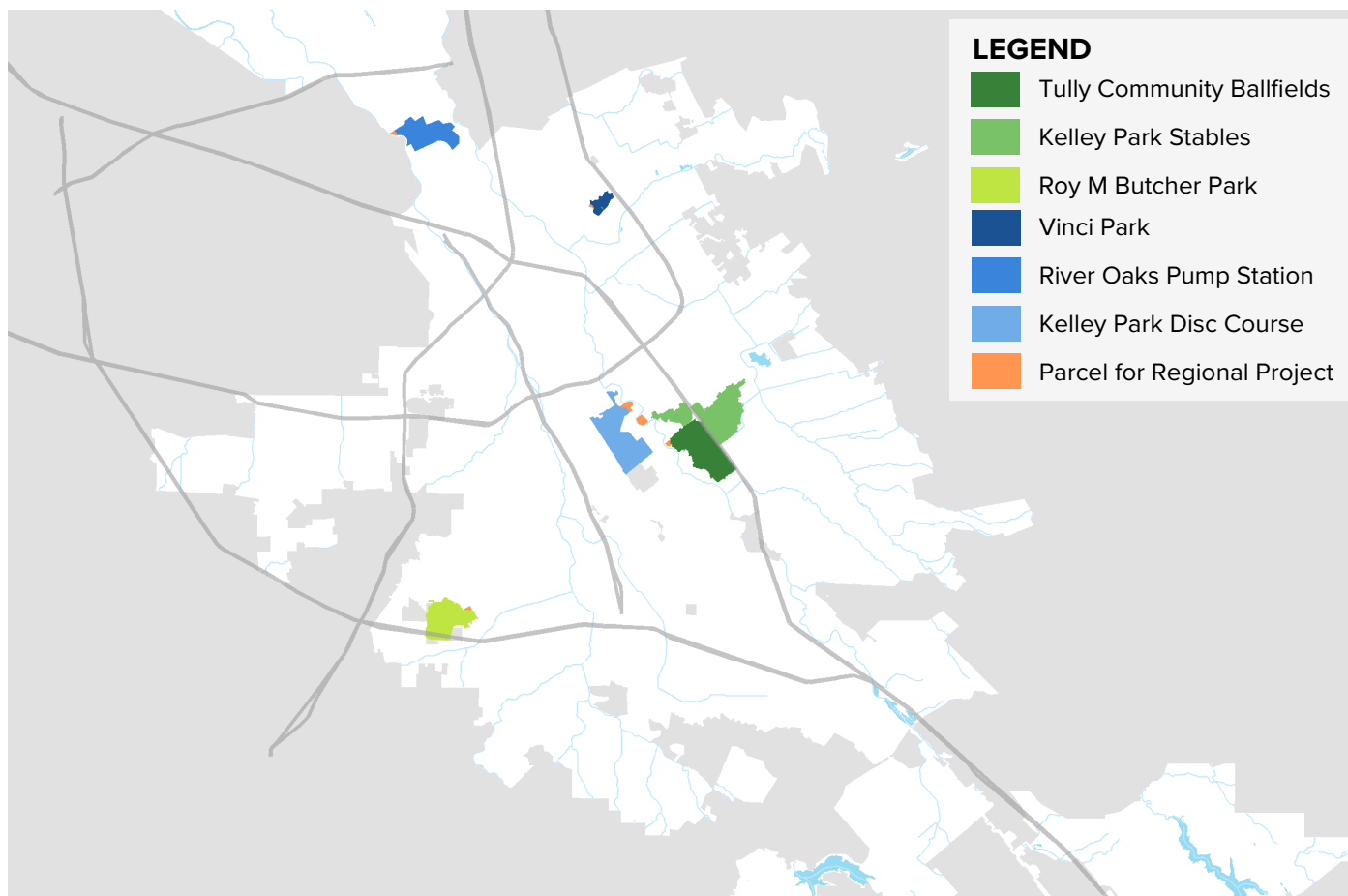


Figure 6-11. Location and Drainage Area of Regional Project Candidates

6. These concepts are intended to facilitate applications for funding, such as state grants, and to support City outreach coordination. More stakeholder outreach will be conducted prior to any concepts moving forward to implementation.

The size of the drainage area and the layout of the stormwater treatment systems were developed based on maximizing water quality treatment and infiltration. Surface stormwater features were prioritized to provide community amenities and minimize costs. However, subsurface systems were determined to be necessary for portions of three of the projects (i.e., Butcher Park, Tully Ballfields, and Vinci Park), where space was limited and existing stormwater infrastructure is too deep to allow gravity drainage to a surface facility.

Each concept design, including the suitability and location of subsurface systems, considered space and geotechnical constraints, such as slopes, soil type, depth to groundwater, depth to bedrock, and contaminated soils. These constraints were assessed based on the available data from the City's GIS spatial data, site visit evaluations, and additional site information obtained from NRCS Soil Survey (soils data), UC Davis SoilWeb (hydrologic soil group), Valley Water (groundwater depths and recharge areas), and GeoTracker (contamination areas). The design configuration and overall cost-effectiveness is highly dependent on encountered subsurface conditions at sites with shallow groundwater or highly variable soil

types. As with all potential project sites, additional physical investigations, such as borings and infiltration rate tests, are needed to verify feasibility of the project concept and inform required changes to the design.

The stormwater performance of each project was evaluated for water quality, flood reduction, and groundwater recharge benefits. Water quality performance was quantified using the results of the RAA modeling. This modeling summarized both the volume capture goals per subwatershed as well as the projected mercury, PCB, and FIB reduction per project. Expected performance of each concept is presented in Appendix C in addition to a budget-level cost estimate. The projected costs of the regional projects are summarized in Table 6-3.

In addition to providing stormwater benefits, the concepts were developed to promote environmental benefits in communities. Figure 6-12 shows an example concept site map and a rendering of treatment facilities at the site with trails and signage.

Table 6-3. Summary of Regional Concepts

Project Name	Impervious Drainage Area (Acres)	Cost Estimate (\$2019)				
		Design Fees ¹	Construction Costs ¹	Project Administration Costs ¹	30-yr O&M Cost ²	Total Lifecycle Cost ³
Tully Ballfields	280	\$1,843,000	\$15,359,000	\$2,765,000	\$5,949,000	\$26,000,000
Kelley Park Stables	349	\$1,935,000	\$16,127,000	\$2,903,000	\$8,099,000	\$29,000,000
Roy M Butcher Park	189	\$1,365,000	\$11,373,000	\$2,047,000	\$4,781,000	\$20,000,000
Vinci Park	37	\$940,000	\$7,831,000	\$1,410,000	\$3,764,000	\$14,000,000
River Oaks Pump Station	213	\$787,000	\$6,561,000	\$1,181,000	\$3,468,000	\$12,000,000
Kelley Park Disc Course	423	\$1,738,000	\$14,484,000	\$2,607,000	\$6,537,000	\$25,000,000
Total	1,383	\$8,608,000	\$71,735,000	\$12,912,000	\$32,598,000	\$126,000,000

1. If a concept is carried forward for future implementation, then costs should be escalated from 2019 dollars to the projected year. Design fees include design, permitting, and environmental. Project administration includes City costs associated with project management and construction oversight.
2. Based on similar precedent projects, preliminary annual O&M costs are estimated as 1% of the total design plus construction costs. If a concept is carried forward for future implementation, then a detailed O&M plan should be developed and O&M costs updated to reflect the schedule of activities therein, and the baseline year for the lifecycle analysis should be updated from 2019 to the projected construction completion date.
3. Net present value, assumes 30-year asset life, 3% escalation rate for O&M.



Figure 6-12. Left: Potential Location of Regional Project. Right: Rendering of Regional Project with Trails and Signage

The scale of the regional projects makes them more cost-effective than other GSI capital project types, such as green streets or LID retrofit projects. Moreover, their scale and location within the public realm (e.g., at parks) presents a greater opportunity to integrate benefits that can be realized by the largest number of City residents. For these reasons, regional projects make up a large component of the City's capital project strategy. These projects, coupled with C.3 regulated

projects on public and private developments, form the core of the citywide GSI strategy. As discussed in the following sections, green street and LID retrofit projects have been prioritized to further diversify the GSI portfolio and supplement this core to increase overall reliability in achieving the long-term water quality goals. The volume captured and impervious area managed by the potential regional projects is shown in Figure 6-13.

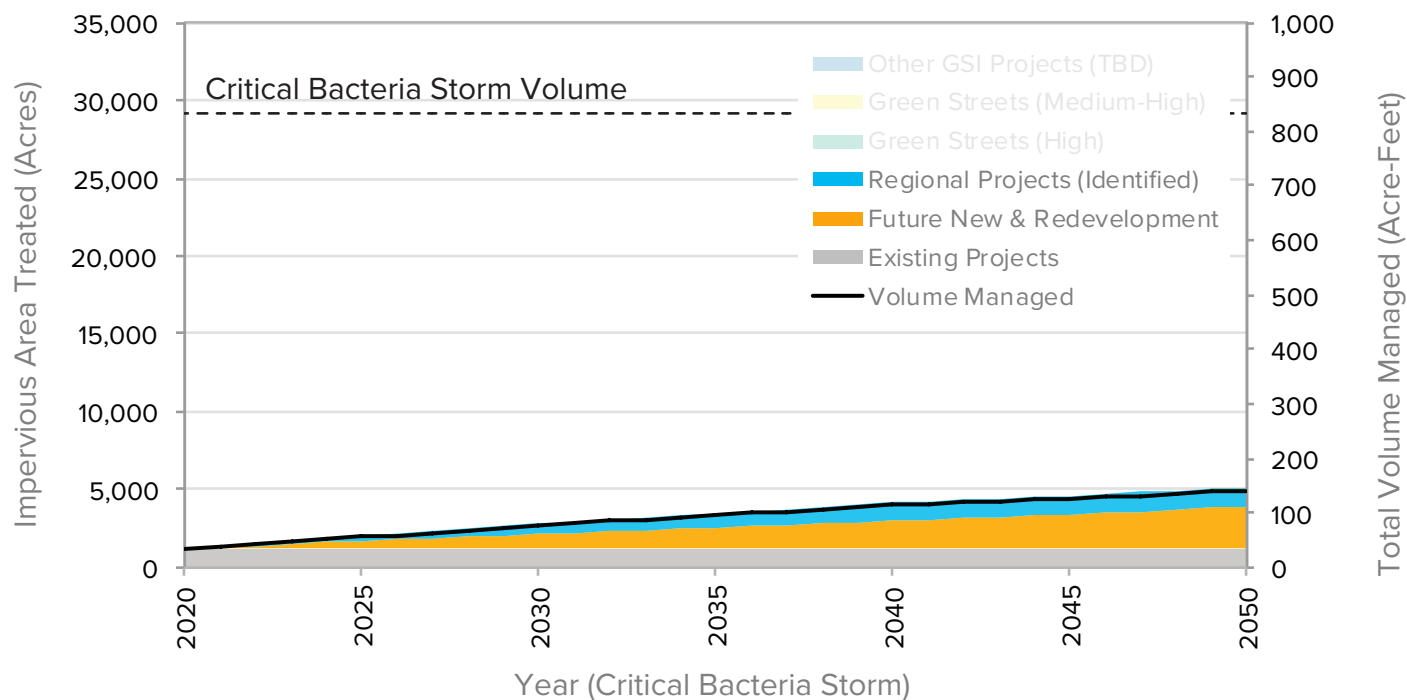


Figure 6-13. Projected Volume Managed by GSI: Existing GSI + C.3 Regulated Project + Regional Projects

6.5 GREEN STREETS

As with the early implementation green street projects discussed in Section 5.3.1, the City will continue to assess the feasibility of green stormwater infrastructure integration into streetscape improvement projects. Co-locating green streets with other City initiatives has the potential to improve capital program cost efficiency and reduce net construction impacts, while helping to address improvement needs and goals of the City. These goals include water quality improvements as well as complete street benefits such as traffic calming, improved bike and pedestrian safety, and increased green space for climate change adaptation. Key City initiatives whose objectives overlap with the goals of green streets and may serve as partners for implementation include: San José Complete Streets

Design Guidelines, Vision Zero San José (including “Walk n’ Roll San José”), San José Bike Plan 2020, and Central San José Bikeways Projects.

The results of the prioritization described in Section 5.3.1 facilitates this process of identifying where the most technically suitable sites for green streets overlap with other City co-benefit goals and planned projects. Figure 6-14 displays the results of the green street technical suitability and co-benefit assessment conducted for the GSI Plan. The technical suitability and co-benefit results were overlaid to prioritize green street segments based on the total score with those scoring more than 45 points being ranked highest based on the data available during the GSI Plan development.

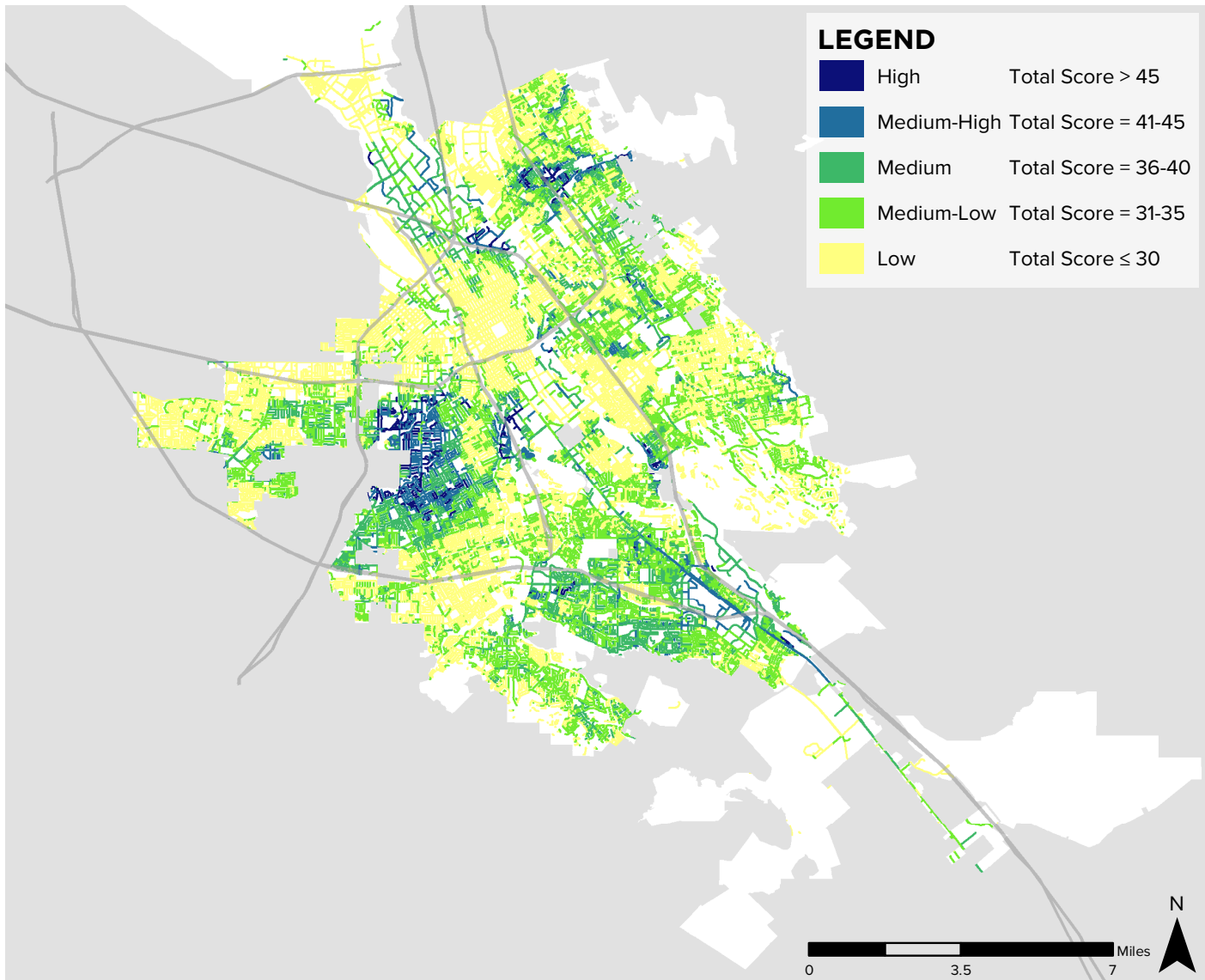


Figure 6-14. Prioritized Green Streets

The prioritization results are coupled with the RAA volume capture needs per subwatershed to establish the green street portion of the citywide GSI strategy (see Appendix B). The quantities of green street capture per subwatershed represent an initial strategy that will involve ongoing coordination among City departments and continued assessment of funding and grant opportunities. The strategy and the prioritized green

street list will be reviewed annually to continue to identify opportunities for green street implementation. Including the contribution from all high and medium-high priority green streets, the total progress toward water capture goals is shown in Figure 6-15.

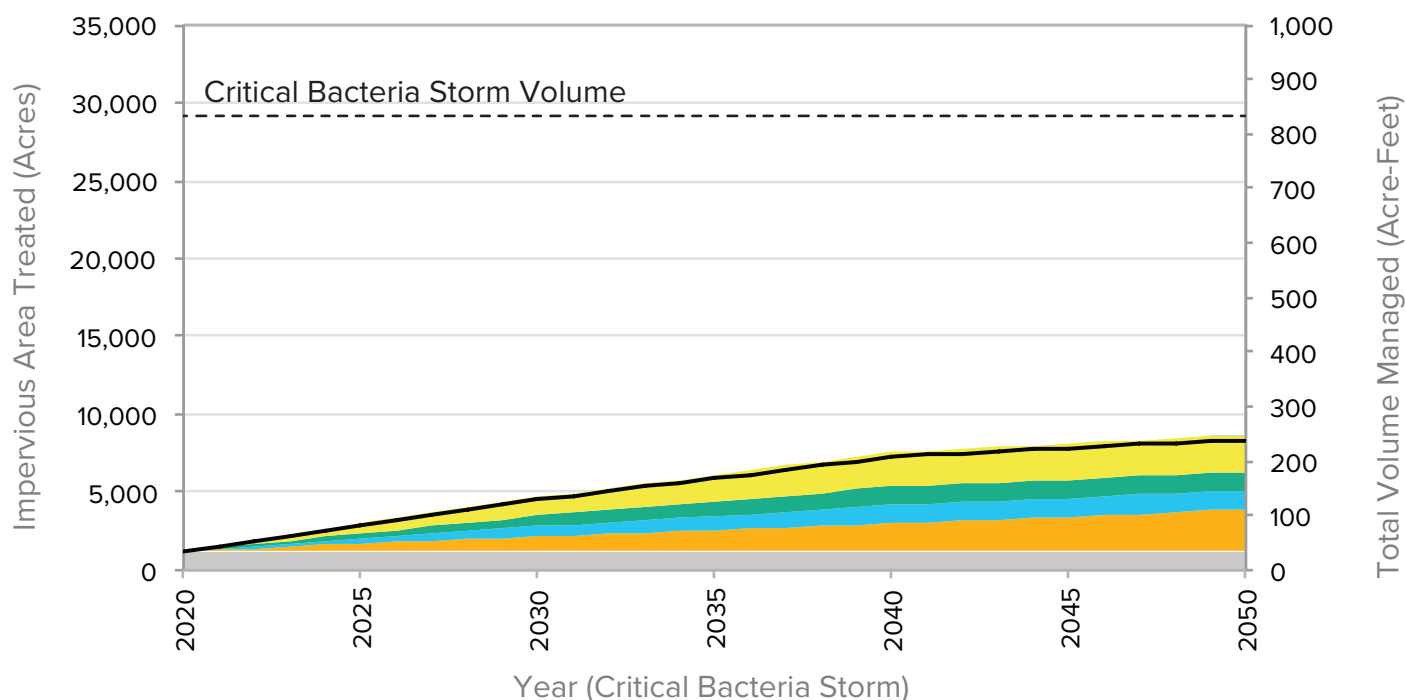


Figure 6-15. Projected Volume Managed by GSI: Existing GSI + C.3 Regulated Projects + Regional Projects + Green Streets

Legend

- Other GSI Projects (TBD)
- Green Streets (Medium-High)
- Green Streets (High)
- Regional Projects (Identified)
- Future New & Redevelopment
- Existing Projects
- Volume Managed

6.6 OTHER GSI PROJECTS

While the projects discussed in the previous sections provide significant stormwater capture, they do not provide enough to capture the full critical bacteria storm citywide. The remaining runoff volume from the critical bacteria storm that is not captured by the existing, C.3 regulatory, identified regional, or green street projects will be addressed through other GSI projects yet to be determined. This category serves as a placeholder to set goals in terms of needed storage capacity of GSI projects throughout the city in addition to the identified project opportunities discussed in the previous sections. Further investigation can determine how these goals can be met utilizing a combination of strategies. Increased future development resulting in more C.3 regulated projects, can be considered in conjunction with additional public GSI projects not discussed in the previous sections. These public GSI projects may include (1) LID on public parcels, (2) additional regional projects yet to be identified, and (3) additional green streets, possibly including lower priority green streets identified in Section 6.5.

LID on public parcels were identified as part of the SWRP and GSI Plan prioritization efforts. Whereas the SWRP countywide GSI prioritization effort resulted in more than 2,400 high priority green street locations, the SWRP effort returned a more manageable number of high priority LID retrofit sites at fewer than 200. The City will use this prioritized list, coupled with the stormwater performance and geotechnical suitability maps developed as part of the GSI Plan, to support its existing process of evaluating LID retrofit opportunities within planned City projects. However, as these

opportunities are relatively limited in scale and can be dependent on co-location with proposed public parcel capital projects, meeting these remaining capture needs per subwatershed may ultimately be achieved in combination with other project types, such as additional regional projects or green streets.

While six regional projects identified in the SWRP and GSI Plan prioritization were previously discussed as part of the GSI implementation strategy, additional regional projects yet to be identified may account for a portion of the remaining volume needed for full capture of the critical bacteria storm. Regional projects tend to be more cost-effective than LID projects due to economies of scale, so additional regional projects may be a part of the strategy for achieving FIB reduction goals through other GSI projects yet to be identified. Further analysis will need to be performed to determine if additional sites are appropriate for regional GSI projects.

Remaining volume capture may also be addressed through implementation of additional green street projects that were identified as lower priority and not considered in the RAA. The RAA only considered green street sites from the highest two priority categories, high and medium-high, in the cost optimization. Additional green streets may be implemented on sites identified as lower priority from the GSI Plan prioritization effort. Green street project sites will need to undergo feasibility analysis to determine suitability for implementation and are subject to further investigation. The lower priority green streets are shown in Figure 6-14 (Section 6.5).



GSI on Bassett Street in San José

The additional GSI projects will undergo feasibility analyses and site investigations to determine specific sites for implementation. While the GSI Plan and RAA inform GSI implementation goals, the strategy for implementation is subject to adaptive management as new information is obtained. The strategy will be refined as the GSI Plan is implemented and more comprehensive municipal engineering analyses (e.g., master planning, capital improvement planning) are performed. As shown in Figure 6-16, the total GSI citywide strategy, with the inclusion of other GSI projects to be determined, addresses the FIB goal for capture of the critical bacteria storm.

The project strategy presented in this chapter provides the direction needed to establish the immediate next steps to realize the City's gray to green stormwater vision. These next steps of GSI Plan implementation, along with the legal, technical, and funding mechanisms put in place to enable them, are described in Chapter 7.

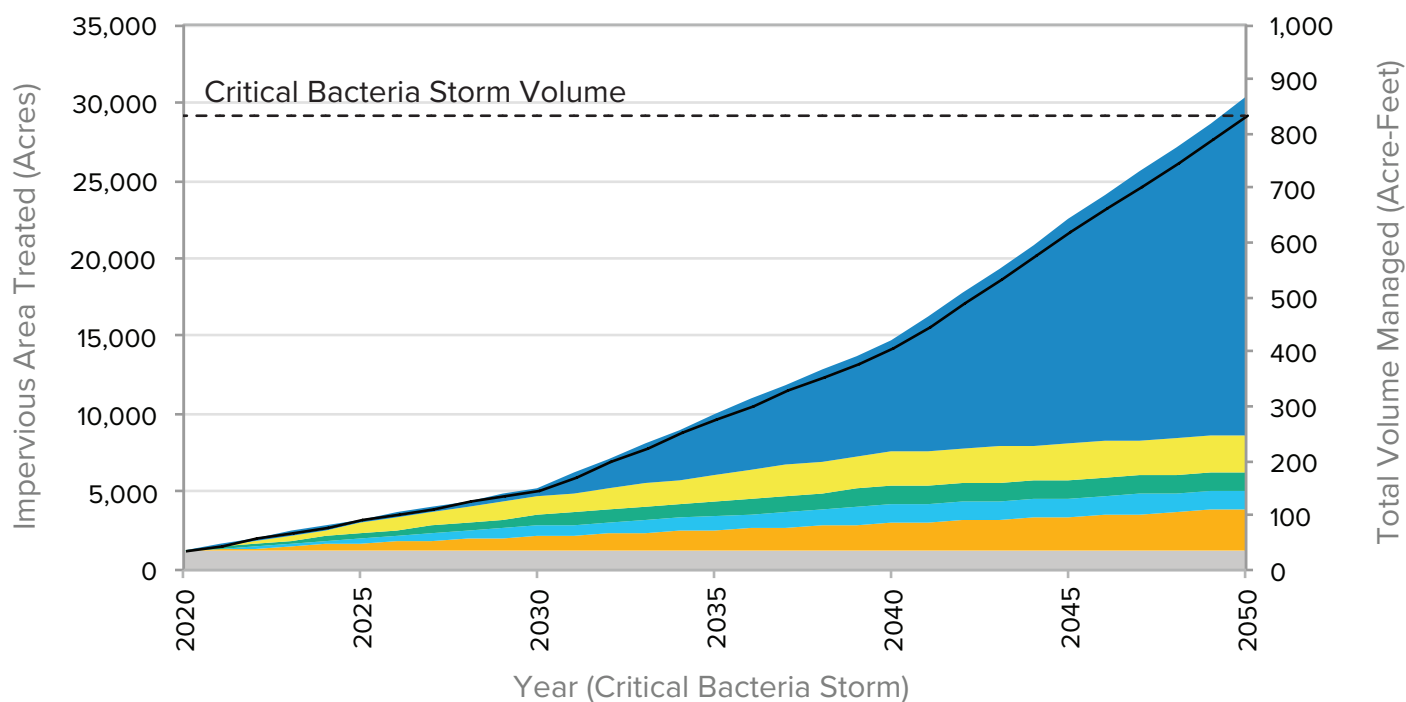


Figure 6-16. Projected Volume Managed by GSI: Existing GSI + C.3 Regulated Projects + Regional Projects + Green Streets + Other GSI Projects

Legend

- Other GSI Projects (TBD)
- Green Streets (Medium-High)
- Green Streets (High)
- Regional Projects (Identified)
- Future New & Redevelopment
- Existing Projects
- Volume Managed



IMPLEMENTATION PLAN

Bioretention in San José

This chapter defines the process for implementing the prioritized projects to achieve the projections defined in Chapter 6. The implementation plan has three main components: (1) the workplan defining the steps to implement the prioritized capital projects, (2) the legal and funding mechanisms that enable implementation, and (3) the technical tools that ensure implemented projects perform and enable quantification of overall progress toward the citywide goals.

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7.1 WORKPLAN FOR PRIORITIZED PROJECTS

The following workplan defines the process for implementing the prioritized regional, green streets, and LID retrofit projects identified to meet citywide water quality goals. This includes describing the near-term steps and schedule to move projects into the design phase, as well as establishing the procedures for integrating these prioritized projects into the City’s capital planning framework.

While the scope of the workplan described in this section is public GSI projects, it is important to note that the City is simultaneously implementing other types of stormwater improvement projects across San José. This includes conducting design review and post-construction inspection of C.3 regulated projects on new and redevelopments, as well as implementing gray stormwater projects to improve water quality and increase flood control. Gray improvements being implemented by the City include trash capture devices to reduce trash and sediment entering San José’s rivers and streams, as well as storm sewer projects to increase system capacity, reduce illicit (non-stormwater) flows into the system, and improve structural reliability.

7.1.1 Regional Projects Workplan

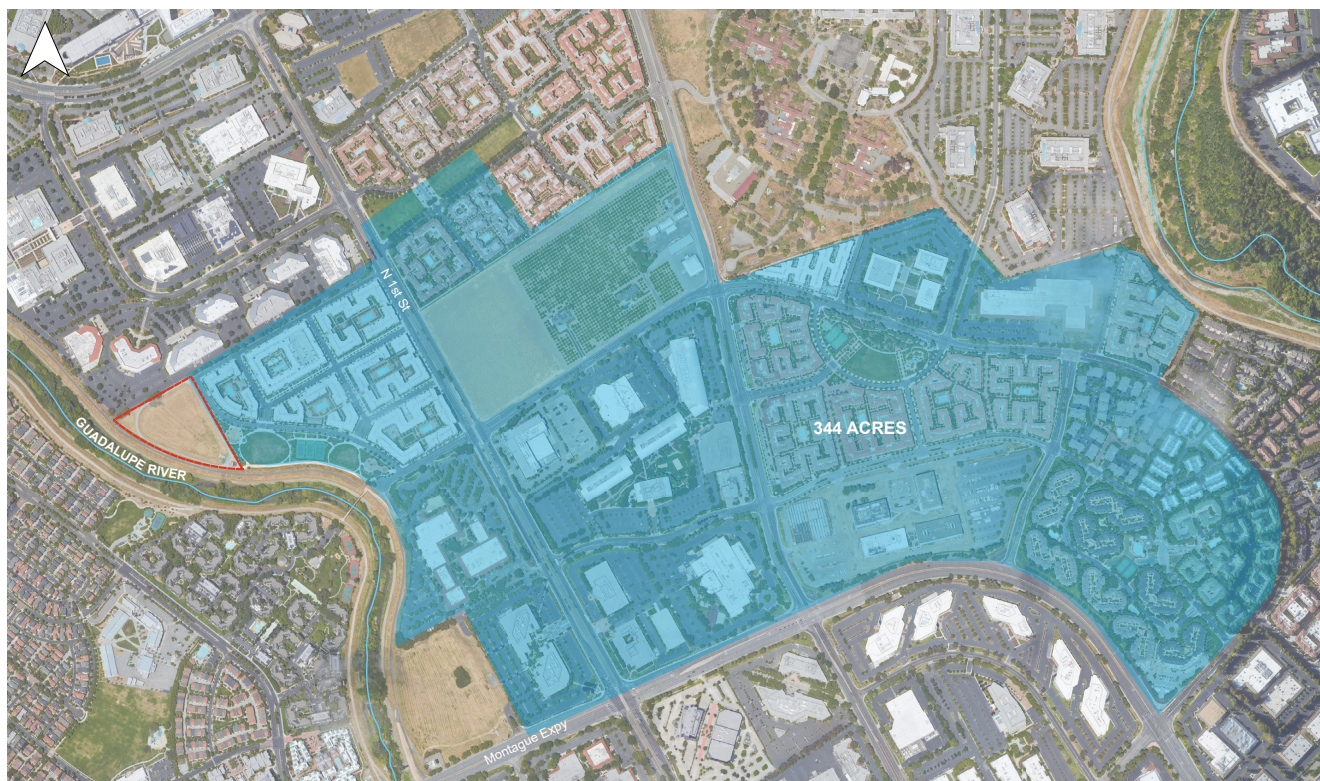
To meet milestones defined in the MRP and the Consent Decree, the City has created a preliminary implementation schedule for the prioritized regional projects defined in Chapter 6. The regional projects are located on City-owned parcels that contain sufficient space to capture runoff from a large drainage area. The drainage area and site location of one of the potential regional concepts are shown in Figure 7-1 and Figure 7-2, respectively. Concept designs for each of the potential regional projects—including project description, drainage areas, site layout, expected benefits, and full cost breakdown—are provided in Appendix C.

The draft schedule and cost outlay for the prioritized regional projects are shown in Figure 7-3 and Figure 7-4, respectively. The proposed schedule and list of projects are for planning purposes only, as both are contingent upon ongoing review and coordination among departments as well as community outreach, and funding. The schedule, costs, and concept designs developed for the GSI Plan provide the necessary information to advance implementation of the regional projects through next steps including feasibility assessments, interdepartmental coordination, and community outreach.



Installation of a Trash Capture Device in San José

RIVER OAKS REGIONAL PROJECT - CONCEPT SITE DRAINAGE AREA



LEGEND

- Project Footprint
- Creek / Channel
- Potential Drainage Area

Figure 7-1. Example Regional Project Concept Drainage Area



Before



After

Figure 7-2. Site Location and Render of a Potential Regional Project

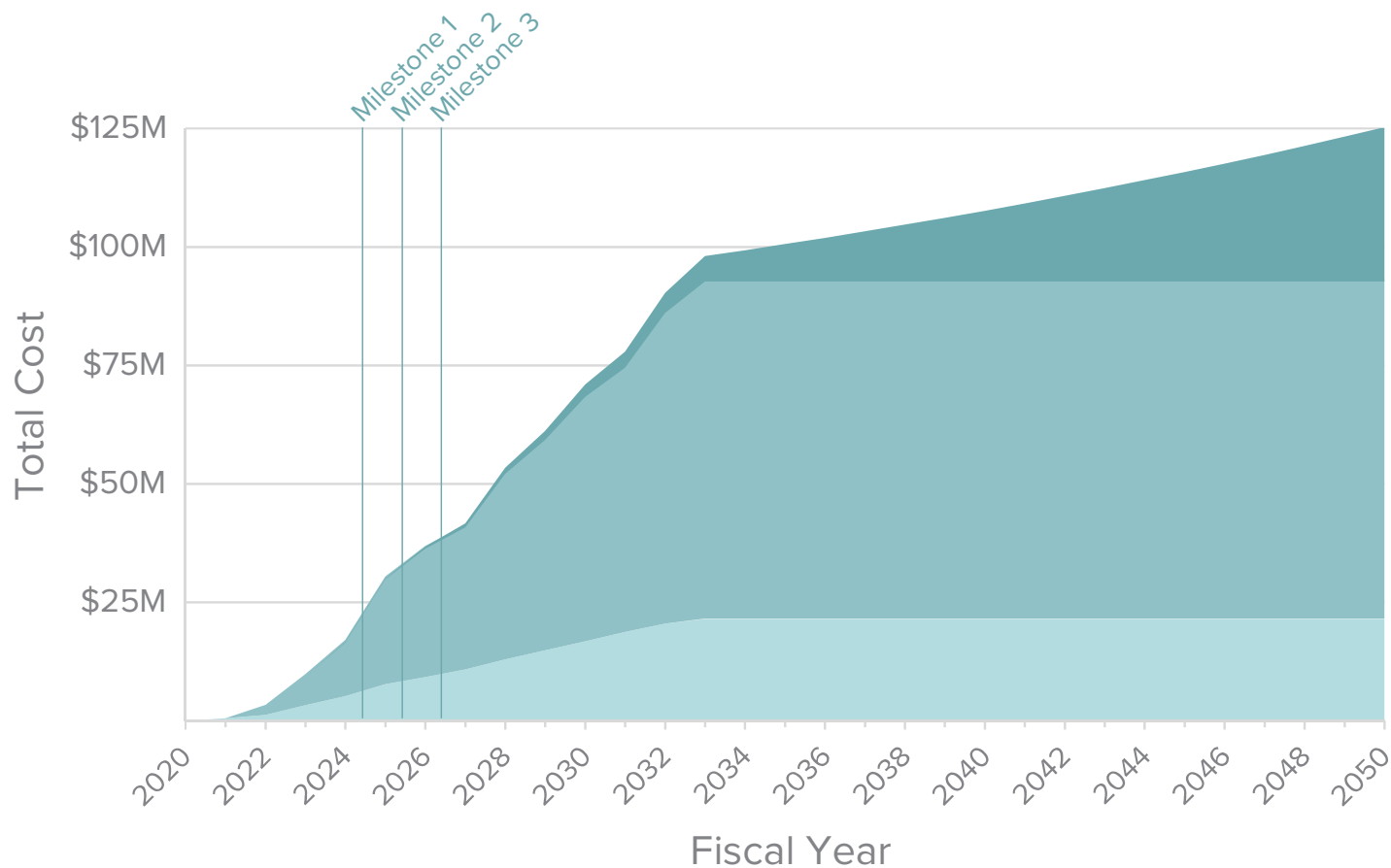


Figure 7-3. Projected Costs of Prioritized Regional Projects to 2050⁷

- Design and Project Management Costs
- Construction Costs
- O&M Costs (Escalated)

7. For City planning purposes only; final project selection and schedules are contingent upon further coordination and stakeholder outreach.

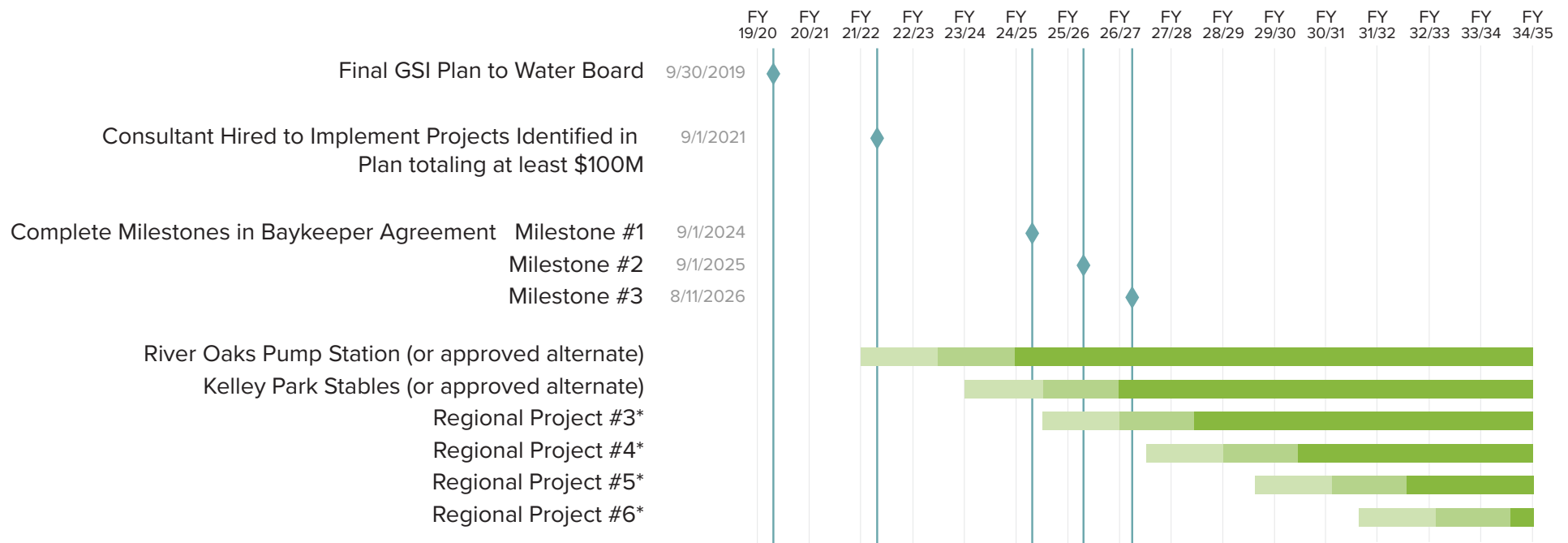


Figure 7-4. Draft Schedule for Prioritized Regional Projects⁸

- Design phase
- Construction phase
- Operations & maintenance phase (continues in perpetuity)

Milestone 1: Completed design, environmental, and geotechnical analysis of projects identified in the Plan representing at least \$25M in total project costs.

Milestone 2: Award Contracts for Projects totaling at least \$25M. Completed design, environmental, and geotechnical analysis of projects identified in the Plan representing at least \$35M in total project costs.

Milestone 3: Award Contracts for Projects totaling at least \$35M. Completed design, environmental, and geotechnical analysis of projects identified in the Plan representing at least \$50M in total project costs.

* Potential regional projects include Vinci Park, Kelley Park Disc Course, Butcher Park, and Tully Ballfields.. The order these will be implemented has not been determined. These projects may be replaced with an approved alternative regional project.

8. For City planning purposes only; final project selection and schedules are contingent upon further coordination and stakeholder outreach.

7.1.2 Green Streets Workplan

As described in Chapter 6, to progress toward meeting Consent Decree and MRP milestones, the City used the RAA results (Appendix B) to quantify the number of green streets needed per subwatershed to meet water quality goals. This information was coupled with the San José-specific prioritization tool to identify proposed green street locations in these subwatersheds. The City will continue to use this approach to proactively identify street locations that are most suitable for a green street project. As funding becomes available, the City can construct green streets in the high-priority locations.

In addition to proactively identifying and implementing green street projects through the process described above, the City will also evaluate opportunities to integrate GSI into planned City street projects. The City prepares and maintains a list of public infrastructure and streetscape projects planned for implementation that have the potential for GSI facilities. For each public project with implementation potential, the City evaluates how GSI can be included to the maximum extent practical. This process led the City to identify and implement the early implementation GSI projects described in Chapter 6. The RAA capture goals and GSI Plan prioritization tool will be used to augment this ongoing process of identifying street projects with GSI potential.

The green streets implementation workplan is as follows:

1. As described in Chapter 6, use the GSI Plan prioritization and RAA results to identify the high priority green street projects per subwatershed to meet capture goals.
2. Each year, review the City's list of planned street projects to identify overlap with high priority green streets.

3. For the areas of overlap identified in Step 2 and the green street priority projects identified in Step 1, follow the BASMAA guidance⁹ to confirm that the candidate projects have the potential to integrate GSI.

3.1 Information Collection – Identify location of catch basins and drainage pathways. Assess ability to substitute pervious pavements for impervious pavements.

3.2 Preliminary Sizing and Drainage Analysis – Identify the most feasible GSI locations within the streetscape and roughly delineate the drainage area. Establish the sizing factor (facility area/tributary area), with a guideline of ≥ 4 percent sizing for bioretention and ≥ 0.5 for dispersal to landscape or pervious pavement (i.e., a maximum of 2:1 ratio of impervious area to pervious). Site reconnaissance will likely be necessary to fill data gaps through visual observation.

3.3 Barriers and Conflicts – Update the site space constraints data based on visual assessment of utility locations, length constraints (e.g., bus stops, driveways, hydrants, mature trees), and sidewalk widths. Also evaluate the extent to which GSI would be an “add on” to the proposed project versus an integrated element of a complete street.

3.4 Project Budget and Schedule – Consider sources of funding that may be available for integrating GSI into the project. Note any constraints on project schedule that would preclude including time to integrate GSI into the design and construction. Note any constraints on project schedule that would complicate aligning a separate funding stream for the GSI elements.

9. BASMAA Development Committee. 2016. Guidance for Identifying Green Infrastructure Potential in Municipal Capital Improvement Program Projects. May 6, 2016.

7.1.3 LID Retrofits Workplan

If, after following the BASMAA guidance, the project still has GSI potential, proceed to the next step.

4. Gather additional data to assess design feasibility and coordinate with the co-located street project (if applicable) to include GSI in the project design.
 - 4.1 Conduct a site visit to review proposed GSI locations, discuss potential concerns, and field-verify site constraints.
 - 4.2 Compile as-built and private utility data to update utility conflict assessment.

Update the space constraint analysis based on field visit and gathered utility data.

5. Perform on-site survey and geotechnical investigations.
 - 5.1 Conduct utility survey to verify alignment and depth of potential utility conflicts.
 - 5.2 Conduct a geotechnical investigation (infiltration test/soil boring/environmental analysis) to confirm soil type, infiltration rate, and soil contamination potential.

Update hydrogeological and space constraint analyses based on utility survey and geotechnical analysis.

If the project is deemed feasible and funding is available it can continue through project implementation following the City's standard capital project delivery process.

As with green streets, the City has an ongoing process to evaluate public projects on parcels for potentially locating green stormwater infrastructure. This process includes several steps that follow the guidance established by BASMAA (BASMAA 2016). The GSI Plan identifies the quantity of GSI needed to achieve water quality goals and prioritizes the LID retrofit sites based on technical site suitability and co-benefit opportunities. The City will integrate its ongoing process of evaluating planned projects on parcels with this additional information from the GSI Plan to significantly improve the process of identifying and implementing the best LID retrofit opportunities. The workplan to implement prioritized LID retrofit sites is as follows:

1. As described in Chapter 6, use the GSI Plan results to establish the high priority LID retrofit projects needed to achieve water quality goals.
2. Proactively review the City's list of planned parcel projects to identify overlap with high priority LID retrofit locations.
3. For these areas of overlap, follow the BASMAA guidance¹⁰ to confirm that the planned parcel projects have the potential to integrate GSI.
 - 3.1 Information Collection – Identify location of roof leaders, downspouts, area drains, and site drainage pathways. Identify landscape and paved areas downgradient from roofs and pavements that could serve as GSI locations. Assess ability to substitute pervious pavements for planned impervious pavements.
 - 3.2 Preliminary Sizing and Drainage Analysis – Identify the most feasible GSI locations within the site and roughly delineate the drainage area. Establish the sizing factor (facility area/tributary area), with a guideline of ≥ 4 percent sizing for bioretention and ≥ 0.5 for dispersal to landscape or pervious pavement (i.e., a maximum of 2:1 ratio of impervious area to pervious). Site reconnaissance will likely be necessary to fill data gaps through visual observation.

10. BASMAA Development Committee. 2016. Guidance for Identifying Green Infrastructure Potential in Municipal Capital Improvement Program Projects. May 6, 2016.

3.3 Barriers and Conflicts – Assess space constraints data based on visual assessment of utility locations and building footprints. Confirm property ownership information and identify potential easements. Evaluate the extent to which GSI would be an “add on” to the proposed project versus an integrated element of the site.

3.4 Project Budget and Schedule – Consider sources of funding that may be available for integrating GSI into the project. Note any constraints on project schedule that would preclude including time to integrate GSI into the design and construction. Note any constraints on project schedule that would complicate aligning a separate funding stream for the GSI elements.

If, after following the BASMAA guidance, the project still has GSI potential, proceed to the next step.

4. Coordinate to include GSI in the project design.

4.1 Conduct a site visit to review proposed GSI locations, discuss potential concerns, and field-verify site constraints and drainage features.

4.2 Field-verify location of utility laterals and confirm easement locations.

Update the space constraint analysis based on field visit.

5. Perform on-site soil investigations.

5.1 Conduct an infiltration test to confirm rate of infiltration. Include soil testing if warranted based on site potential for soil contamination (e.g., contamination potential due to historical land use, proximity of underground storage tanks, or existing groundwater contamination spatial data layers). Include a soil boring if design includes a subsurface infiltration system or if available data indicates the potential for shallow depth to groundwater or bedrock.

Update hydrogeological data based on results.

If the project is deemed feasible and funding is available it can continue through project implementation following the City’s standard capital project delivery process.

7.2 IMPLEMENTATION MECHANISMS

The GSI Plan quantifies volume capture needs and prioritizes specific projects for near-term integration into CIPs and long-term integration into City planning efforts. However, implementation of these projects is still contingent upon the City having the proper legal mechanisms to implement the Plan, and identifying sufficient funding sources for GSI planning, design, construction, and maintenance.

7.2.1 Legal Mechanisms

As described in Section 1.3, the City of San José and other municipalities subject to Provision C.3 of the MRP must require post-construction stormwater control measures on regulated development projects. Post-construction stormwater controls reduce pollutants from flowing to streams, creeks, and the Bay and reduce the risk of flooding by managing peak flows.

Chapter 20.95 of the City's Municipal Code includes stormwater management requirements that are consistent with the MRP. It contains references to two Council policies that govern the requirements for post-construction stormwater controls:

- » Council Policy 6-29, Post-Construction Urban Runoff Management
- » Council Policy 8-14, Post-Construction Hydromodification Management

The City's Municipal Code establishes legal authority for the City to require regulated private development projects to comply with MRP requirements. GSI capital projects must conform to the sizing and design requirements contained in Provision C.3 except under certain limited circumstances and they are primarily public projects under control of the City. The City's General Plan, along with its Urban Village Plans, Complete Streets Plan and other plans described in Chapter 3 govern and direct the City's actions in developing and implementing the GSI Plan. The City also intends to use the SCVURPPP GSI Handbook and associated guidelines, details, and specifications to assist with the design of GSI projects (see Chapter 4).

The City intends to evaluate its implementation of projects as part of this GSI Plan and, as needed, may consider whether additional policies or ordinances could help facilitate GSI Plan implementation in the future.

7.2.2 Funding Mechanisms

The City of San José currently uses a combination of federal and state grants and storm sewer fees to fund construction and O&M of CIP projects. The workplan for prioritized projects presented in Chapter 7 defines more than \$100 million in spending on high priority regional projects. In addition, the workplan defines the process to significantly increase annual implementation of green street and LID retrofits to reach capture goals. Recognizing that current revenue sources would not be sufficient to fund these expenditures, the City conducted a study to evaluate funding alternatives to meet the revenue shortfall. The City reviewed potential funding mechanisms in the following ways:

- » Benchmarked funding mechanisms being used by a sampling of other California agencies
- » Reviewed legal requirements and limitations on the City's ability to implement various mechanisms
- » Completed preliminary ratepayer focus groups and phone surveys to assess attitudes about stormwater, including the potential for a finance measure to fund improvements to storm sewer infrastructure

The California Constitution imposes a number of requirements and limitations on the City's ability to increase revenues that apply to funding options for stormwater management. These stormwater funding options and their limitations are summarized in Table 7-1.

In addition to those summarized in Table 7-1, other GSI funding options currently used and/or being considered by the City, include:

- » Grants: To date, the City has secured several grants totaling more than \$4 million to design and construct early implementation GSI projects.
- » Integration with Transportation Projects: Installing and maintaining GSI facilities as part of integrated roadway programs can reduce total City costs and enable pursuit of funding mechanisms that might not normally be available to a traditional stormwater project.

Table 7-1. Stormwater Funding Options & Limitations

Revenue Mechanism	Description	Requirements	Restrictions on Use
General Tax	Revenue for any purpose, e.g., City's general business tax	Majority approval required at an election consolidated with a regularly scheduled general election for members of the City Council, unless an emergency is declared by unanimous vote of the City Council.	Use allowed for any governmental purpose
Special Tax	Revenue for specific purpose, e.g., City's special transient occupancy tax for cultural activities and facilities	Two-thirds voter approval	Limited to purpose specified in ballot measure
Property-Related Fee	A charge imposed on a parcel or upon a person as an incident of property ownership, including a user fee or charge for a property-related service	Notice and Majority Protest Procedures for sewer, water and refuse collection fees For other types of property related fees, majority approval by property owners or two-thirds approval by registered voters	Fee amount must correlate to service provided to the parcel charged and fee revenue cannot fund general government services
Assessment District Fee	A charge upon real property by an agency for a special benefit conferred upon the real property located within the boundaries of the assessment district	Notice and Majority Protest Procedures ¹ Vote is weighted according to proportional financial obligation of affected property	Charge is limited to fund improvements which provide a direct and special benefit to property and not for general benefits or general government services. Charge must be for the reasonable cost of the "proportional special benefit" to the parcel.
Parcel Tax or Tax Imposed Through a Community Facilities District	Flat tax imposed on real property	Cannot be based on property value (ad valorem) Two-thirds qualified electors approval required	Parcel taxes limited to purpose specified in ballot measure. For CFDs, maintained or construction of public improvements consistent with San Jose Municipal Code Chapter 14.27.
General Obligation Bonds	Bonds issued by the City. Repayment secured by a promise to levy additional taxes in an amount as necessary to pay debt service on the bonds	Two-thirds voter approval required	Bond proceeds may be spent on the acquisition or improvement of real property only

1. The State Constitution does not specify the authority to establish an assessment district. As a charter city, San José may utilize the authority to establish an assessment district under State law or may follow provisions in the City's Municipal Code authorizing the establishment of an assessment district. However, the requirements under the State Constitution described above must also be followed.

Options that the City may consider in the future include:

- » **Alternative Compliance:** Providing regulated projects with alternative mechanisms for C.3 stormwater compliance (e.g., when compliance cannot be achieved on-site) can leverage development activities to build and maintain public GSI systems. Credit trading programs can incentivize nonregulated properties to retrofit impervious surfaces. Some alternative compliance mechanisms are currently allowed under the MRP, but more complex approaches like in-lieu fees and credit trading will require development of new programs and ordinances.
- » **Public-Private Partnerships (P3s):** This is an option in which GSI facilities are jointly funded by the City and a private organization or land owner for the benefit of both parties.

Based on analysis of the funding gap and consideration of preliminary public opinion research, the funding mechanisms deemed to be most feasible thus far are general obligation bond funding, a parcel tax, and grants. To better determine the feasibility and fiscal impacts of these alternatives, the City is currently conducting follow-up analyses. The goals of these follow-up tasks include:

1. Develop a more thorough funding analysis/strategy of the two most feasible funding mechanisms: General Obligation Bonds (to fund capital projects) and Parcel Tax (for O&M), or other mechanisms as outlined in Table 7-1.
2. Develop and implement a more comprehensive outreach/polling plan to more clearly appraise the support for the recommended funding strategies that require voter approval.
3. Refine the analysis of additional stormwater infrastructure and program needs, including increased regulatory requirements, infrastructure improvements, and operations and maintenance costs.

San José Disaster Preparedness, Public Safety, and Infrastructure General Obligation Bond

In 2018, the voters of San José passed the ballot Measure T – The Disaster Preparedness, Public Safety and Infrastructure Bond. The measure authorizes the City to issue up to \$650 million in general obligation bonds for a comprehensive investment in San José's infrastructure. As the City grew, many of the critical facilities that are relied upon for safety, transportation,

and water became outdated and undersized. To address the infrastructure needs, the City developed a list of bond projects that included street and bridge repair, LED lighting, upgrades to existing and construction of new safety facilities, storm system conveyance and flood prevention projects, and environmental protection projects.

The Disaster Preparedness, Public Safety and Infrastructure Bond list of projects allocates approximately \$25 million to clean water projects. The goal of priority projects, likely to include green stormwater infrastructure, is to provide multiple benefits by simultaneously delivering clean water to the Bay and beautifying existing City owned open space.

A mix of funding sources is necessary to meet the cost schedule for prioritized regional projects outlined in Section 7.1.1. While refining its funding strategy per the results of the analyses outlined above, the City will continue to pursue funding of at least \$100 million by December 31, 2020 as set forth in the Baykeeper consent decree.

Operations and Maintenance of Green Stormwater Infrastructure

Effective operation and maintenance is essential to the success of green stormwater infrastructure and improvement of water quality. The City currently maintains an inventory of green stormwater infrastructure facilities on public property and in the public right-of-way. However, as this inventory grows, the City will have a significant annual resource demand beyond what is currently available. The City will need additional funding sources and will continue to evaluate options.

7.3 PERFORMANCE ASSURANCE

With a workplan, legal authority, and funding mechanisms in place, the remaining key element of a successful implementation plan is the technical guidance to assure project performance. The City has developed several key technical tools to guide and track GSI performance, as described in the following subsections.

7.3.1 Technical Guidance Tools

The success of the GSI Plan is contingent upon the performance of implemented GSI facilities meeting or exceeding the model-predicted performance. GSI performance assurance is required for projects on both private and public property. To increase reliability that implemented projects perform as predicted, the City has compiled a suite of tools that set the standards for GSI design, construction, inspection, and maintenance. These tools are summarized in Table 7-2.

SCVURPPP C.3 Handbook

The C.3 Handbook was written to help developers, builders, and project applicants select and size appropriate post-construction stormwater controls for their projects. The handbook provides the regulatory background and requirements under the MRP.

SCVURPPP GSI Handbook – Part I

The GSI Handbook provides guidance on sizing and design of stormwater controls. GSI projects in San José, including regulated projects and other projects on private property, will be designed and built in accordance or consistent with the best practices presented in the GSI Handbook. The models used to simulate GSI performance are structured so that they accurately capture the standard details and specifications of various facility types, thereby allowing the models to simulate the GSI facility hydraulics accurately.

SCVURPPP GSI Handbook – Part II

Part II of the GSI Handbook includes a comprehensive set of design details and specifications for typical green stormwater infrastructure that the City can utilize to support the design and construction of GSI.

San José Complete Streets Design Standards & Guidelines

The Complete Street Design Guidelines provides design guidance for integrating green stormwater infrastructure into streetscapes while considering other street uses. GSI can be used to complement complete street design when included in traffic calming and pedestrian safety.

Table 7-2. GSI Performance Assurance – Technical Guidance Documents

Guidance Topic	Project Phase	Guidance Document
Sizing Requirements	Planning & Design	SCVURPPP C.3 Handbook
		San José GSI Plan (See Chapter 4)
Design Guidance	Planning & Design	SCVURPPP GSI Handbook – Part I
		SCVURPPP GSI Handbook – Part II
		San José Complete Streets Design Standards & Guidelines
Typical Details & Specifications	Design & Construction	SCVURPPP GSI Handbook
Maintenance & Monitoring Plan	Inspection & Maintenance – Program Oversight	San José GSI Maintenance and Monitoring Plan (See Appendix D)
Maintenance Field Guide	Inspection & Maintenance – Field Work	San José GSI Maintenance Field Guide

San José GSI Maintenance and Monitoring Plan

Once GSI projects have been constructed in conformance with City standards, the City has developed a thorough inspection and maintenance program to provide assurance that the facilities will perform as intended over their lifespan. Long-term maintenance and inspection activities are described in detail in the Maintenance & Monitoring Plan (Appendix D). The Maintenance and Monitoring Plan (MMP) describes the structure of the citywide maintenance and monitoring program established to assure compliance with the MRP and reduction of flow during the equivalent of the 82nd percentile 24-hour storm.

San José GSI Maintenance Field Guide

The Maintenance Field Guide is a companion document to the MMP that provides detailed instructions to field personnel on the inspection and maintenance of various GSI types on both public and private property as a means of ensuring ongoing compliance with the MRP requirements. Observations made during an inspection at the beginning of a maintenance task inform maintenance activity needs. Lessons learned from the existing maintenance and the monitoring program serve as the basis for revising design standards.

GSI Database

The City maintains a database of GSI projects and associated project activities. Once the status of a project is updated to reflect that GSI has been installed, then that particular installation enters an inspection cycle. From that point on, inspection records are uploaded to the database, and facilities are adaptively managed to meet the observed needs of each project. This comprehensive project data tracking system provides assurance that inspections and maintenance are being conducted in compliance with the MRP requirements. The MMP (Appendix D) and the following section describe in detail the process of tracking completed GSI projects. The tracking is done to both document performance toward water quality goals and maintain asset management information.

7.3.2 Project Tracking Plan

A required component of the GSI Plan is to develop a process for tracking and mapping completed public and private GSI projects and making the information available to the public. The City will continue to implement existing internal tracking procedures for processing public and private projects with GSI, meeting MRP reporting requirements, and managing inspections of stormwater treatment facilities. For a detailed description of the City's internal tracking process, refer to the Maintenance and Monitoring Plan (Appendix D). In addition to these existing procedures, the City will provide data to SCVURPPP for countywide tracking of completed public and private GSI projects. This countywide tracking tool can be used to document a project's pollutant reduction performance as well as overall total progress toward City or county-level water quality goals.

Countywide Data Tracking System

SCVURPPP has developed a centralized, web-based data management system with a connection to GIS platforms for tracking and mapping all GSI projects in the Santa Clara Valley. This product is called the SCVURPPP Green Stormwater Infrastructure (GSI) Database. The GSI Database provides a centralized, accessible platform for City staff to efficiently and securely upload and store GSI project data, and enhances SCVURPPP's ability to efficiently and accurately calculate and report water quality benefits associated with GSI projects. It also allows selected GSI project information and maps to be made publicly available.



Figure 7-5. Key Technical Tools

Additional details about the GSI Database are presented below.

Data Types - The database structure can accommodate input, storage and display of various types of data that comprise all the information about a given GSI project. The information stored in the database includes project details provided by City staff as well as information compiled and/or calculated by SCVURPPP for each project.

Data inputs can include:

- » Project Location – This field is linked to GIS files for mapping purposes. The project location information allows the project to be identified on a map, provides the project area, and identifies associated GIS data layers (e.g., land-use(s), soil types).
- » Project Type – This field describes whether the project is public or private, and whether it is a C.3 regulated project, LID parcel-based retrofit, green street, or regional project. This information may help determine how pollutant load reductions are calculated.
- » Project Status – This field denotes if the project is under construction or complete.
- » Stormwater treatment types and relevant characteristics – These fields include the land area treated, hydraulic sizing criteria used, and other factors important for calculating pollutant reductions.
- » Additional (Supporting) Information – This includes other project-related files such as pictures, construction drawings, plan sheets, etc.

» GIS data layers (land-use classifications, soil types, impervious area, rainfall data, etc.)

» Load reduction accounting calculation methods

Data Collection Process - The primary GSI data collection process is implemented at the City level. City staff will continue to collect and manage information on GSI projects within the City's jurisdiction using its existing data management systems (described in Section 6.4.2). City staff upload GSI information into the GSI Database through a web-based data entry portal. Additionally, City staff can upload other types of data files such as pictures or PDFs into the system. The data are secured with different levels of permissions depending on the user (e.g., SCVURPPP staff, City staff, or the public).

Data Outputs - Outputs of the GSI Database include information required for regulatory annual reports as well as the data needed to calculate pollutant loads reduced, runoff volume reductions, and impervious area reduced. Maps displaying project locations and other related attributes such as pollutant generation, watershed boundaries, and water bodies can also be produced.

Figure 7-6 presents the flow of general data inputs to the GSI Database and some anticipated data outputs that can be made available to the City and the general public.

The GSI Database includes the capacity to calculate project-specific pollutant load reductions achieved based on BASMAA's *Interim Accounting Methodology for TMDL Loads Reduced* (BASMAA 2017).

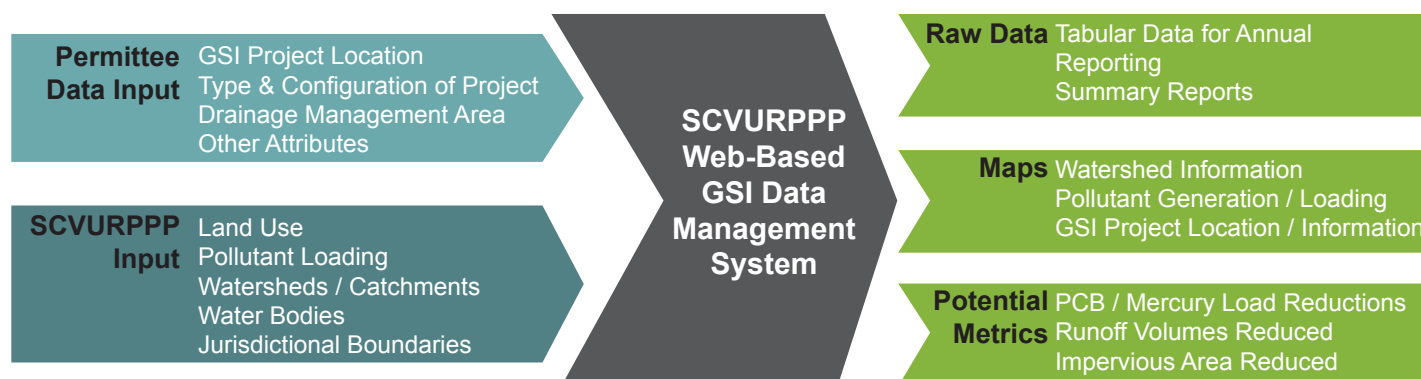


Figure 7-6. Structure and Capabilities of SCVURPPP GSI Database



Green stormwater infrastructure is a powerful tool that the City of San José is utilizing to create a healthier, more sustainable urban future. Planning and investing in nature-based stormwater management technologies ensures the City is moving toward achieving long-term goals to improve water quality, reduce flooding risks, mitigate climate change impacts, and restore natural hydrology.

The GSI Plan serves as a roadmap showing how the City of San José will transform its urban landscape and storm drainage systems from a singular reliance

on traditional “gray” infrastructure to an integrated approach that includes more resilient and multi-beneficial “green” stormwater infrastructure systems. Traditional “gray” stormwater infrastructure, of which most of the City’s storm drain system is comprised, is designed to convey stormwater flows quickly away from urban areas. However, the peak flows and volumes can cause erosion and habitat degradation in downstream creeks to which stormwater is discharged. GSI systems reduce and slow flows, promote infiltration and evapotranspiration, collect runoff for non-potable uses, and treat runoff.

CONCLUSION

GSI integrates building and roadway design, drainage infrastructure, urban forestry, soil conservation and sustainable landscaping practices to reduce the impact of stormwater flows on downstream systems and can provide additional benefits over traditional infrastructure, such as greening of public spaces, increased pedestrian safety, and habitat restoration. These benefits help build resilience to the impacts of climate change and support sustainability goals. GSI helps to make better use of stormwater as a valuable resource, capturing it to recharge groundwater supplies or using it to meet non-potable demands, such as irrigation or toilet flushing.

The GSI Plan addresses planning and implementation within the City of San José's jurisdiction and demonstrates the City's long-term commitment to implement GSI to reduce pollutants discharged to local waterways and meet regulatory requirements. The GSI Plan serves as an implementation guide and reporting tool to provide reasonable assurance that pollutant reduction requirements in the City's stormwater discharge permit will be met. Implementation of this plan is a major Citywide effort requiring close collaboration among City departments, especially those responsible for projects affecting future alignment, configuration, or design of impervious surfaces that produce stormwater runoff, as well as those responsible for operation and maintenance of existing and future GSI facilities.

Given the relatively small scale of most GSI projects (e.g., LID on an individual parcel, single street block converted to green street), thousands of GSI projects will ultimately be needed throughout the City to meet the quantified Citywide water quality goals. Although GSI projects will require site investigations to assess feasibility and costs, the analyses conducted for the GSI Plan provide a preliminary investigation of the amount and type of GSI needed spatially (e.g., by subwatershed) to achieve these goals. However, as the GSI Plan is implemented and more comprehensive municipal engineering analyses (e.g., master planning, capital improvement planning) are performed, an adaptive management process will be key to ensuring that goals are met. In summary, this GSI Plan can inform implementation goals, but the pathway to meeting those goals is subject to adaptive management and can potentially change based on new information or engineering analysis performed over time.



Green Street in Residential Development, South San José



City of San José

APPENDICES

- A List of Acronyms
- B Reasonable Assurance Analysis
- C Project Concepts
- D Maintenance & Monitoring Plan
- E Green Street Prioritization Maps

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A

LIST OF ACRONYMS

Acronym / Abbreviation	Definition
ADA	American with Disabilities Act
Annual Report	Annual Report to the San Francisco Bay Regional Water Quality Control Board
BASMA	Bay Area Stormwater Management Agencies Association
Bay	San Francisco Bay
BSM	Biotreatment Soil Media
BMP	Best Management Practice
CCR	California Code of Regulations
CIP	Capital Improvement Project or Program
City	City of San José
CLRP	Comprehensive Load Reduction Plan
DAC	Disadvantaged Community
DDOT	District Department of Transportation (Washington DC)
EPA	Environmental Protection Agency
ESD	Environmental Services Department
FDR	Full Depth Reclamation
FHWA	Federal Highway Administration
Framework	Green Infrastructure Plan Framework
FY	Fiscal Year
GI	Green Infrastructure
GSi	Green Stormwater Infrastructure
GIS	Geographic Information System
HDM	Highway Design Manual
H&H	Hydrologic and Hydraulic (Model)
IPM	Integrated Pest Management
LID	Low Impact Development
MG	million gallon(s)
MGD	million gallons per day
MRP	Bay Area Municipal Regional Stormwater Permit
MS4	Municipal Separate Storm Sewer System
MTC	Metropolitan Transportation Commission
NPDES	National Pollutant Discharge Elimination System
PBCE	Plan, Building and Code Enforcement
PCBs	Polychlorinated Biphenyls
PICP	Permeable Interlocking Concrete Pavement
POC	Pollutants of Concern
PP	Pervious Pavement
PRNS	Parks, Recreation and Neighborhood Services
PW	Public Works
RAA	Reasonable Assurance Analysis
ROW	Right-of-Way
RWQCB	San Francisco Bay Regional Water Quality Control Board ("Water Board")
SCVWD	Santa Clara Valley Water District ("Valley Water")
SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program
SMCWPPP	San Mateo Countywide Water Pollution Prevention Program
SWRP	Santa Clara Basin Stormwater Resource Plan
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency

B

**REASONABLE
ASSURANCE
ANALYSIS**

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City of San José Reasonable Assurance Analysis Addressing Fecal Indicator Bacteria



ENVIRONMENTAL SERVICES DEPARTMENT
WATERSHED PROTECTION DIVISION



APRIL 11, 2019

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1 INTRODUCTION

To support the development of the City of San José (City) Green Stormwater Infrastructure (GSI) Plan, the City initiated a Reasonable Assurance Analysis (RAA) to evaluate the amount and ability of GSI to reduce stormwater discharges of fecal indicator bacteria (FIB) to the City's creeks and San Francisco Bay. In 2016, the City entered into a Consent Decree with the San Francisco Baykeeper (Baykeeper) (US District Court, Northern District of California 2016) that required the City to develop and implement a Comprehensive Load Reduction Plan (CLRP) and RAA that is supported by quantitative and process-based models that can simulate hydrology and determine the amount of GSI needed to meet FIB targets defined by the Consent Decree. The City's GSI Plan and this RAA serve as the CLRP addressing the Consent Decree, and follows guidance and guidelines for RAAs established by the Los Angeles Regional Water Quality Control Board (LARWQCB) (2014), the U.S. Environmental Protection Agency (USEPA) Region 9 (2017), and the Bay Area Stormwater Management Agencies Association (BASMAA) (2017). The RAA methodology is consistent with similar efforts addressing FIB in other watersheds and regions in California, including Enhanced Watershed Management Programs (EWMPs) prepared in the Los Angeles Region that demonstrated compliance with Total Maximum Daily Loads (TMDLs) for FIB (Ballona Creek Watershed Management Group 2016), and CLRPs addressing *Total Maximum Daily Loads for Indicator Bacteria, Project I – Twenty Beaches and Creeks in the San Diego Region (Including Tecolote Creek)* (San Diego Bacteria TMDL) (San Diego Bay Responsible Parties 2016, SDRWQCB 2010).

In 2017, the USEPA Region 9 released *Developing Reasonable Assurance: A Guide to Performing Model-Based Analysis to Support Municipal Stormwater Program Planning* (EPA RAA Guide) (USEPA 2017), which provides guidance on the technical needs of the RAA and considerations for model selection. Building upon the EPA RAA Guide, BASMAA prepared the *Bay Area Reasonable Assurance Analysis Guidance Document* (Bay Area RAA Guidance) (BASMAA 2017), which provides specific guidance on modeling to support RAAs performed in the Bay Area to meet requirements of the Municipal Regional Stormwater Permit (MRP) (Order No. R2-2015-0049) (SFBRWQCB 2015). The Bay Area RAA Guidance outlines approaches and methodologies generally consistent with the *Guidelines for Conducting Reasonable Assurance Analysis in a Watershed Management Program, Including an Enhanced Watershed Management Program* (Los Angeles RAA Guidelines) developed by the LARWQCB (2014), while addressing the specific characteristics of water-quality impairments affecting the San Francisco Bay (i.e., mercury and polychlorinated biphenyl [PCB]). The EPA RAA Guide and Bay Area RAA Guidance both outline essential steps for performing an RAA, as depicted in **Figure 1-1**.

Depending on the audience, the purpose of the RAA can vary in terms of what constitutes reasonable assurance. The EPA RAA Guide provides an example of three differing perspectives for defining reasonable assurance (USEPA 2017):

- **Regulator Perspective** - Reasonable assurance is a demonstration that the implementation of a GSI Plan will result in sufficient pollutant reductions over time to meet TMDL or MRP requirements.
- **Stakeholder Perspective** - Reasonable assurance is a demonstration that specific management practices are identified with sufficient detail and implemented on a schedule to ensure that necessary improvements in water quality will occur.
- **Municipal/Permittee Perspective** - Reasonable assurance is based on a detailed analysis of water quality targets themselves, and a determination of the feasibility of those requirements. The RAA may also assist in evaluating the financial resources needed to meet pollutant reductions over a required period of time.

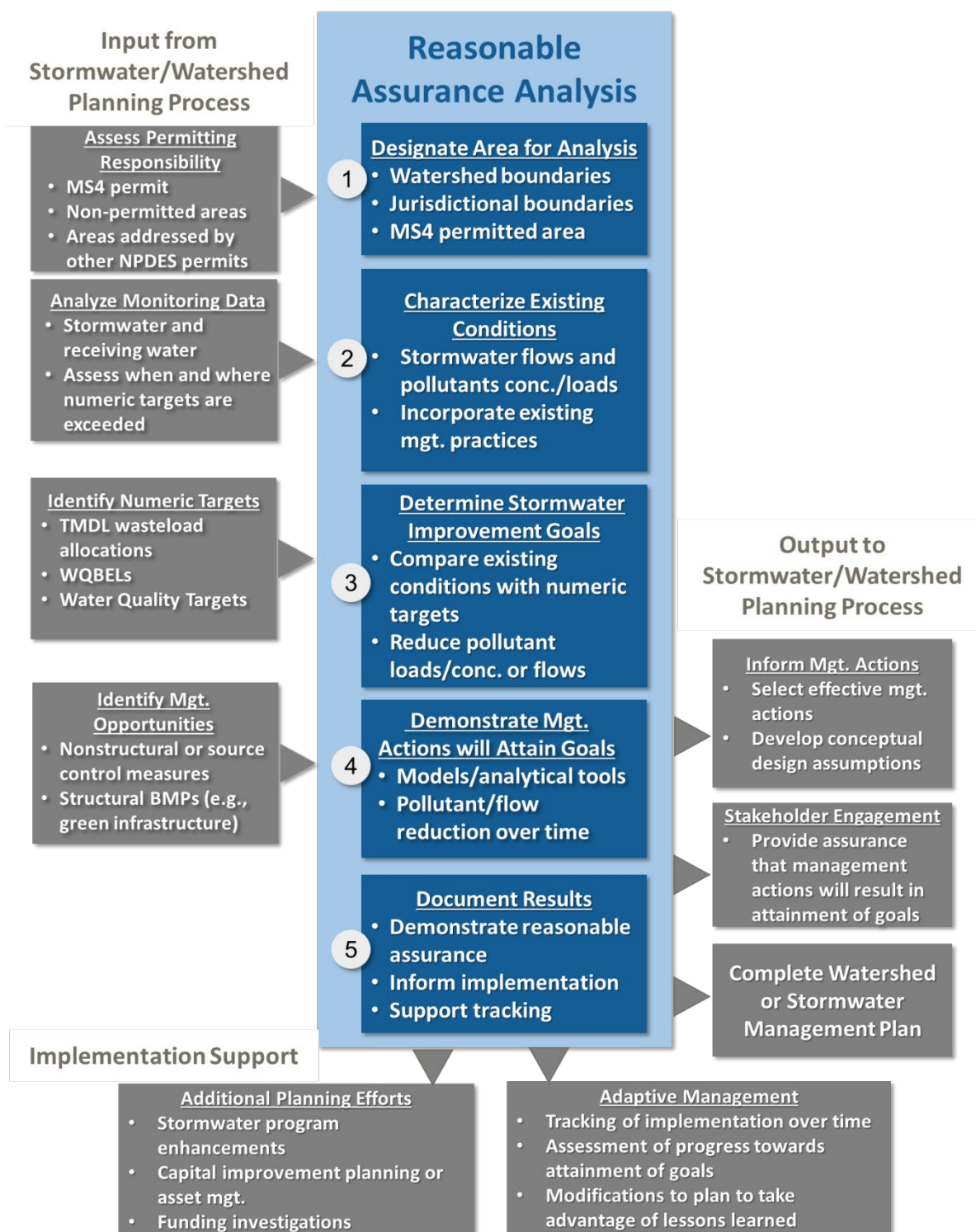


Figure 1-1. RAA Process Flow Chart (USEPA 2017).

As a result of the differing perspectives, each of the steps of the RAA shown in **Figure 1-1** may have varying levels of interest for different audiences in terms of providing reasonable assurance. To streamline RAAs performed in the Bay Area and to standardize expectations of each of the RAA steps, the Bay Area RAA Guidance sought to provide greater details regarding the methods and goals for each of the RAA steps. The following provides a summary, consistent with Figure 1-1, of the outcomes from the Bay Area RAA Guidance and methods to tailor the RAA addressing FIB to meet these recommendations:

1. **Identification of the Area for Analysis** – For the purpose of modeling baseline pollutant loading, the area of analysis includes the land areas that are hydrologically connected to the impaired waterbodies. These areas include urban land areas subject to MRP requirements, urban areas subject to separate stormwater permits, and non-urban land areas. MRP applicable land areas are defined as those contributing to permitted discharges from storm drains and watercourses within permittee jurisdictions (i.e., within the boundaries of the permittee’s jurisdiction), and include land areas owned/operated by Federal, State, and regional entities that are subject to separate stormwater management requirements via separate discharge permits. Additionally, non-urban land areas within the area of analysis may not be subject to the TMDL and/or the MRP. Urban and non-urban areas that are not subject to TMDLs and/or the MRP should be accounted for in RAA models, but do not require control measure assumptions or load reduction calculations. The area of analysis for the RAA addressing FIB is consistent with the Bay Area RAA Guidance in terms of accounting for permitted and non-urban areas, with a focus on assessing the GSI needed to address the FIB Load Reduction Standard for urban areas. This ensures consistency with parallel efforts for the GSI plan to address MRP requirements for PCB and mercury load reductions to meet TMDL wasteload allocations.
2. **Characterizing Existing Conditions** – The Bay Area RAA Guidance outlines methodologies for representing PCB and mercury loads subject to TMDLs. The baseline pollutant loading for use in the RAA can be selected or calculated using one of the following three methods: (1) utilize the baseline loading presented in the TMDL Staff Reports (SFBRWQCB 2006; SFBRWQCB 2008); (2) utilize the baseline loading produced by the Regional Watershed Spreadsheet Model (RWSM) output; or (3) recalculate the baseline loading using a calibrated model of the baseline period for the area of analysis. A separate RAA is being performed by the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP) to recalculate the baseline load using a calibrated hydrologic model (SCVURPPP 2018). To determine the FIB Load Reduction Standard per the Consent Decree, this same hydrologic model is utilized to provide consistency with parallel GSI planning efforts addressing MRP TMDLs for PCBs and mercury.
3. **Determining Stormwater Improvement Goals** – The FIB Load Reduction Standard specified in the Consent Decree is based on reductions of flow from each subwatershed of the City’s municipal storm sewer system, equivalent to full retention of a Critical Bacteria Storm. The baseline hydrologic model developed in Step 2 is utilized to calculate the stormwater volume associated with this Critical Bacteria Storm. This method is consistent with approaches used in the *Enhanced Watershed Management Program for Ballona Creek Watershed* (Ballona Creek EWMP) and San Diego CLRPs that addressed TMDLs for FIB (Ballona Creek Watershed Management Group 2016, San Diego Bay Responsible Parties 2016). The resulting stormwater volume serves as the stormwater improvement goal for evaluation of the amount and type of GSI needed to manage this stormwater volume.
4. **Estimating Load Reduction Achieved by Controls (Demonstrating that Management Actions Will Attain Goals)** – Unlike the RAAs that were the focus of the Bay Area RAA

Guidance (focusing on PCB and mercury load reductions), the FIB Load Reduction Standard is based on a stormwater volume management goal. Therefore, this RAA includes methods for estimating volume reductions associated with GSI to address the FIB Load Reduction Standard. Although other nonstructural and source controls, such as activities that address homeless encampments, public education, catch basin cleaning, etc., can potentially provide further reduction of FIB loads, further study is needed to quantify the potential for FIB load reduction so that these nonstructural and source control activities can be considered in the RAA. It is anticipated that as the studies are performed and more is learned about nonstructural solutions to FIB load reduction, through adaptive management the RAA will be updated to reassess the necessary GSI to meet the FIB Load Reduction Standard. As a result, the RAA presently only addresses the benefits of GSI in terms of managing stormwater runoff associated with the Critical Bacteria Storm. The Bay Area RAA Guidance states that “GSI performance should be simulated directly using a process-based model or simulated using a combination of continuous simulation-based volume performance and empirically based concentration performance to estimate load reductions.” The RAA utilizes a process-based model to simulate the performance of various GSI projects in terms of managing the Critical Bacteria Storm.

5. **Documentation** – Documentation of RAA results is critical to the demonstration that the GSI Plans will address the FIB Load Reduction Standard. The documentation can serve various purposes, including providing: (1) reasonable assurance to stakeholders and regulators that the plans will lead to effective implementation, (2) information to support next steps for implementation (e.g., capital improvement planning, investigation of funding options), and (3) quantitative results to support an adaptive management process, tracking of implementation over time, and/or assessment of progress towards attainment of pollutant reduction goals (USEPA 2017). The Bay Area RAA Guidance provides recommendations for minimum requirements for RAA documentation, including summaries of model input (e.g., model parameters, data sources, or other assumptions), calibration results, model processes and procedures, key model outputs (e.g., baseline loads, load reduction goals), modeled GSI and source control measures, and modeled load reductions by control measure category. This report provides all necessary documentation to meet recommendations of the Bay Area RAA Guidance and is consistent with other RAAs performed to address FIB in the Los Angeles and San Diego Regions (Ballona Creek Watershed Management Group 2016, San Diego Bay Responsible Parties 2016).

The following sections provide an overview of the modeling system supporting the RAA, a description of the approaches used to address each of the RAA steps outlined above, and a full demonstration that the implementation of the GSI projects prescribed in the GSI Plan shall, with a reasonable level of assurance, address the FIB Load Reduction Standard.

2 IDENTIFICATION OF THE AREA OF ANALYSIS

As recommended in the EPA RAA Guide and Bay Area RAA Guidance, and consistent with RAAs performed to address FIB load reduction in the Los Angeles Region, the RAA provides an accounting of sources of stormwater from areas addressed by Municipal Separate Storm Sewer System (MS4) permits, areas addressed by other National Pollutant Discharge Elimination System (NPDES) permits, and other non-permitted areas (e.g., open space) (Ballona Creek Watershed Management Group 2016, BASMAA 2017, USEPA 2017). This allows for estimation of stormwater improvement goals specific to areas addressed by MS4 permits, and identification of management actions (e.g., GSI) that are designed to manage stormwater runoff from these areas. The Bay Area RAA Guide states that “if areas not subject to municipal jurisdiction are included, their flows and loads should be

distinguishable” (BASMAA 2017). Therefore, the RAA area of analysis includes MS4 permitted areas, other NPDES permitted areas, and non-urban areas (**Figure 2-1**), with stormwater volumes estimated for each category, but stormwater improvement goals and GSI identified for only those areas addressed by the MRP or other NPDES permitted areas owned by the City. The following subsections describe the processes for separating and allowing modeling of distinguishable flows from areas addressed by NPDES permits (MS4 permit, Caltrans, and industrial areas) and non-urban open space/agriculture.

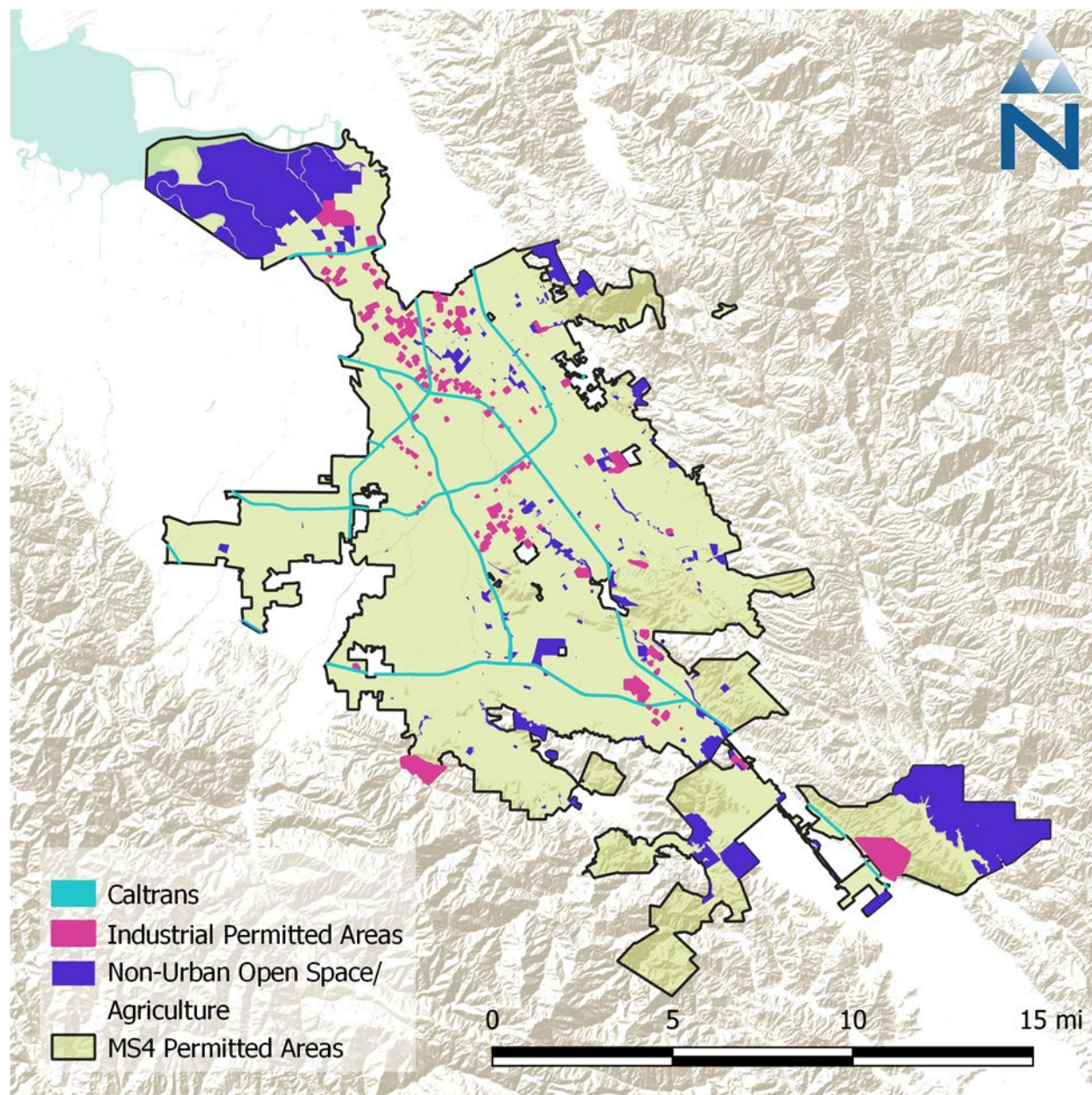


Figure 2-1. City of San José area of analysis.

2.1 Non-Urban Open Space/Agriculture

GSI is designed to capture, infiltrate, and/or treat stormwater runoff from urban areas. Consequently, non-urban open space within the City was separated into distinguishable modeled non-urban areas for the RAA. These areas were identified by separating all the land designated as *Agriculture* or *Open Space* in the City of San José Zoning Map from the other categories. **Figure 2-1** presents the open space/agricultural areas designated as non-urban for the RAA.

2.2 Caltrans

The California Department of Transportation (Caltrans) operates with a statewide NPDES MS4 permit that regulates the discharge of stormwater associated with the operation and management of the State's highway system. Caltrans right-of-way was estimated through an analysis of road classifications. Using Caltrans GIS Data road centerline dataset, all roads designated as state, federal, or interstate highways were selected. A representative buffer width varying between 60 and 100 feet was estimated based on a review of aerial imagery and applied to the centerline to create a buffered right-of-way polygon. Finally, geometric holes created by this buffering technique at interchanges were filled. This analysis resulted in over 600 acres of land attributed to Caltrans. **Figure 2-1** presents the Caltrans areas designated for the RAA.

2.3 Industrial Stormwater Permits

Industrial facilities with industrial stormwater permits must meet requirements outlined in their permit for managing and treating stormwater at the parcel or site level. Active industrial stormwater permits within the City were identified using EPA's Enforcement and Compliance History Online (ECHO) database. Permitted facilities included two categories (1) those facilities operating under individual NPDES permits, and (2) those facilities operating under the industrial general permit (IGP). Individual permits are typically issued for larger facilities or those with unique requirements that deviate from those outlined under the IGP. One individual industrial permit for the Mineta San José International Airport was identified within the City. 208 facilities identified through the EPA ECHO database search were included in the IGP which totaled over 2,300 acres.

Both individual NPDES permits and the IGP are regulated under a program separate from the MRP. Therefore, industrial parcels addressed by the IGP were designated as non-MRP areas within the model to distinguish stormwater flows from areas addressed by the MRP and subject to GSI implementation. These parcels encompass a relatively small area compared to the size of the City, but some of these facilities are located within areas expected to have higher PCB loading based on typical stormwater concentrations from industrial land uses (BASMAA 2017, Wu et al. 2017). **Figure 2-1** presents the industrial areas designated for the RAA.

Since the Mineta San José International Airport is owned by the City, the land parcel associated with the airport was included in the MS4 permitted areas managed by the City. Although this area is technically regulated by the industrial NPDES permit, since it is owned by the City it is considered part of the area of analysis for the RAA addressing FIB.

2.4 MS4 Permit

The MS4 permitted areas in the City were determined by subtracting the above non-MS4 areas designated as non-urban open space/agriculture, Caltrans, and industrial (subject to individual NPDES permits and the IGP). As can be seen in **Figure 2-1**, most of the City area is designated to be

addressed by the MS4 permit. These areas are the focus of the determination of stormwater improvement goals (**Section 4**) and the determination of management actions (i.e., GSI) to meet these goals (**Sections 5 and 6**).

3 CHARACTERIZATION OF EXISTING CONDITIONS

Critical to the RAA is the characterization of stormwater flows under existing baseline conditions. This understanding serves as the foundation of the RAA and identifies the starting point for planning management actions. The City has collaborated with SCVURPPP to develop a continuous simulation model that supports the City's RAA addressing FIB, and parallel efforts to perform an RAA that addresses MRP requirements for GSI Plans to reduce PCB and mercury loads to San Francisco Bay. To provide consistency for both RAA efforts, a single hydrologic model was developed and calibrated for all watersheds in the Santa Clara Basin (including those associated with the City). The baseline hydrology model reported in this section served as the foundation for estimation of the Critical Bacteria Storm volume to be managed by the City to meet the FIB Load Reduction Standard (**Section 4.3**).

3.1 Overview of the Baseline Hydrology Model

The hydrologic baseline model of Santa Clara Basin watersheds is based on the Loading Simulation Program in C++ (LSPC) (Shen et al. 2004), a watershed modeling system that includes Hydrologic Simulation Program – FORTRAN (HSPF) (Bicknell et al. 1997) algorithms for simulating watershed hydrology, erosion, water quality processes, and in-stream fate and transport processes. LSPC is built upon a relational database platform, making it easier to collate diverse datasets to produce robust representations of natural systems. LSPC integrates GIS outputs, comprehensive data storage and management capabilities, the original HSPF algorithms, and a data analysis/post-processing system into a convenient PC-based Windows environment. The algorithms of LSPC are identical to a subset of those in the HSPF model with selected additions, such as algorithms to address land use change over time. LSPC is an open-source public-domain watershed model available from EPA.

The LSPC hydrologic model includes a comprehensive method for representing the various processes associated with the pathways of water through a watershed. **Figure 3-1** is a generalized schematic of the underlying hydrology model (Stanford Watershed Model) used in HSPF and LSPC. The schematic represents land-based processes for a single land unit in the model. Meteorological data are the driver for the modeled hydrologic processes. As shown in the schematic, precipitation is the primary input, while total actual evapotranspiration (TAET) and streamflow are the primary outputs in the water budget. Potential evapotranspiration (PEVT; not explicitly shown in the schematic) is another key meteorological boundary condition for the model. The interaction of model parameters shown below in **Figure 3-1** will ultimately determine how much PEVT becomes TAET. There are several pathways that water can take as it makes its way through the network. For each land unit, process-based parameters that reflect differences in geology, soils, vegetation, and land cover will govern the rates and volumes of water at each stage throughout the schematic.

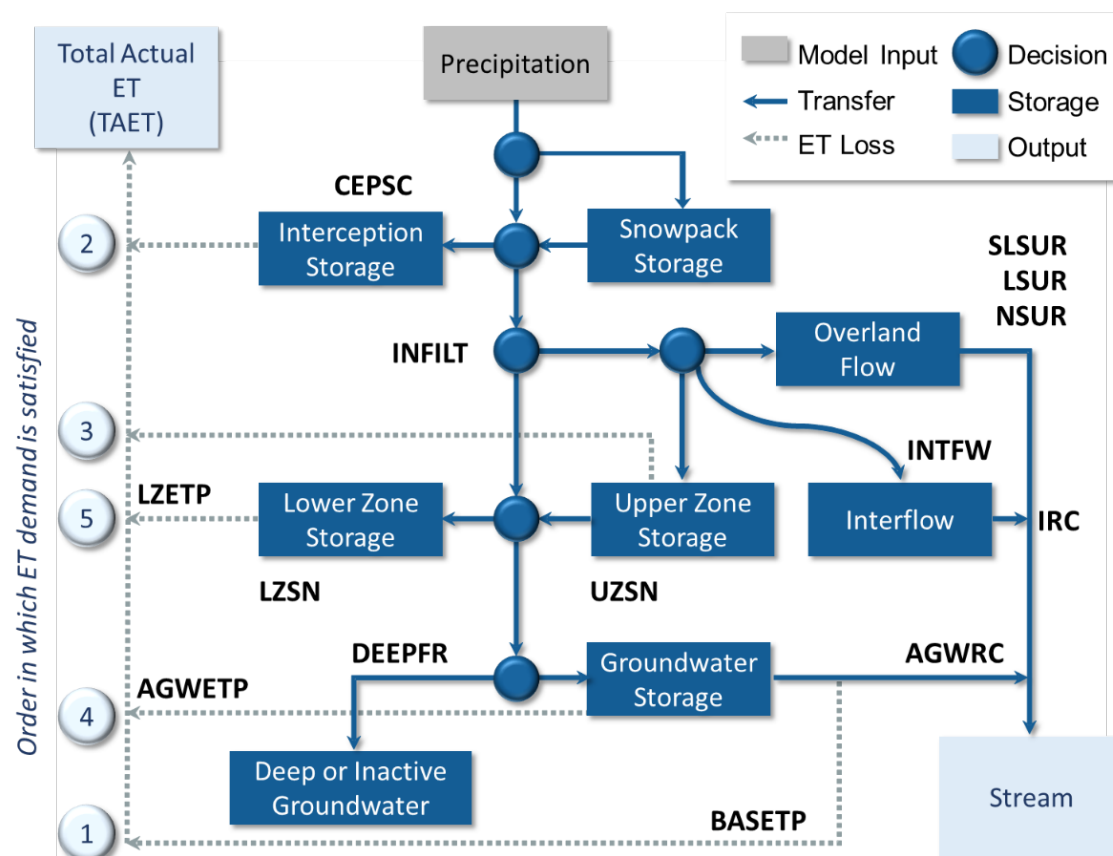


Figure 3-1. Hydrologic Model Schematic (based on the Stanford Watershed Model).

3.2 Watershed Delineation

One of the primary requirements in hydrologic model development involves watershed delineation. Identifying watershed boundaries enables modelers to portray specific characteristics of the region's watersheds such as slope, land use, impervious cover, climatic variations, elevation, etc. to inform hydrology of the region. A fine-resolution subwatershed delineation provides increased spatial resolution and model accuracy for predicting hydrologic characteristics within a watershed and allows for routing of flows and associated pollutant loads within each watershed to the Bay. The watershed delineation focused on the Santa Clara Basin, and includes the Coyote Creek and Guadalupe River watersheds and adjacent watersheds discharging to the Bay. The Uvas and Llagas watersheds were also included in the model because of overlap of the City of San José boundary.

3.2.1 Digital Elevation Model (DEM)

A Digital Elevation Model (DEM), or terrain surface, is a raster representing the physical land surface elevation of the watershed. This elevation dataset is critical for analyzing flow direction, natural drainage networks, and for calculating the slope of overland flow. Therefore, the DEM resolution is a key to represent level of detail and accuracy of the data. Two different DEMs were available for representing elevation in the Santa Clara Basin:

- Santa Clara County and City of San José DEM – Derived from high-resolution LiDAR data in 2006 and available at a 1-meter spatial resolution.

- USGS National Elevation Dataset – National coverage of DEMs expressing landscape elevation through a raster grid data product with 30-meter resolution.

Figure 3-2 shows the extent of the 1-meter and 30-meter DEM boundaries. The high-resolution 1-meter DEM covers 45% of the Santa Clara Basin primarily within the urban core around the City of San José. Much of the high-resolution coverage falls within the Coyote Creek and Guadalupe River subwatersheds. The 30-meter USGS DEM raster dataset for Santa Clara County area and 1-meter high-resolution DEM for City of San José (derived from high-resolution LiDAR data in 2006) were merged into one raster dataset. **Figure 3-3** shows the absolute elevation across the entire Santa Clara Basin. Elevation ranges from less than 75 ft along the northern and south western parts of the watershed to over 2,000 ft at the highest peaks along the western and eastern edges of the watershed.

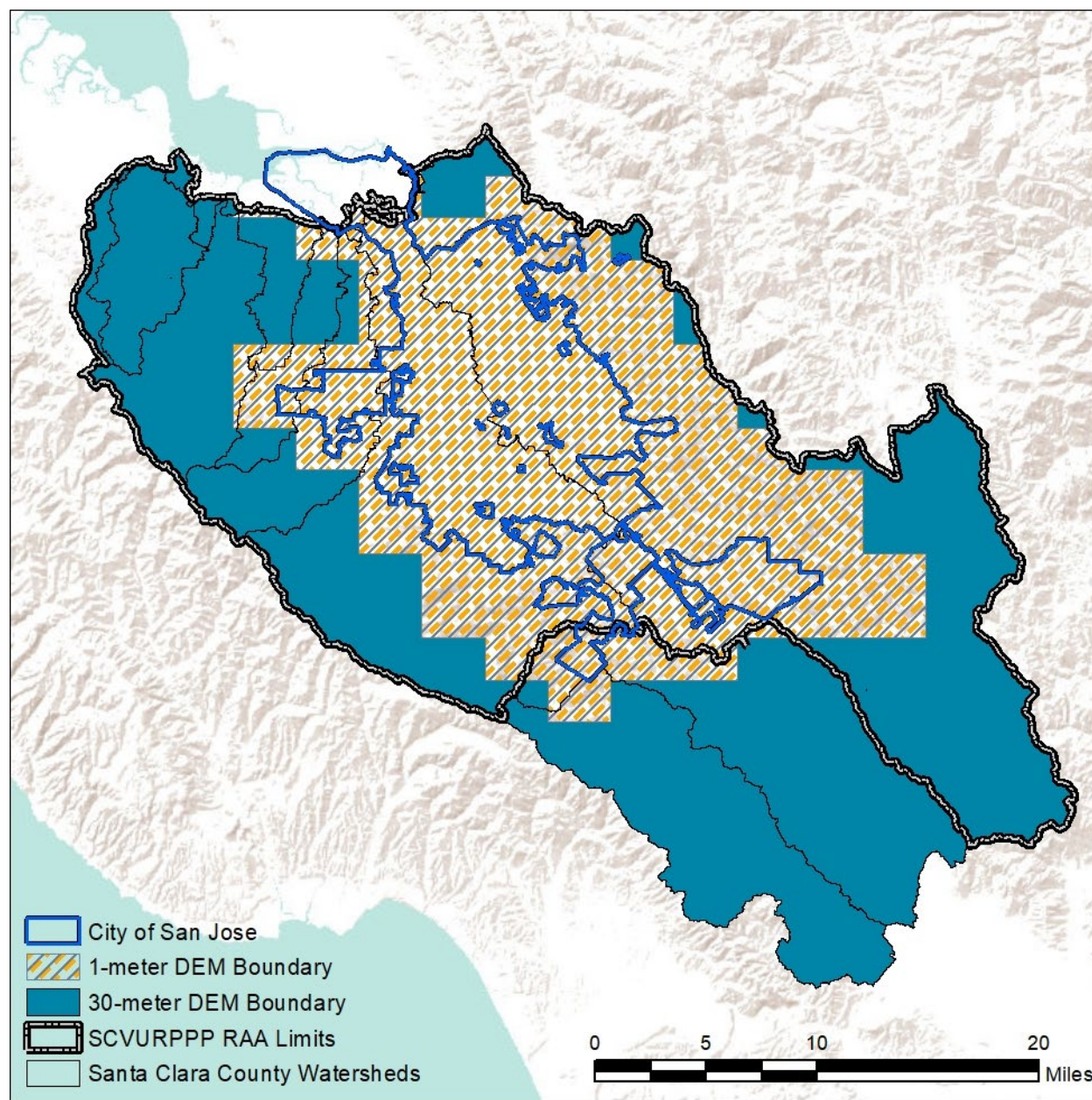


Figure 3-2. Spatial extent of the 1-meter (City of San José) and 30-meter (USGS) DEM data products.

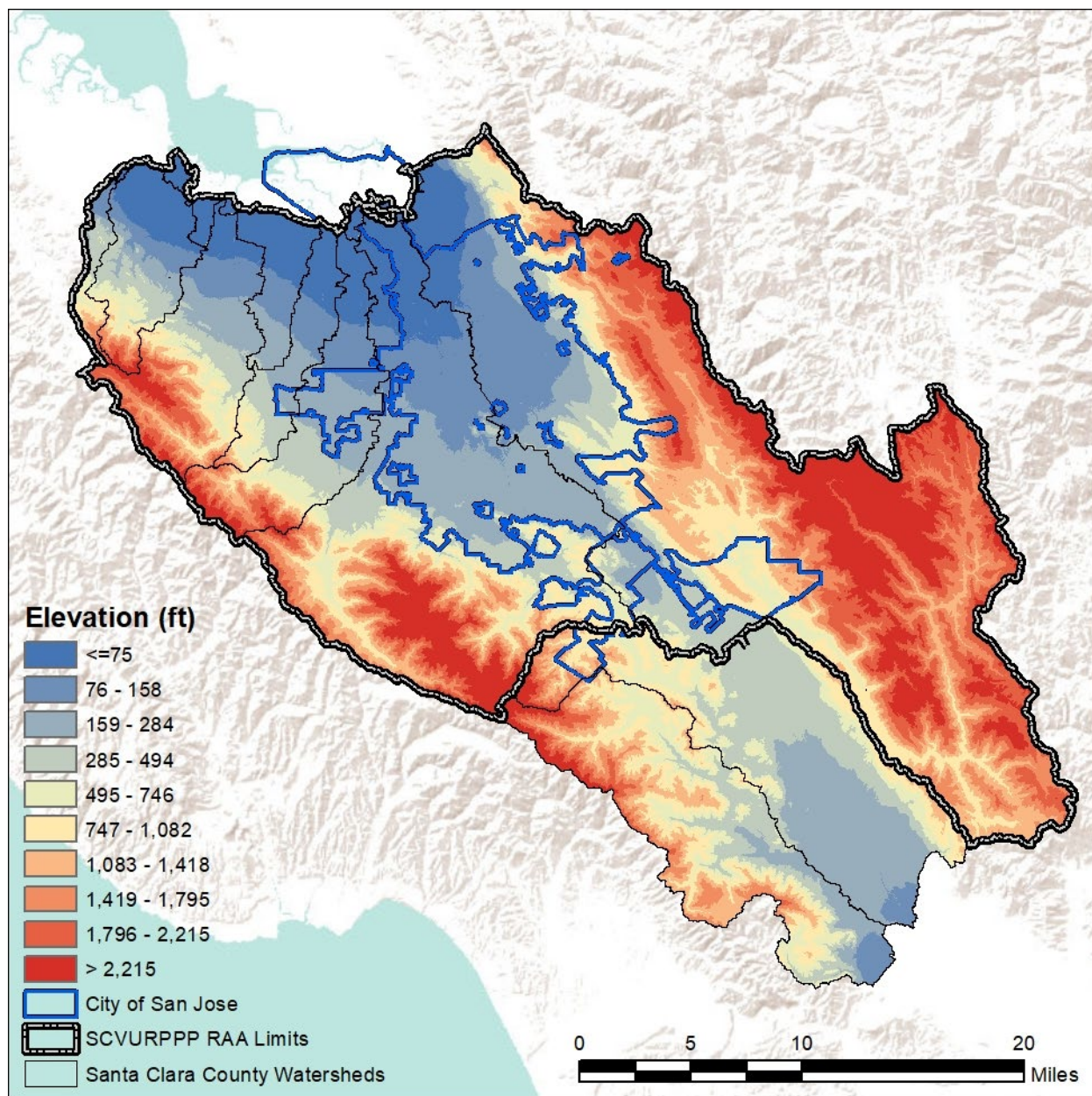


Figure 3-3. Elevation and 10-digit hydrologic boundaries of the Santa Clara Basin.

3.2.2 Delineation Methodology

The subwatershed delineation was performed using the combined DEM (**Figure 3-3**) and an inventory of storm drains, streams, and other waterways compiled from the SWRP and the City of San José Storm Sewer Master Plan (SSMP). A multi-step delineation process was used in GIS to ensure accuracy of the boundaries, consistency with other local efforts (e.g., SWRP, SSMP), and alignment with locations of assessment points used for model calibration (**Section 3.5.2**). The sequence of steps for subwatershed delineation included:

1. GIS datasets representing waterways (i.e., storm drains, streams, etc.) were *burned* into the combined DEM, meaning they were inset into the raster as low points.

2. Any resulting sinks (i.e., raster cells that do not flow to a neighboring cell) were filled in to prevent artificial accumulation of potential flows.
3. A flow direction raster was then created using the filled DEM from Step 2.
4. A flow accumulation raster was created from the flow direction file from Step 3.
5. A stream flowlines raster was created from the flow accumulation layer from Step 4.

Finally, the stream flowlines created in Step 5 were used in conjunction with a set of key observation points, including locations of streamflow gages, to create a subwatershed raster that was ultimately converted into polygon subwatershed layer for sampling other spatial data for LSPC model configuration. The spatial extent of the delineated major watershed was verified to mostly align with the extents of the Santa Clara Basin and Santa Clara Valley Water District watershed boundaries. The spatial extent of the delineated watersheds was also referenced against the City of San José SSMP catchments. Since the planning-level scale of the RAA water quality model does not require high-resolution subwatersheds on the order of those identified for the SSMP, some RAA model subwatershed include multiple subwatersheds addressed by the SSMP.

3.2.3 Model Subwatersheds

The subwatershed delineation included outlets for monitoring gages and reservoirs, while preserving stream connectivity and routing requirements for the model. Within the heavily urbanized areas that were relatively flat, the higher-resolution 1-meter DEM improved the representation of subwatershed boundaries. For non-urbanized areas, the 30-meter DEM with a coarser resolution was sufficient to establish the flow boundaries. Consequently, the mostly urban areas covered by the 1- meter DEM were divided into more subwatersheds, while the non-urban areas covered by the 30- meter DEM were divided into fewer. **Table 3-1** summarizes the number of subwatersheds within the Santa Clara Basin. The Uvas and Llagas watersheds were included in the model because of overlap of the City of San José boundary. The delineation process resulted in 862 subwatersheds for the Santa Clara Basin, including 348 subwatersheds within the City. The Coyote Creek watershed, the largest watershed in the Santa Clara Basin, has the most subwatersheds. The Sunnyvale Channel watershed is the smallest in Santa Clara Basin with the fewest subwatersheds. **Figure 3-4** depicts the delineated subwatersheds in the area.

Table 3-1. Summary statistics of subwatershed delineations by major watershed

Watershed	Count	Mean Size (acres)	Median Size (acres)
Coyote Creek	295	755	576
Guadalupe River	200	548	464
Llagas Creek	92	718	627
San Tomas Aquino Creek	62	455	370
Uvas Creek	57	967	691
Permanente/Stevens Creeks	52	582	370
San Francisquito Creek	20	598	328
Adobe/Barron/Matadero Creeks	32	563	567
Calabazas Creek	31	427	324
Sunnyvale Channel (East and West)	16	592	445
Baylands	5	1326	1678
Total	862	--	--

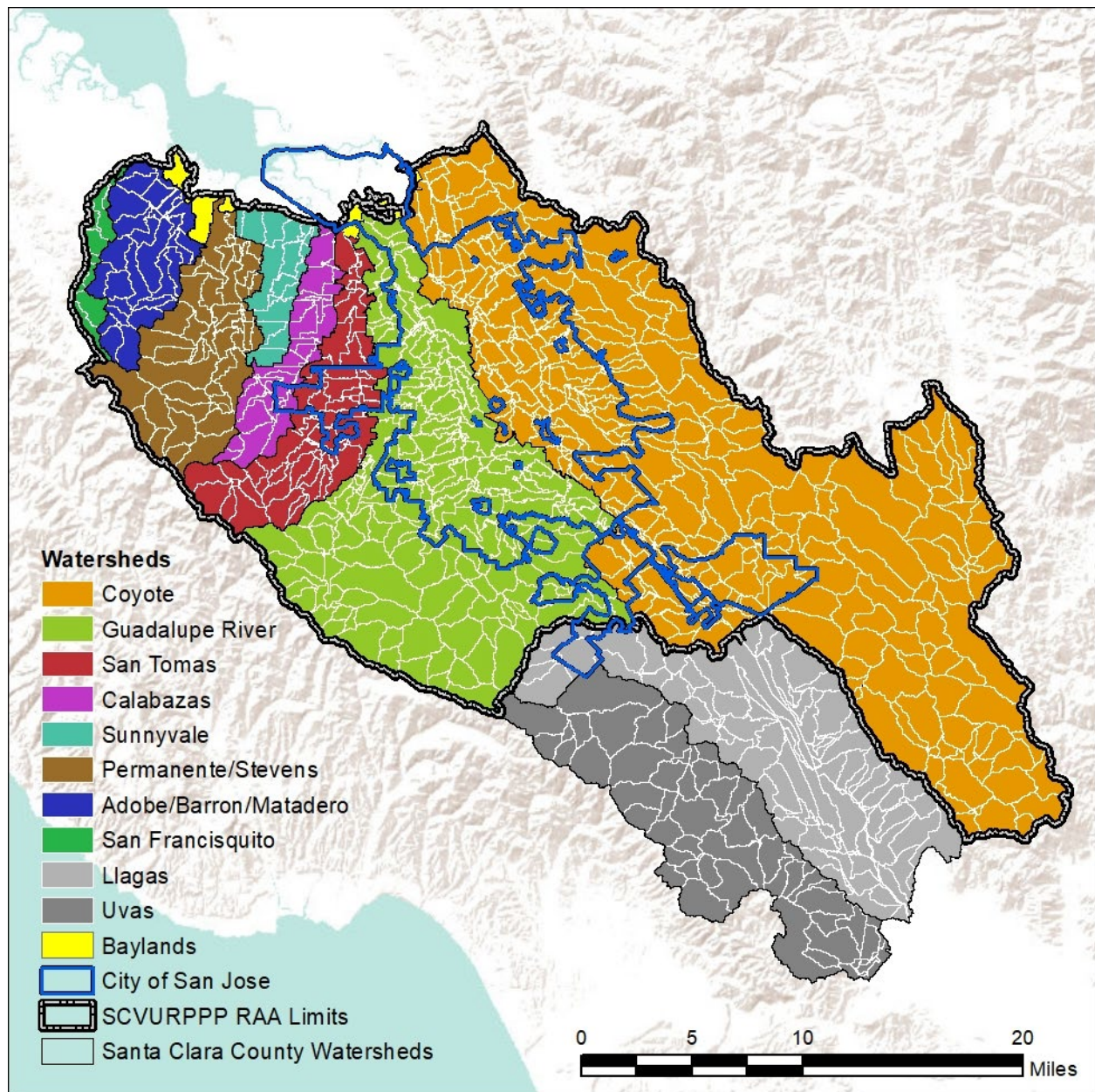


Figure 3-4. Santa Clara Basin watershed and subwatershed delineations.

3.3 Model Representation of Land Characteristics

Hydrologic Response Units (HRUs) are the core hydrologic modeling land units in the watershed model. Each HRU represents areas of similar physical characteristics attributable to certain processes. Spatial or geological characteristics such as 1) soil group, 2) slope/steepness, 3) land cover/use, and 4) imperviousness are typically used to define HRUs. These four datasets were the primary attributes used in San Jose for classifying HRUs. The areal combination of primary characteristics ultimately determines the number of meaningful HRU categories considered for the model. Some consolidation of HRUs is required to balance the need for spatial resolution with model simulation efficiency. **Figure 3-5** shows the organizational relationship of HRUs, subwatersheds, and model parameterization. Secondary attributes are properties (e.g., impervious cover) that are summarized by HRU to estimate numerical values for the model.

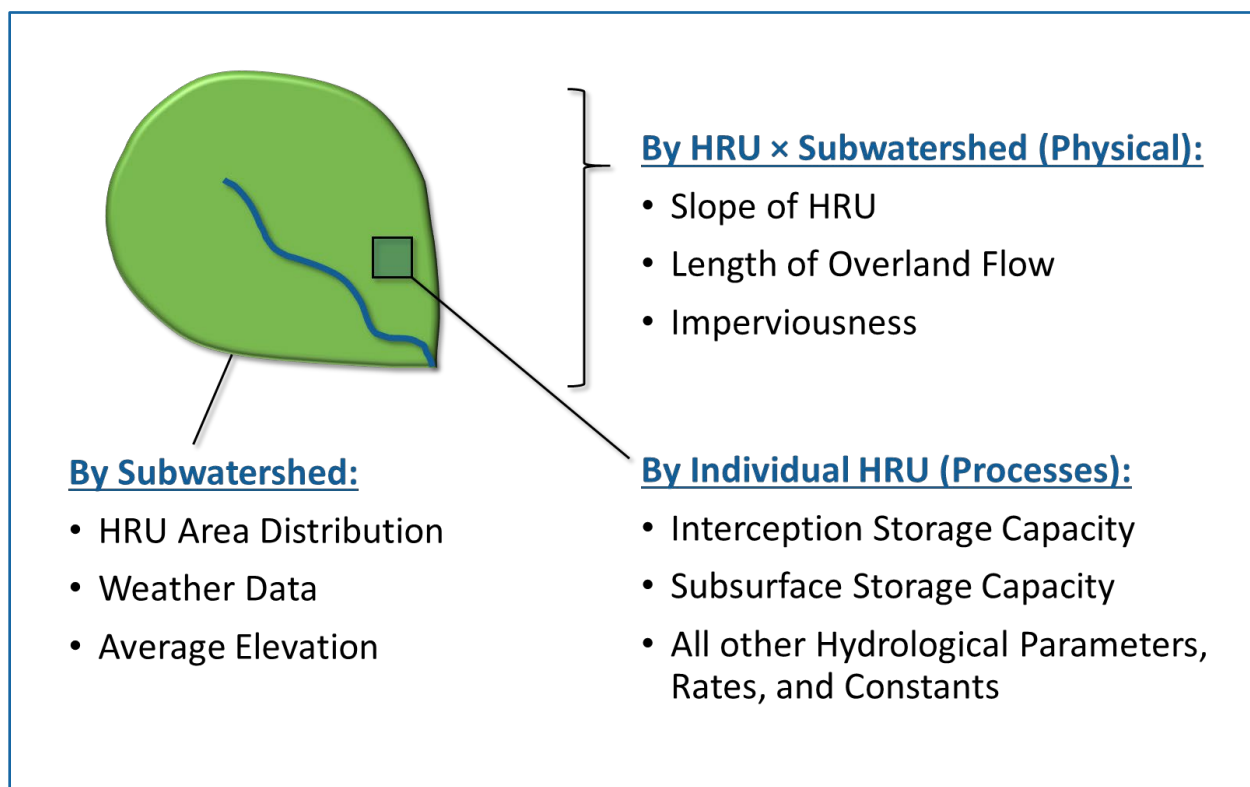


Figure 3-5. Organizational relationship of HRUs, subwatersheds, and model parameterization.

Table 3-2 summarizes the GIS datasets and the corresponding data sources used in HRU processing. All data layers were downloaded from publicly available data sources or received from municipalities (e.g. City of San José). The following subsections provide detailed descriptions of each HRU component dataset.

Table 3-2. Summary of input datasets detailing data source and type

GIS Layer	Data Source	Description
Soil Survey Geographic Database (SSURGO)	United States Department of Agriculture (NRCS 2016a)	2016 - polygon layer
State Soil Geographic Database (STATSGO)	United States Department of Agriculture (NRCS 2016b)	2016 - polygon layer
Slope	Generated from DEM	30m raster
Land Cover	National Land Cover Database (Homer et al. 2015)	c. 2011 – 30m raster
Land Use	City of San José Zoning Map	c. 2018 – polygon layer
Imperviousness Cover	NLCD (Xian et al. 2011)	c. 2011 – 30m raster

3.3.1 Hydrologic Soil Group

Soils data were obtained from the Soil Survey Geographic Database (SSURGO) and State Soil Geographic Database (STATSGO), both published by the Natural Resource Conservation Service (NRCS). There are four primary hydrologic soil groups (HSG) used to characterize soil runoff potential. Group A generally has the lowest runoff potential whereas Group D has the highest runoff potential. Both SSURGO and STATSGO soils databases are composed of a GIS polygon layer of map units and a linked database with multiple layers of soil property. Soil characteristics of each hydrologic soil group are described in **Table 3-3**.

Table 3-3. NRCS Hydrologic soil group descriptions

Hydrologic Soil Group	Description
A	Sand, Loamy Sand, or Sandy Loam
B	Silt, Silt Loam or Loam
C	Sandy Clay Loam
D	Clay Loam, Silty Clay Loam, Sandy Clay, Silty Clay, or Clay

Data Source: Natural Resource Conservation Service (NRCS), Technical Release 55 (TR-55)

Figure 3-6 presents the spatial distribution and a tabular summary of the SSURGO hydrologic soil groups for the watershed. The dominant soil group in the watershed is Group C, containing sandy clay loam with relatively low infiltration rates. Group D is the next most common soil group in the watershed, containing clay loam, and silty clay loam that typically have lowest infiltration rates, compared to other hydrologic soil groups. Less than 1% of the watershed areas had mixed soils, which were grouped with the nearest primary group as follows: A/D → B, B/D → C, and C/D → D. Approximately 2% of the watershed HSG area was unknown in the SSURGO database. For those areas, the corresponding HSG from the STATSGO dataset was used to supplement the data gaps. Finally, about 1% of the watershed was also unknown in the STATSGO dataset and was classified as D soil group.

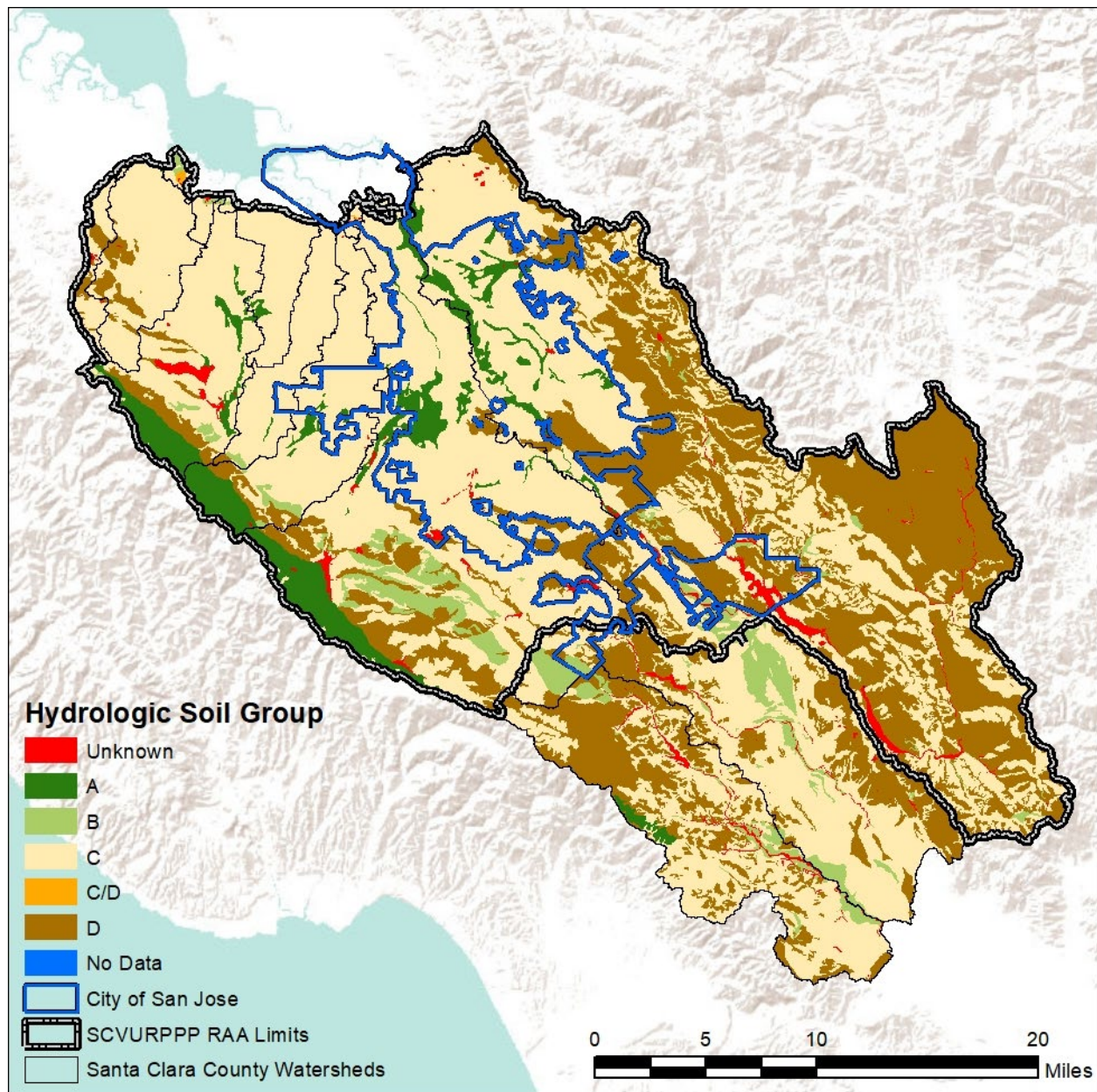


Figure 3-6. SSURGO hydrologic soil groups in the Santa Clara Basin.

3.3.2 Slope

The DEM grid was used to develop a percent slope raster, which was then reclassified into three groups (i.e., $\leq 10\%$, 10%-35%, and $>35\%$) corresponding to *low*, *medium*, and *high* slope areas, respectively. The *low* slope threshold of 10% was selected primarily for representing urban areas as 77% of the total developed area is below the 10% slope threshold. The slope threshold between *medium* and *high* of 35% was selected based on a natural breakpoint identified in the distribution of slopes across the total watershed area. This threshold results in about 48% of the total Santa Clara Basin area falling into the *medium* slope group, 36% as low and 16% as high. **Figure 3-7** presents the spatial distribution of the reclassified slope categories.

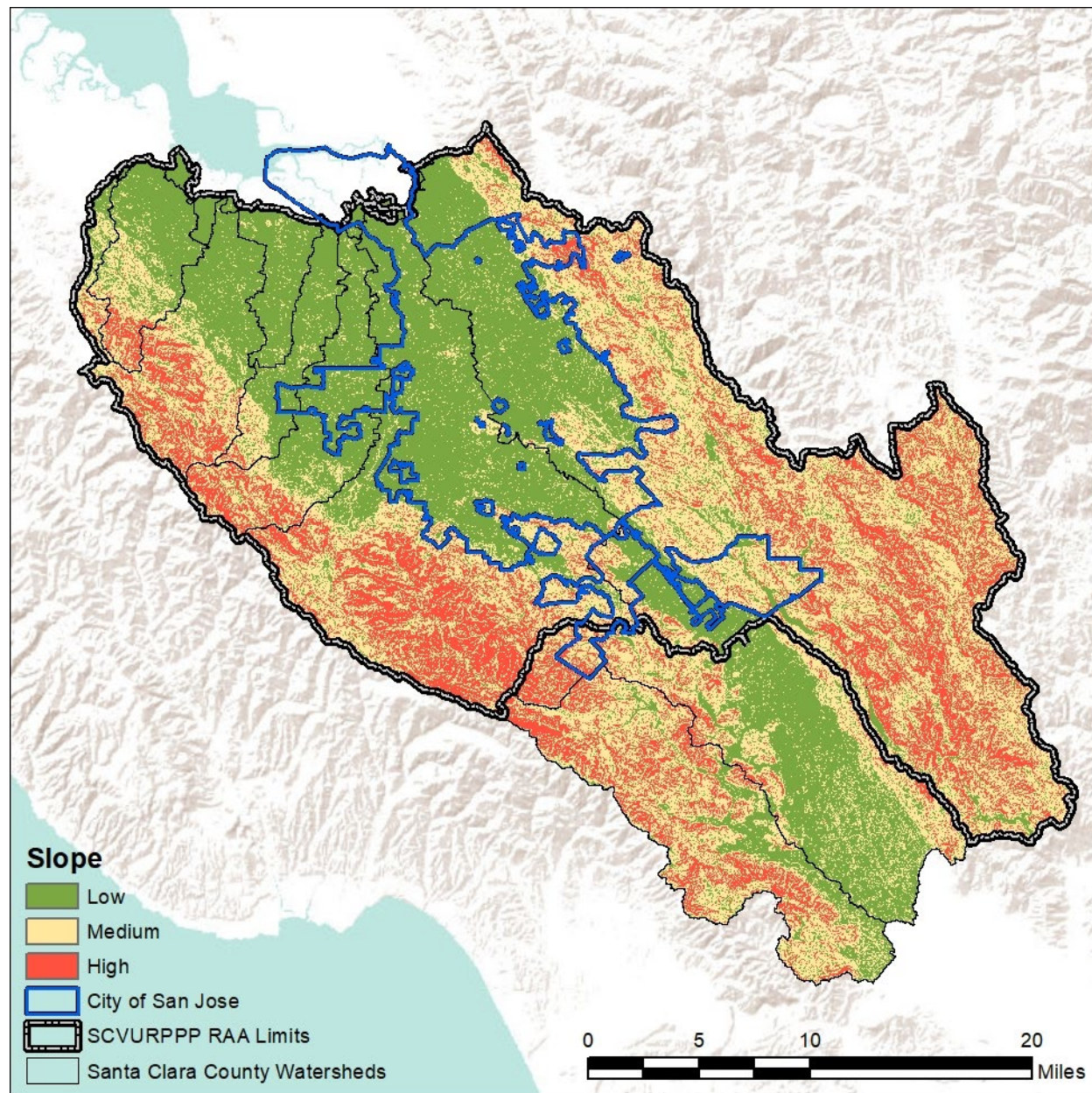


Figure 3-7. Map showing reclassified landscape slope groups.

3.3.3 Land Cover & Land Use

Land cover and land use data are the primary base layers for HRUs. Land cover describes the physical characteristics that cover the landscape (e.g., forest, wetlands, development) while land use describes the programmatic nature of land cover (e.g., type of development, functional use of open space, zoning etc.). The sources of land cover and land use data used in developing the LSPC watershed model were the 2011 National Land Cover Database (NLCD) and the City of San José zoning map, respectively.

The NLCD is maintained by the Multi-Resolution Land Consortium (MRLC), a joint effort between multiple federal agencies. The primary objective of the MRLC NLCD is to provide a current data product in the public-domain which provides a consistent characterization of land cover across the United States. The first iteration of the NLCD dataset was 1992. Since the 2001 NLCD version, a consistent 16-class land cover classification scheme has been adopted nationwide. The 2011 NLCD adopted this 16-class scheme at a 30-meter grid resolution. The minimum mapping unit is 5 30-m pixels (1.1 acres) for most land cover classes, except urban (1 pixel, 0.2 acres) and cropland and hay/pasture (12 pixels, 2.7 acres) (Homer et al. 2015).

The City of San José zoning dataset is the basic means of land use regulation for the City. It has 44 land use categories, including industrial, commercial, residential, open space, agriculture, water, as well as planned development lands. The zoning dataset also provides detailed classification for each zoning district (e.g. single-family residential, multifamily residential, etc.). The planned development indicates the type of development that may be built on all parcels within each district. **Table 3-4** summarizes the composite land cover and land use distribution for the region. Two-digit land cover codes represent NLCD classifications while three-digit land cover codes show City of San José zoning classes.

Table 3-4. Summary of land use and land cover datasets used to develop LSPC model HRU categories.

Data Source	GIS Code	Description	Area (acres)	Area (%)
National Land Cover Database (NLCD)	11	Open Water	2,308	0.40%
	21	Developed Open Space	51,348	8.86%
	22	Developed Low Intensity	37,621	6.49%
	23	Developed Medium Intensity	54,249	9.36%
	24	Developed High Intensity	13,903	2.40%
	31	Barren Land	189	0.03%
	41	Deciduous Forest	101	0.02%
	42	Evergreen Forest	56,426	9.74%
	43	Mixed Forest	126,408	21.81%
	52	Shrub/Scrub	58,447	10.08%
	71	Grassland/Herbaceous	74,810	12.91%
	81	Pasture/Hay	1,104	0.19%
	82	Cultivated Crops	14,453	2.49%
	90	Woody Wetlands	977	0.17%
	95	Emergent Herbaceous Wetlands	888	0.15%
City of San José Zoning Map	100	Agriculture	7,909	1.36%
	101	Cluster (Multiple Residential)	150	0.03%
	102	Cluster (R-1-5 Residential)	38	0.01%

Data Source	GIS Code	Description	Area (acres)	Area (%)
	103	Cluster (R-1-8 Open Space)	6	0.00%
	104	Cluster (R-1-8 Residential)	279	0.05%
	105	Combined Industrial	84	0.01%
	106	Commercial General	979	0.17%
	107	Commercial General Commercial	36	0.01%
	108	Commercial General Hotel/Motel	16	0.00%
	109	Commercial General Mix	5	0.00%
	110	Commercial General Residential	9	0.00%
	111	Commercial Neighborhood	460	0.08%
	112	Commercial Office	305	0.05%
	113	Commercial Pedestrian	964	0.17%
	114	Downtown Primary	242	0.04%
	115	Heavy Industrial	2,521	0.43%
	116	Industrial Park	4,072	0.70%
	117	Light Industrial	1,170	0.20%
	118	Main Street Commercial	14	0.00%
	119	Main Street Group	43	0.01%
	120	Mobile home Park	659	0.11%
	121	Multiple Residential	2,230	0.38%
	122	Open Space	35	0.01%
	123	Planned Development	12	0.00%
	124	Planned Development Cemetery	15	0.00%
	125	Planned Development CIC	41	0.01%
	126	Planned Development Commercial	1,322	0.23%
	127	Planned Development Commercial/Restaurant	18	0.00%
	128	Planned Development CP	1	0.00%
	129	Planned Development Hotel/Motel	8	0.00%
	130	Planned Development Industrial	3,690	0.64%
	131	Planned Development Mix	986	0.17%
	132	Planned Development Multi-Family Residential	3	0.00%
	133	Planned Development OS	5,977	1.03%
	134	Planned Development PQP	929	0.16%
	135	Planned Development Residential	11,370	1.96%
	136	Planned Development Residential/Commercial Mixed	90	0.02%
	137	Planned Development Retail and Park	80	0.01%
	138	Public/Quasi-Public	46	0.01%
	139	Rural Residential	19	0.00%
	140	Single-Family Residential	36,471	6.29%
	141	Transit Employment	36	0.01%
	142	Two-Family Residential	1,761	0.30%
	143	Water	1,258	0.22%

Data Source	GIS Code	Description	Area (acres)	Area (%)
Total			579,588	100.0%

Figure 3-8 shows a combined, generalized land cover and land use map for the Santa Clara Basin based on the two data sources discussed above. Forest and Grass/Shrub are the dominant natural land cover classifications in the Santa Clara Basin making up approximately 31.9% and 23.0% of the total watershed area, respectively. When combined with the dominant developed land cover classification, “Developed, Mixed”, which represents 28.3% of the total watershed area, these three categories together represent 83.1% of the total Santa Clara Basin area.

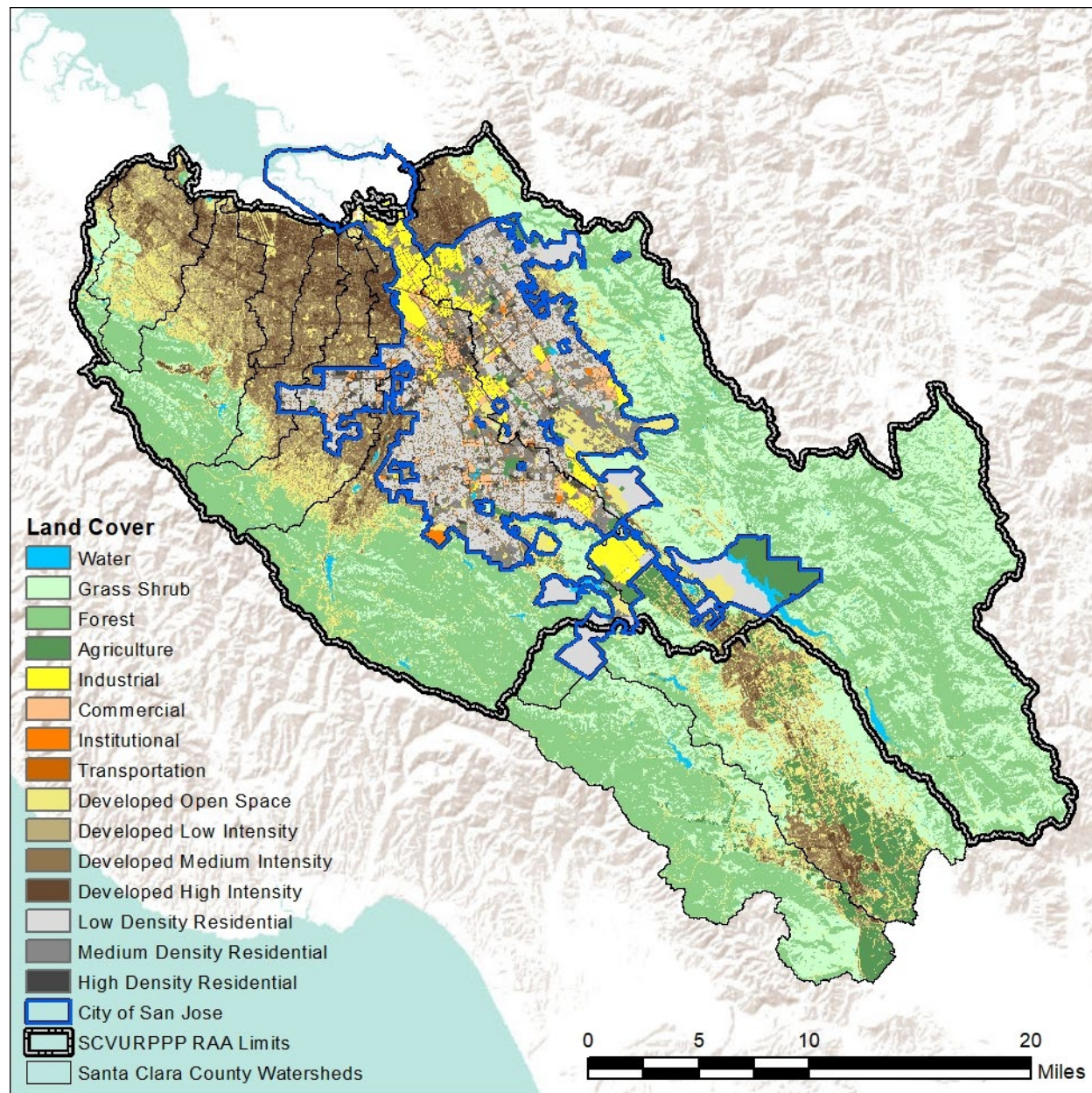


Figure 3-8. Combined major categories based on the land cover and land use data sets.

3.3.4 Impervious Cover

MRLC publishes a developed impervious cover dataset as a companion to the NLCD land cover. This dataset is also provided as a raster with a 30-meter grid resolution. Impervious cover is expressed in each raster pixel as a percentage of total area ranging from 0 to 100 percent. **Figure 3-9** shows the NLCD 2011 developed impervious cover dataset for the Santa Clara Basin. Because this dataset provides impervious cover estimates for areas classified as *developed*, non-zero values in **Figure 3-9** closely align with developed areas in **Figure 3-8**.

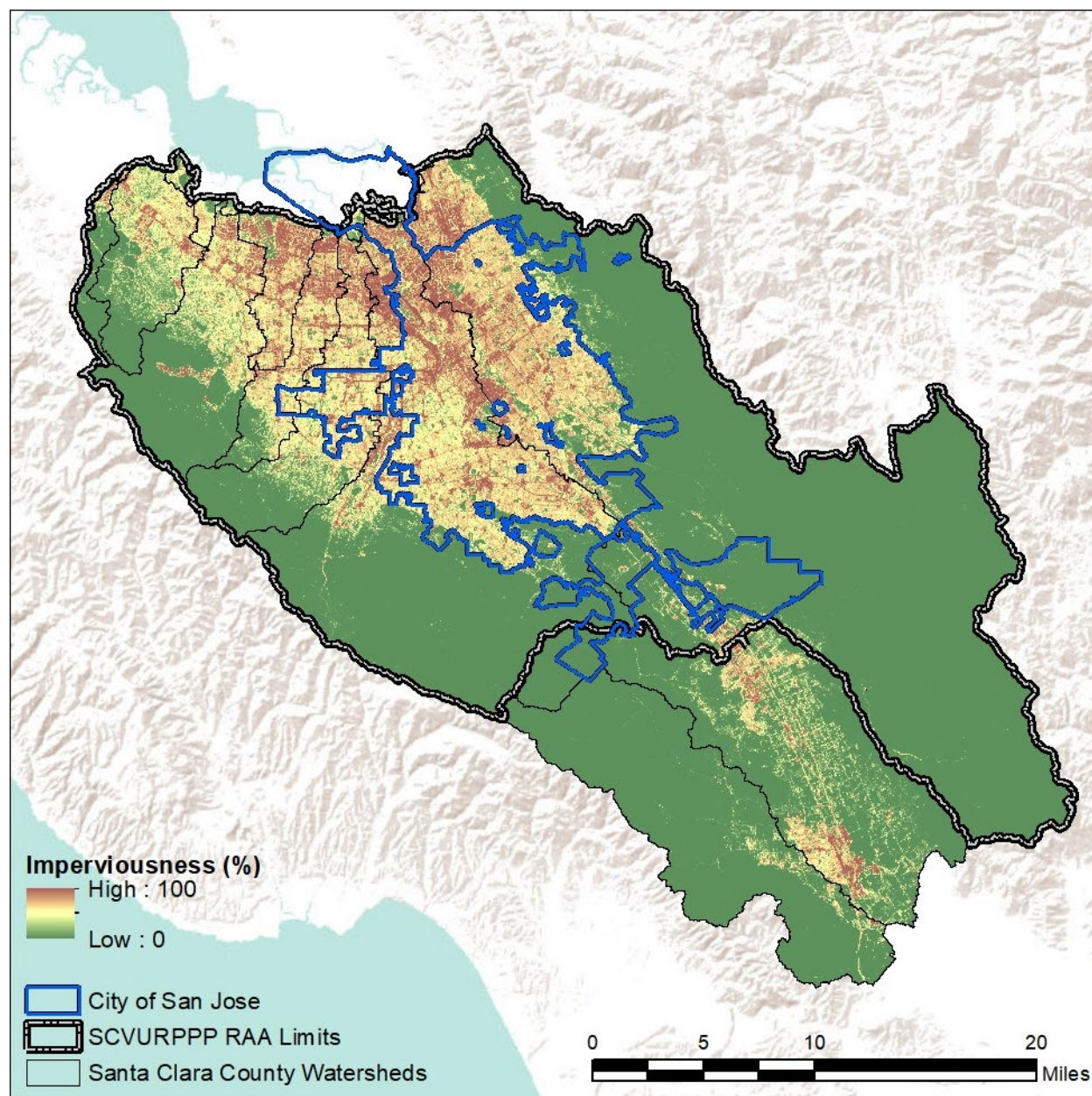


Figure 3-9. NLCD 2011 percent impervious cover in the Santa Clara Basin.

3.3.5 Directly Connected Impervious Cover

In the physical environment, the lines between impervious and pervious land are not always clearly distinguished. For example, runoff from impervious surfaces may flow over pervious land on route to a storm drain or watercourse. For modeling purposes, Effective Impervious Area (EIA) represents the portion of total impervious area, or Mapped Impervious Area (MIA), that routes runoff directly to the stream segments. It is derived as a function of directly-connected impervious area (DCIA), with other adjustments as needed to account for other structural and non-structural management practices in the flow network.

Figure 3-10 illustrates the transitional sequence from MIA to DCIA. Runoff from impervious areas that are not connected to the drainage network may flow onto pervious surfaces, infiltrate, and become part of pervious subsurface and overland flow. Because segments are modeled as being parallel to one another in LSPC, this process can be approximated using a conversion of a portion of impervious land to pervious land. On the open landscape, runoff from disconnected impervious surfaces can overwhelm the infiltration capacity of adjacent pervious surfaces during large rainfall/runoff events creating sheet flow over the landscape—therefore, the MIA→EIA translation is not actually a direct linear conversion. Finding the right balance between MIA and EIA can be an important part of the hydrology calibration effort.

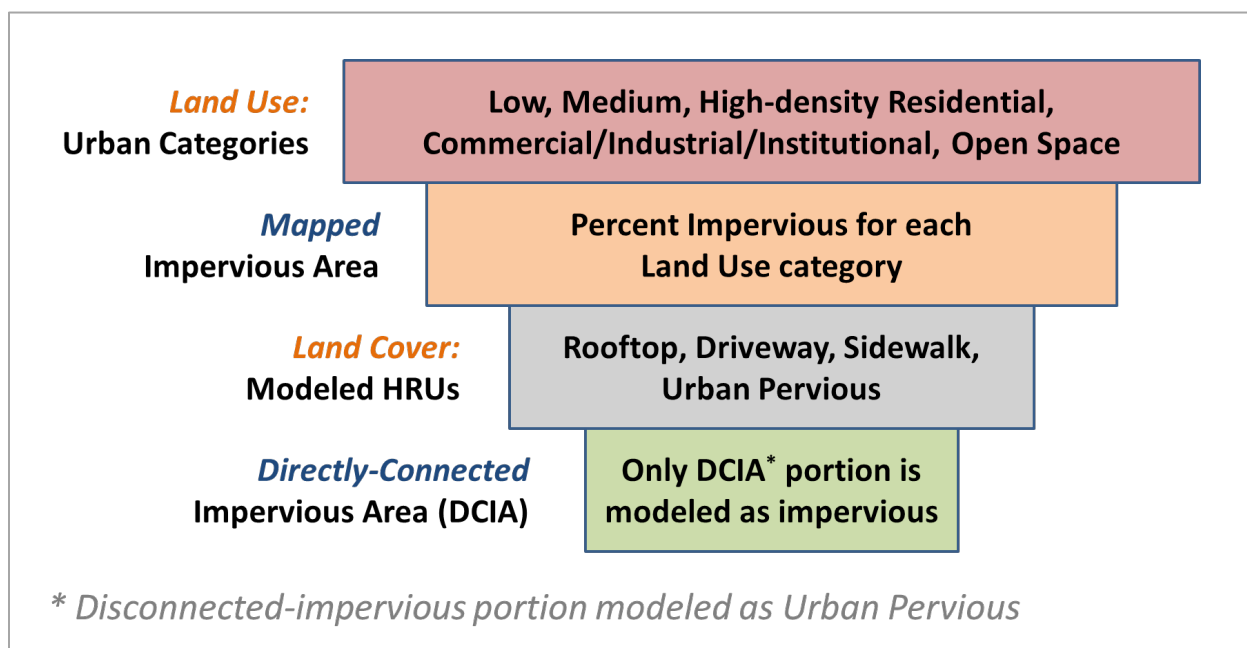


Figure 3-10. Translation Sequence from Mapped Impervious Area to Directly Connected Impervious Area.

Empirical relationships like the Sutherland Equations (2000) presented in **Figure 3-11** show a strong correlation between the density of developed area and DCIA. The curve for high-density developed land trends closer to the line of equal value than the curve for less developed areas. Similarly, as the density of mapped impervious area approaches 1, the translation to DCIA also approaches 1.0.

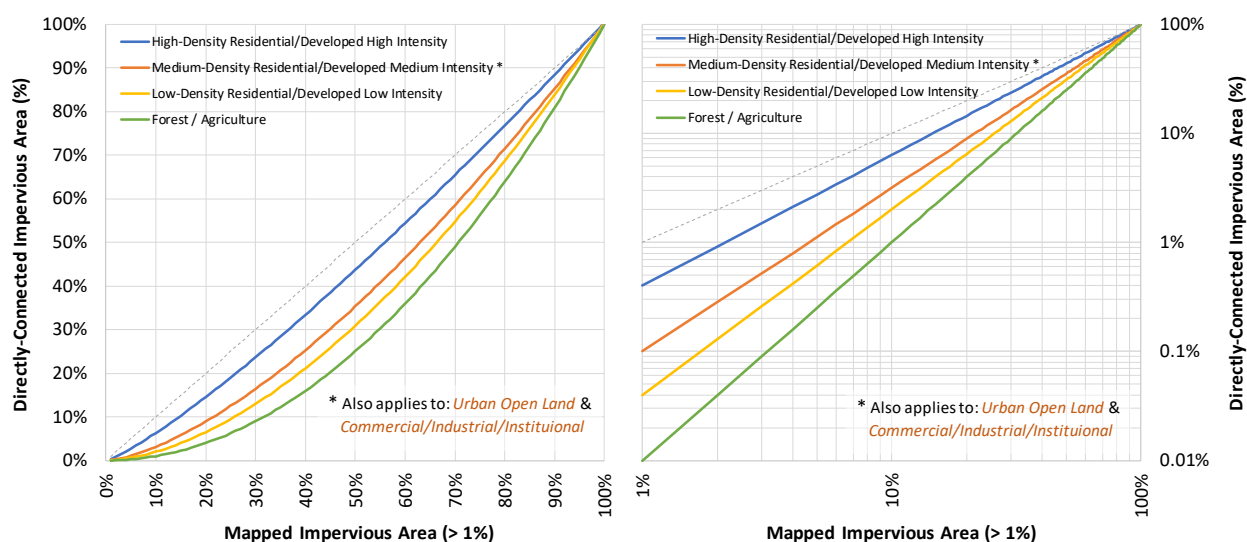


Figure 3-11. Relationships between Mapped and directly-connected impervious area (Sutherland 2000).

An initial estimate of EIA equal to $MIA \times DCIA$ was used to adjust the MIA presented in the GIS dataset before using those areas in the LSPC watershed model. This refinement is necessary to avoid an initial overestimation of impervious surfaces contributing runoff before initiating process-based model calibration. This empirical approximation can be further refined during model calibration to account for other flow disconnections resulting from structural or non-structural BMP practices or other inline hydraulic routing features.

3.3.6 Hydrologic Response Units

Using the reclassified datasets discussed in the previous sections, a set of representative HRUs was developed to reflect key land characteristics of the Santa Clara Basin. These HRUs serve as the functional pervious and impervious land segment units in the watershed model. The following steps were performed to develop HRU categories:

- Re-project all GIS layers into USA Contiguous Albers Equal Area Conic projected coordinate system (EPSG-102003) to ensure proper overlay and accurate area calculations
- Clip all GIS layers to watershed extent to ensure data overlay to the same spatial extent
- Convert all vector GIS layers into raster grids, resampled to a 30-meter resolution (i.e., 30-meter pixel width by 30-meter pixel height)
- Intersect all input spatial layers and tabulate area distribution for each of the unique combinations of “primary attributes,” including land cover, soil group, and slope.
- Using the final set of HRUs, summarize “secondary attributes” by HRU. Secondary attributes include characteristics such as imperviousness, which can be used to inform the parameterization of model processes

Table 3-5 summarizes the percent area by soil and slope HRU groups by each land cover HRU category. Combining the 13 land cover groups, four soil groups, and three slope groups results in 156 unique HRU combinations; however, the amount of area that each combination ultimately represents influences whether there is a need to maintain all combination or if further grouping can occur. For example, “Medium Density Residential” does not overlap at all with HSG-B and has less than 1% of its area overlapping with high slopes. Therefore, the LSPC watershed model was not configured with any Medium Density Residential HSG-B category for any of the three slope groups, and any Medium

Density Residential high slope category areas were reclassified to the medium slope category as a simplification as high slopes represented <1% of the total area for that land cover. **Figure 3-12** shows the spatial map and area distribution of the final HRUs categories across the Santa Clara Basin.

Table 3-5. Summary of percent land cover area distribution by HRU categories for the Santa Clara Basin.

Order	LUC	Percent of Area	Soil Group (% Landuse Area)				Slope (% Landuse Area)		
			A	B	C	D	0-10	10-35	>35
			1	2	3	4	1	2	3
1	Forest	30.9%	8.9%	5.8%	46.5%	38.7%	0.8%	56.5%	42.8%
2	Grass_Shrub	23.5%	1.4%	2.4%	36.7%	59.5%	4.8%	83.1%	12.1%
3	Agriculture	4.2%	5.3%	9.8%	63.8%	21.1%	74.7%	25.1%	0.3%
4	Developed_Open	0.0%	0.0%	0.0%	31.0%	69.0%	100.0%	0.0%	0.0%
5	Developed_Mixed	28.0%	6.6%	4.8%	80.2%	8.4%	77.9%	21.6%	0.6%
6	Low_Density_Res	6.7%	10.6%	1.8%	71.5%	16.2%	71.4%	24.3%	4.3%
7	Medium_Density_Res	2.4%	9.2%	0.0%	84.0%	6.9%	82.6%	17.3%	0.1%
8	High_Density_Res	0.5%	11.6%	0.0%	88.1%	0.3%	98.6%	1.4%	0.0%
9	Industrial	2.1%	15.0%	0.0%	71.6%	13.3%	89.0%	11.0%	0.0%
10	Commercial	1.0%	10.1%	0.0%	88.2%	1.7%	94.6%	5.4%	0.0%
11	Institutional	0.2%	24.2%	0.0%	58.6%	17.1%	51.6%	47.9%	0.5%
12	Transportation	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%	0.0%	0.0%
13	Water	0.6%	80.4%	1.9%	12.1%	5.6%	54.3%	45.4%	0.3%

Color gradients indicate more Watershed Area and increasing percentage of Soil, and Slope, respectively.

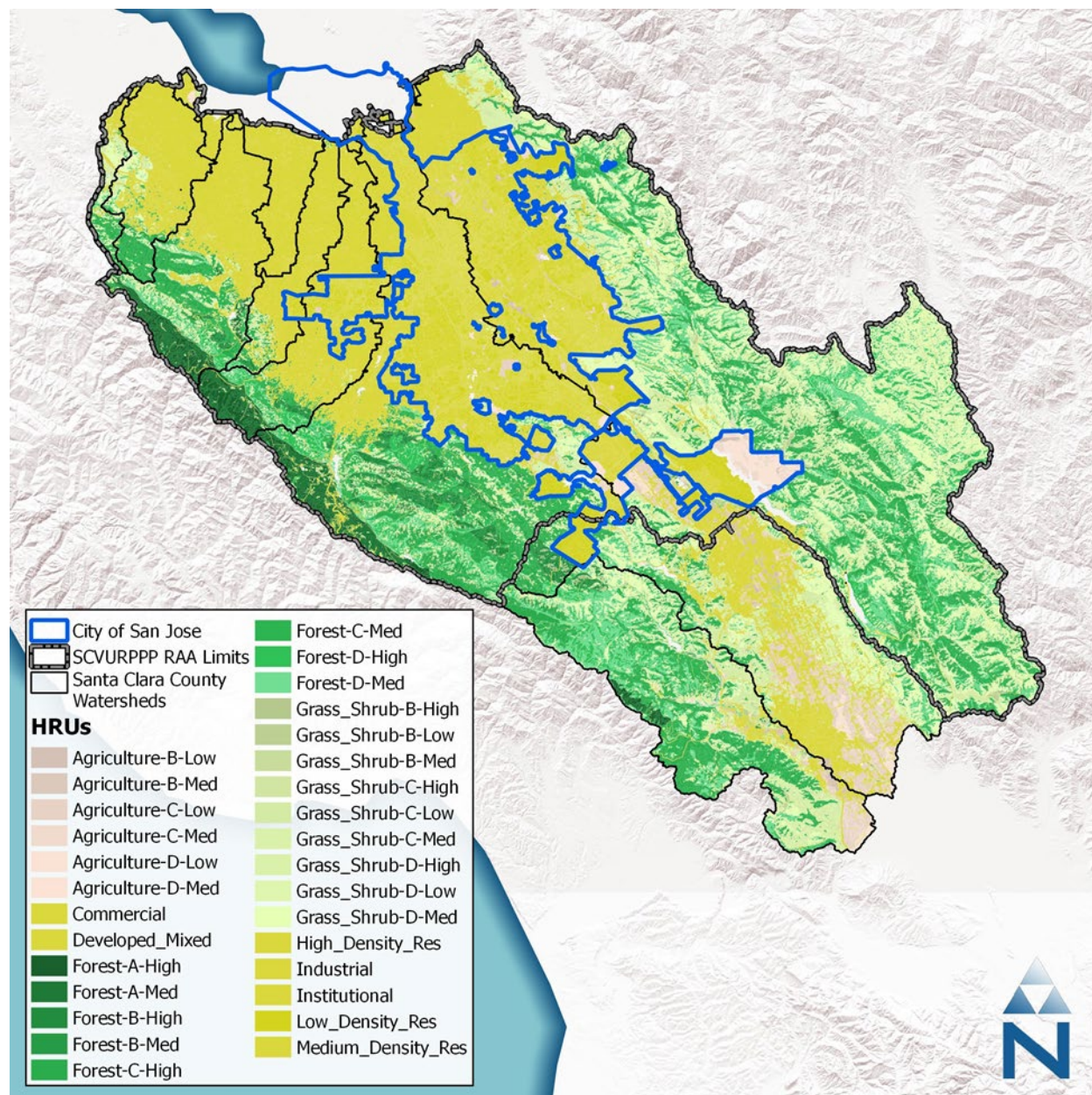


Figure 3-12. Map showing spatial representation of hydrologic response units.

3.4 Meteorological Boundary Conditions

Meteorological data such as precipitation, evapotranspiration, temperature, and other climate time series are the primary forcing functions of the model. Analytical considerations of data sources include data quantity and quality. Primary meteorological data products compiled and reviewed for this effort included two observed precipitation data products from the National Climatic Dataset Center (Global Historical Climatology Network daily—GHCND and Local Climatic Data). Secondary meteorological data, which are derived or interpolated from primary sources, included monthly precipitation totals from the Parameter-elevation Regressions on Independent Slopes Model (PRISM), hourly precipitation distributions and potential evapotranspiration (ET) estimates from the North

American Land Data Assimilation System (NLDAS2), a quality-controlled spatiotemporal dataset supported by the National Aeronautics and Space Administration (NASA), and reference ET rates from the California Irrigation Management Information System (CIMIS).

Because hydrologic models are highly dependent on the quantity and quality of meteorological forcing data, sometimes challenges arise when trying to associate point-sampled weather gauge data over complex terrain (Henn et al. 2018). The development and application of high-resolution gridded data products to support continuous-simulation modeling and other geophysical applications has increased with advancements in computing capability and resources. Research related to those products focuses on methodology refinements, assessment of differences between products, and identification of primary drivers and geophysical conditions that affect the robustness of their application in different settings (Henn et al 2018; Behnke et al. 2016). All seven of the gridded products reviewed by Behnke et al. (2016) use the PRISM methodology to interpolate spatially because it considers orographic influence on rainfall variability.

The use of products like NLDAS2 and PRISM also helps to overcome some of the common issues encountered when working with rainfall gauge data, which sometimes contain impaired intervals of missing, deleted, or accumulated data. Missing or deleted intervals are periods during which either the gauge malfunctioned, or the data records were lost. Accumulated intervals contain cumulative precipitation reported over several hours or days, but the exact temporal distribution of the data is unknown due to a gauge malfunction. The Land Surface Model (LSM) uses observed gauge data to guide the meteorological data extrapolation at fixed spatial intervals. LSM extrapolation considers orographic influence on the spatial variation, which can capture the influence of weather movements like those depicted in **Figure 3-13**. Topographic properties like elevation, aspect, and the windward/leeward location of the prediction point are considered when modeling rainfall variability (both timing and volume) across the landscape. As a result, LSMs extrapolate conditions for ungauged areas and interpolate spatial variability between gauged areas in a non-linear way. LSM approaches can capture localized impacts such as rain shadow over the landscape. The quality-control and increased spatiotemporal resolution of meteorological boundary conditions improves the predictions of continuous simulation watershed models and benefits water balance calculations in large-scale continuous-simulation applications. NLDAS2 and PRISM are both also updated in real-time in a consistent format, making it easier to periodically update boundary conditions for the watershed model as new information becomes available.



Figure 3-13. Orographic influence on weather movement.

Table 3-6 presents a summary of available meteorological data by source that were reviewed as part of model development. Table icons indicate the temporal resolution of the data by source. NLDAS2 also includes the full suite of hourly meteorological timeseries that the model uses, except for dewpoint temperature; however, dewpoint temperature, which is a function of air temperature, station pressure, and specific humidity, was computed from those NLDAS2 timeseries. The recommended approach is to intersect NLDAS2 and PRISM and scale the NLDAS2 hourly rainfall timeseries distributions with PRISM timeseries. The resulting intersect is an hourly 4-km spatial distribution of PRISM timeseries (based on NLDAS2 rainfall distributions) for the Santa Clara Basin—there are 137 unique sets of meteorological timeseries available for assignment to the modeled subwatersheds.

Table 3-6. Summary of the climate parameters evaluated during the initial inventory

Meteorological Data	Temporal Resolution of Meteorological Data by Source (Timestep: ● Hourly, ○ Daily, □ Monthly)						
	(a) GHCN	(b) LCD	(c) CDEC	(d) RAWS	(e) DRI	(f) PRISM	(g) NLDAS2
Precipitation	○	●	●	●	○	□	●
Potential Evapotranspiration	--	--	--	--	--	--	●
Air Temperature (Min/Max)	○	--	--	--	--	□	--
Air Temperature	--	●	--	●	--	--	●
Solar Radiation	--	●	--	●	--	--	●
Cloud Cover	--	●	--	●	--	--	●
Wind Speed	--	●	--	●	--	--	●
Wind Direction	--	●	--	●	--	--	●
Station Pressure	--	--	--	--	--	--	●
Specific Humidity	--	--	--	--	--	--	● ¹
Dewpoint Temperature	--	●	--	●	--	--	● ²

Acronyms: (a) Global Historical Climatology Network, (b) Local Climatic Data, (c) California Data Exchange Center, (d) Remote Automated Weather Stations, (e) Desert Research Institute, (f) Parameter-elevation Regressions on Independent Slopes Model-Monthly aggregated timeseries, (g) North American Land Data Assimilation System.

1: *Specific Humidity* converted to *Relative Humidity* as a function of *Air Temperature* and *Station Pressure*

2: *Dewpoint Temperature* calculated as a function of *Air Temperature* and *Relative Humidity*

3.4.1 Subwatershed Assignment

In the LSPC model, one set of meteorological timeseries is assigned to each of the 862 delineated model subwatersheds—it is also assumed that the associated rainfall falls uniformly within each subwatershed. To better manage the rigidity of that assumption, subwatersheds were delineated at a finer resolution in portions of the watershed where rainfall variability was relatively high over short distances. Data analysis from other modeling studies at times show notable differences in observed rainfall data collected at different locations at the same facility (e.g., opposite ends of an airport runway). Henn et al. (2018) also describe paired comparisons of observed rainfall gauges located within the extent of a single LSM grid, which report different rainfall volumes and distributions. Ultimately, the predicted hydrologic response of higher-resolution meteorological boundary conditions validates how representative they are of weather conditions upstream of the modeled assessment point (**Section 3.5.2**).

Figure 3-14 shows the regional distribution of annual average PRISM rainfall overlaid with modeled subwatersheds, PRISM, and NLDAS2 data centroids. Meteorological boundary conditions were associated with subwatersheds by assigning the grid that covered most of the subwatershed area.

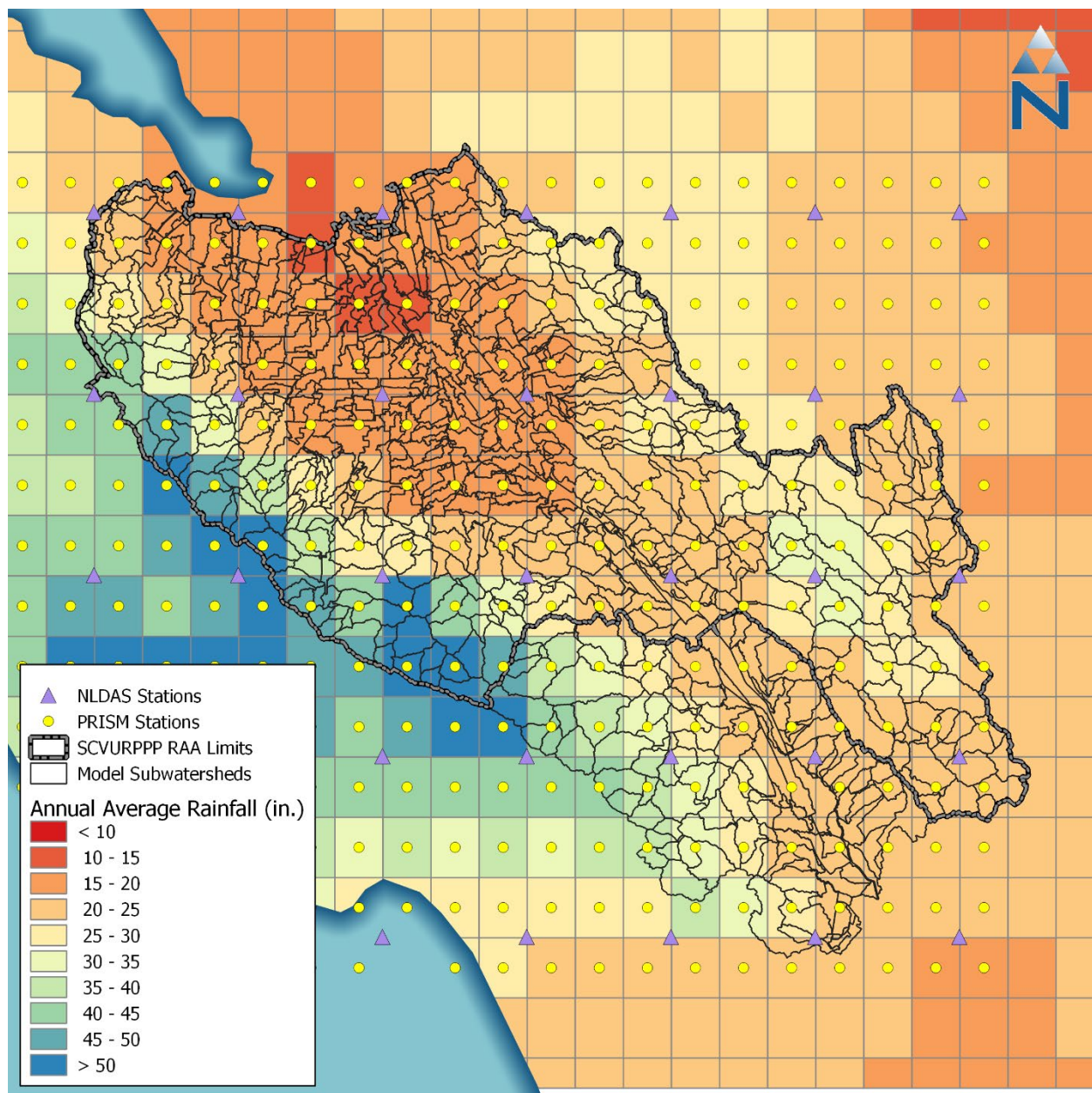


Figure 3-14. Annual average PRISM rainfall depths with associated PRISM and NLDAS2 data centroids.

3.4.2 Elevation and Aspect Analysis

The PRISM data were analyzed against topographic data to better understand the implications of orographic influences reflected in the PRISM annual average rainfall totals. The normal elevation of each PRISM centroid was paired with its corresponding long-term average rainfall total. Hillslope aspect was derived from the National Elevation Dataset (NED) Digital Elevation Model (DEM) and evaluated near the vicinity of each PRISM centroid. The representative aspect values were categorized into north-, east-, south-, and west-facing quadrants.

The influence of elevation was evaluated first. PRISM centroids were sorted by increasing elevation and associated average annual rainfall was plotted. The data were grouped into five equal elevation bins for analysis (low, medium-low, medium, medium-high, and high)—the median elevation of each bin is plotted for reference, as shown in **Figure 3-15**.

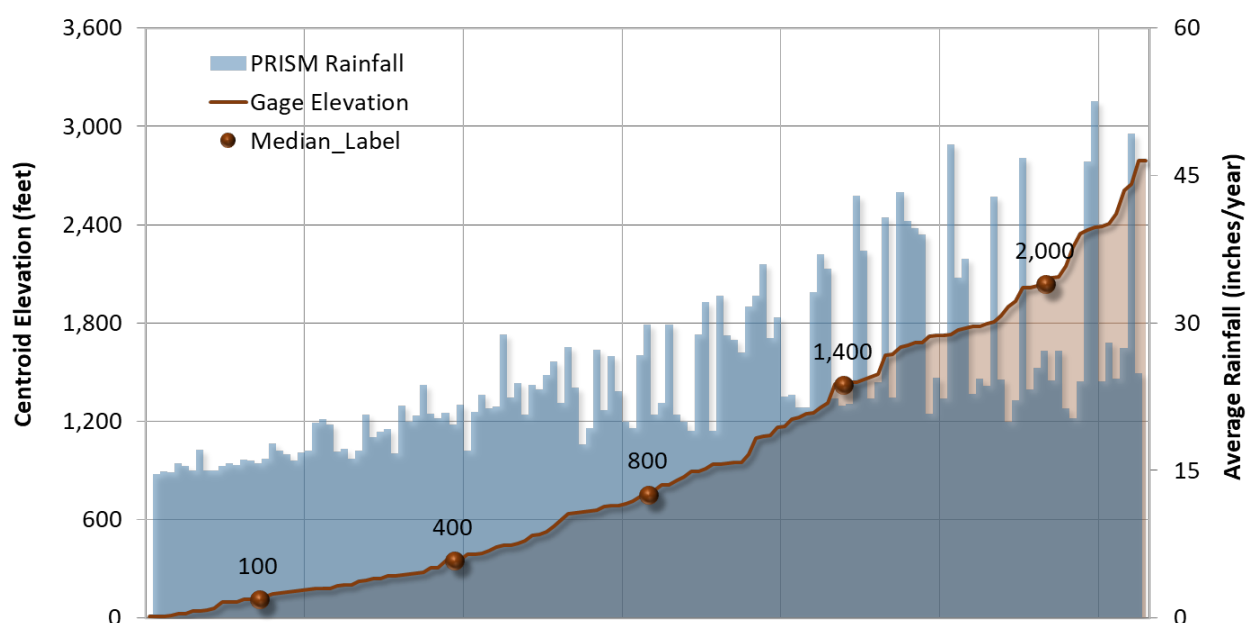


Figure 3-15. Average annual PRISM rainfall vs. centroid elevation (with median elevation of 5 bins).

The graph shows a gradual increase in rainfall with elevation; however, the variability suggests that other factors besides elevation also influence annual average rainfall. The data were also binned and analyzed by aspect. **Figure 3-16** shows how average rainfall varies by both elevation and aspect.

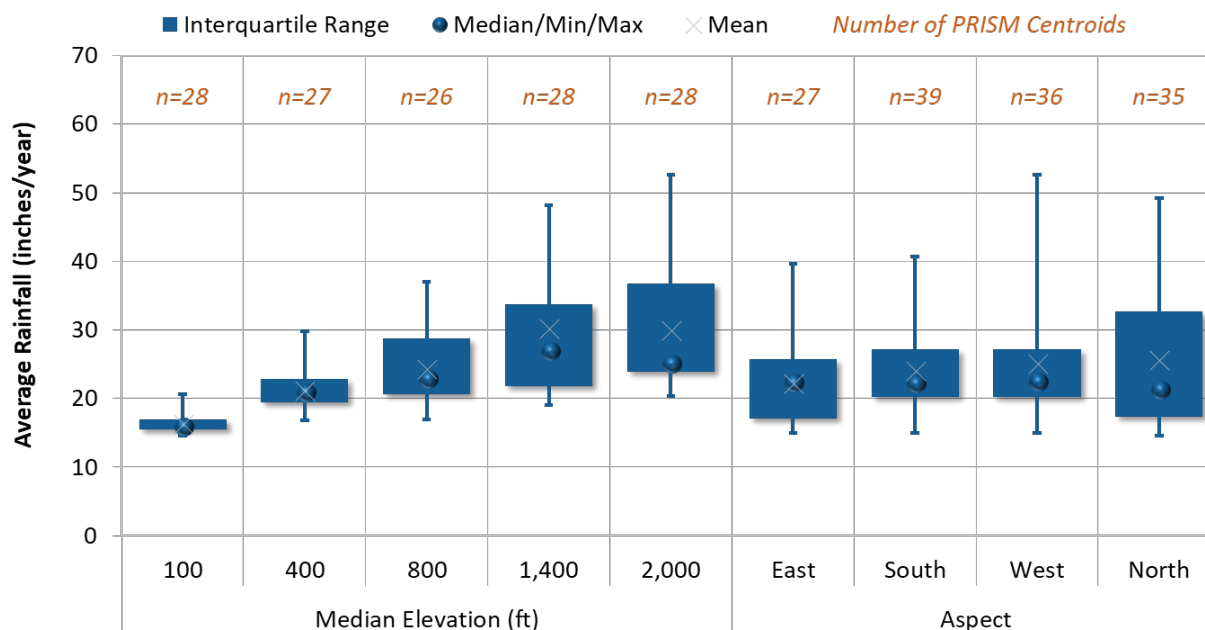


Figure 3-16. Box plots of average annual rainfall variability by elevation and aspect.

To assess the combined impact of elevation and aspect in the Santa Clara Basin, PRISM average annual rainfall centroids were grouped into 20 bins of elevation and aspect (5 elevation × 4 aspect groups). There were about 5 to 8 centroids within each of the 20 bins, and the median rainfall was calculated for each bin, as summarized in **Table 3-7**.

Table 3-7. Median rainfall (and distribution of PRISM centroids) by elevation and aspect

Elevation		Hillslope Aspect (No. Centroids)				Total
Bin	Median (ft)	East	South	West	North	
1	100	6	8	7	7	28
2	400	5	8	7	7	27
3	800	5	7	7	7	26
4	1,400	6	8	7	7	28
5	2,000	5	8	8	7	28
Total		27	39	36	35	137
Elevation		Hillslope Aspect (Median Rainfall, in./yr)				Median
Bin	Median (ft)	East	South	West	North	
1	100	16	17	17	16	16
2	400	22	23	21	19	21
3	800	23	21	29	22	23
4	1,400	27	25	24	39	31
5	2,000	27	25	24	37	25
Median		22	22	23	21	22

Color gradient shows **relative rainfall depth**. Darker is higher.

Figure 3-17 is a surface plot of the median rainfall (vertical axis) verses elevation and aspect (horizontal plane)—the surface illustrates the central tendency of the combined impact of elevation and aspect on average annual rainfall. The right panel of **Figure 3-17** is the birds-eye view from the

top of the surface shown in the left panel—it shows horizontal and vertical surface transects for aspect and elevation, respectively.

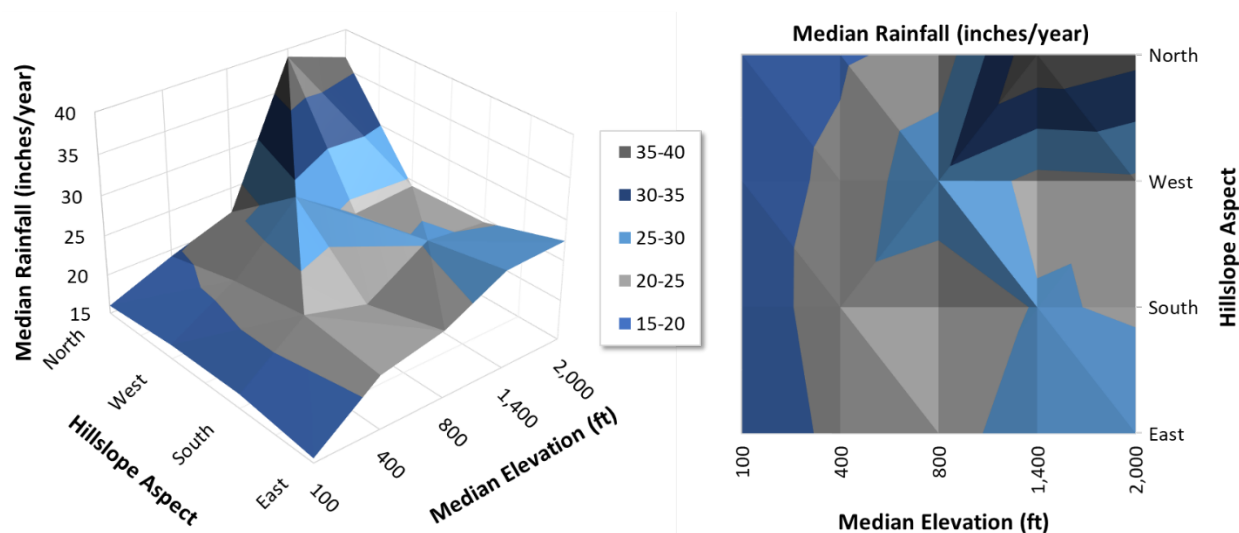


Figure 3-17. Surface plot of median rainfall (vertical axis) vs. elevation and aspect (horizontal plane).

Figure 3-17 shows that the driest areas of the study area are the lowest-elevation areas, regardless of aspect; however, the wettest are highest-elevation north-facing slopes. In general, at about 400 feet the impact of aspect on annual average rainfall volume appears to be negligible. The 100- and 400-foot elevation transects have the least variability in median rainfall. There is a lot of variability along the aspect transects, with the north-facing slopes having the widest range of variability across the range of elevations. This insight guided the selection/assignment of representative gages to subwatersheds and helped with interpretation of modeled responses.

3.5 Model Calibration

A phased weight-of-evidence approach was used for hydrology calibration. An initial set of model parameters were selected from the Bay Area Hydrologic Model (BAHM) (Clear Creek Solutions 2014) and refined by HRU using guidance from *BASINS Technical Note 6: Estimating Hydrology and Hydraulic Runoff Parameters* (USEPA 2000). The goal was to characterize the relative hydrological response of the various HRU combinations of land cover, soil type, and slope such that the routed aggregate response of the model was representative of observed trends at the flow monitoring gages. When model results diverged from observed data, Google Earth was used to further investigate and identify unrepresented features such as impoundments, concrete-lined channels, or other hydraulic features that may be attributable to the divergent model results. Finally, wherever it was possible to represent those notable features, model parameters were fine-tuned so that the calculated error statistics fell within the targeted model performance ranges.

3.5.1 Calibration Process & Objectives

Table 3-8 presents recommended model performance metrics for hydrology from the Bay Area RAA Guidance (BASMAA 2017). The Bay Area RAA Guidance specifies annual percent difference calibration metrics, which aligns with the spatial and temporal scales of the Bay TMDLs. For additional resolution regarding the timing of flow and pollutant loads, monthly and seasonal model hydrology performance were also evaluated as part of the calibration effort.

Table 3-8. Model calibration performance targets (Bay Area RAA Guidance document, Table 4-2)

Model Parameters	%Difference (Annual Simulated vs. Observed)		
	Very Good	Good	Fair
Hydrology/Flow ¹	< 10%	10-15%	15-25%

1: From Donigian 2000 as cited in LARWQCB 2014

A two-phase weight-of-evidence approach was used to guide LSPC's calibration. In the first phase, typical parameter values from *BASINS Technical Note 6: Estimating Hydrology and Hydraulic Runoff Parameters* (USEPA 2000) were selected to refine the initial set of BAHM parameters and stratify their variability to the modeled HRUs. Land-level hydrology was calibrated to best reflect the central tendency of land use runoff using supporting information such as geology, soil type, canopy cover, and surface cover conditions. After the model was calibrated to reflect overall trends and reasonable process dynamics, the second phase involved fine tuning the parameters and calculating various error statistics to find a most appropriate calibration within the range of acceptable parameter values to characterize instream transport routing processes in conjunction with other natural or anthropogenic activities, as applicable.

For hydrologic calibration of HSPF (Bicknell et al. 1997), performance targets have been specified in various literature sources to guide the assessment of long-term, annual, and seasonal patterns (Donigian et al. 1984, Lumb et al. 1994, and Donigian 2000). The LSPC model is functionally identical to the HSPF model. Based on those literature sources, performance targets for simulation of the water balance components are summarized in **Table 3-9**. The error is the ratio of the absolute mean error to the mean of the observations and is expressed as a percent. Model performance was deemed fully acceptable where a performance evaluation of "Good" or "Very Good" was attained. If these levels are not attained, an analysis of sources of uncertainty and implications for model usability were conducted. The values for Error in Annual Storm Volumes in **Table 3-9** are equivalent to the hydrology calibration metrics recommended by the Bay Area RAA Guidance and listed in **Table 3-8**. The additional calibration metrics listed in **Table 3-9** were considered in the hydrology calibration to provide added confidence in model performance, beyond the minimal performance criteria recommended from the Bay Area RAA Guidance.

Table 3-9. Performance targets for HSPF hydrology simulation (modeled vs. observed)

Model Statistic	Very Good	Good	Fair	Poor
Error in Total Volume	<5%	5-10%	10-15%	>15%
Error in 50% Lowest Flow Volumes	<10%	10-15%	15-25%	>25%
Error in 10% Highest Flow Volumes	<10%	10-15%	15-25%	>25%
Error in Annual Storm Volumes	<10%	10-15%	15-25%	>25%
Winter Total Volume Error	<15%	15-30%	30-50%	>50%
Winter Storm Volume Error	<15%	15-30%	30-50%	>50%
R ² Monthly	≥0.85	≥0.75	≥0.65	<0.65

Sources: Donigian et al. (1984), Lumb et al. (1994), and Donigian (2000)

3.5.2 Model Assessment Points

Table 3-10 presents a temporal summary of available streamflow data within the Santa Clara Basin from the United States Geological Survey (USGS) and Santa Clara Valley Water District (SCVWD).

A weight-of-evidence based modeling approach is strengthened by evaluating model performance against observed streamflow across different sized watersheds and time periods that capture a range of hydrologic conditions.

Eight streamflow gages were selected for comparison during the model calibration and validation process. In general, USGS gages tended to have a longer observed period and provided continuous data over the entire year while SCVWD gages primarily provided more recent data with some gages operating over limited timeframes to only capture the wet season. These streamflow records were flagged to differentiate periods of “good” data from “missing” or “estimated” records, which were derived using non-standard methods.

Table 3-10. Temporal summary of USGS and SCVWD streamflow gages in the Santa Clara Basin.

Agency	Station Name	Station ID	Drainage Area (sq. mi.)	Water Years (October 1, 1998 – September 30, 2017)																		
				1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
USGS	Matadero Ck at Palo Alto CA	11166000	7.3	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Guadalupe River above Highway 101 at San Jose CA	11169025	160.0					●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Saratoga Ck at Saratoga CA	11169500	9.2	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Coyote Ck near Gilroy CA	11169800	109.0							●	●	●	●	●	●	●	●	●	●	●	●	●
	Coyote Ck ab Highway 237 at Milpitas CA	11172175	319.0		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
SCVWD	Hale Creek below Magdalena Ct- High Flow Only	1456	2.7	●	●	●	●	●	●	●	●	●	●	○	○	●	●	○	○	○	○	○
	Permanente Creek at Rancho San Antonio- High Flow Only	1459	3.5															○	○	○	○	○
	Thompson Creek at Quimby Rd.-High Flow Only	1463	18.1	●	●	●	●	●	●	●	●	●	●	○	○	○	○	○	○	○	○	○
	Upper Silver Creek at Yerba Buena- High Flow Only	1491	5.1										○	●	●	●	●	●	●	●	●	●
	West Permanente Creek below Deer Farm- High Flow Only	1523	4.0																○	○	○	○
	Stevens Ck above Hwy 85 near Central Ave	1532	25.0	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Calabazas Ck above Rainbow Ave	1540	4.0															○	○	○	○	○
	Berryessa Ck above Calaveras Blvd	1545	15.6							●	●	●	●	○	○	●	●	○	○	○	○	○
	Permanente Ck above Berry Ave	1549	8.2	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	San Tomas Creek above Williams Rd	2050	13.4	○	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	○
	Coyote Creek at E. William- High Flow Only	2056	245.8																	○	○	○
	Ross Ck at Cherry Ave	2058	7.6	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	○

Legend: Data Quantity (Percent Complete):

0%	25%	50%	75%	100%
----	-----	-----	-----	------

Data Quality (Percent Estimated):

No Data	○	◐	◑	◒	◓
	90-100%	65-90%	35-65%	10-35%	0-10%

The gages selected for calibration had at least five continuous years of “good” data records. Smaller, isolated watersheds with shorter periods of record were used for calibration, while the larger watersheds with longer continuous data were used for validation. The gages selected for calibration represent headwater areas where it was possible to isolate specific categories of HRUs or other features of interest for adjustment of model parameters during the calibration process (discussed in **Section 3.5.3**).

3.5.3 Model Calibration

A disciplined approach to calibration was employed that emphasized meaningful adjustments to a limited set of model parameters, identifying physical processes to justify parameter changes during successive iterations, and deemphasizing simple curve-fitting to match observed data. The watershed model calibration process focused on refining LSPC hydrology parameters while assessing the impact on model performance at three headwater USGS gages. **Table 3-11** presents a summary of the drainage area characteristics for these three gages. These gages are in very different parts of the watershed: one is northern and more urban, one is western and highly forested with high slopes, and the third represents the most western part of the watershed with high elevation. The watershed sizes, elevation ranges, locations, slope types, and land use distributions vary. Each gage is separately covering different, isolated aspects of the HRU combinations to accurately depict the hydrology of the region. **Figure 3-18** presents a map showing the location of each of the three USGS gages selected for model calibration. All three sites are isolated from major impoundments or other visible hydromodifications that would heavily influence the calibration process.

Table 3-11. Summary of watershed characteristics for primary calibration sites

Calibration Site	Drainage Area	Predominant Land Cover	Predominant Hydrologic Soil Group	Predominant Slope
MATADERO C A PALO ALTO CA (USGS 11166000)	7.26	Developed (85%) Forest (14%)	D (61%) C (36%)	Low (59%) Med (39%)
SARATOGA C A SARATOGA CA (USGS 11169500)	9.22	Forest (91%) Developed (9%)	A (58%) C (19%) D (17%)	Med (85%) Low (14%)
COYOTE C NR GILROY CA (USGS 11169800)	109	Grass (49%) Forest (49%)	D (68%) C (30%)	Low (50%) Med (50%)

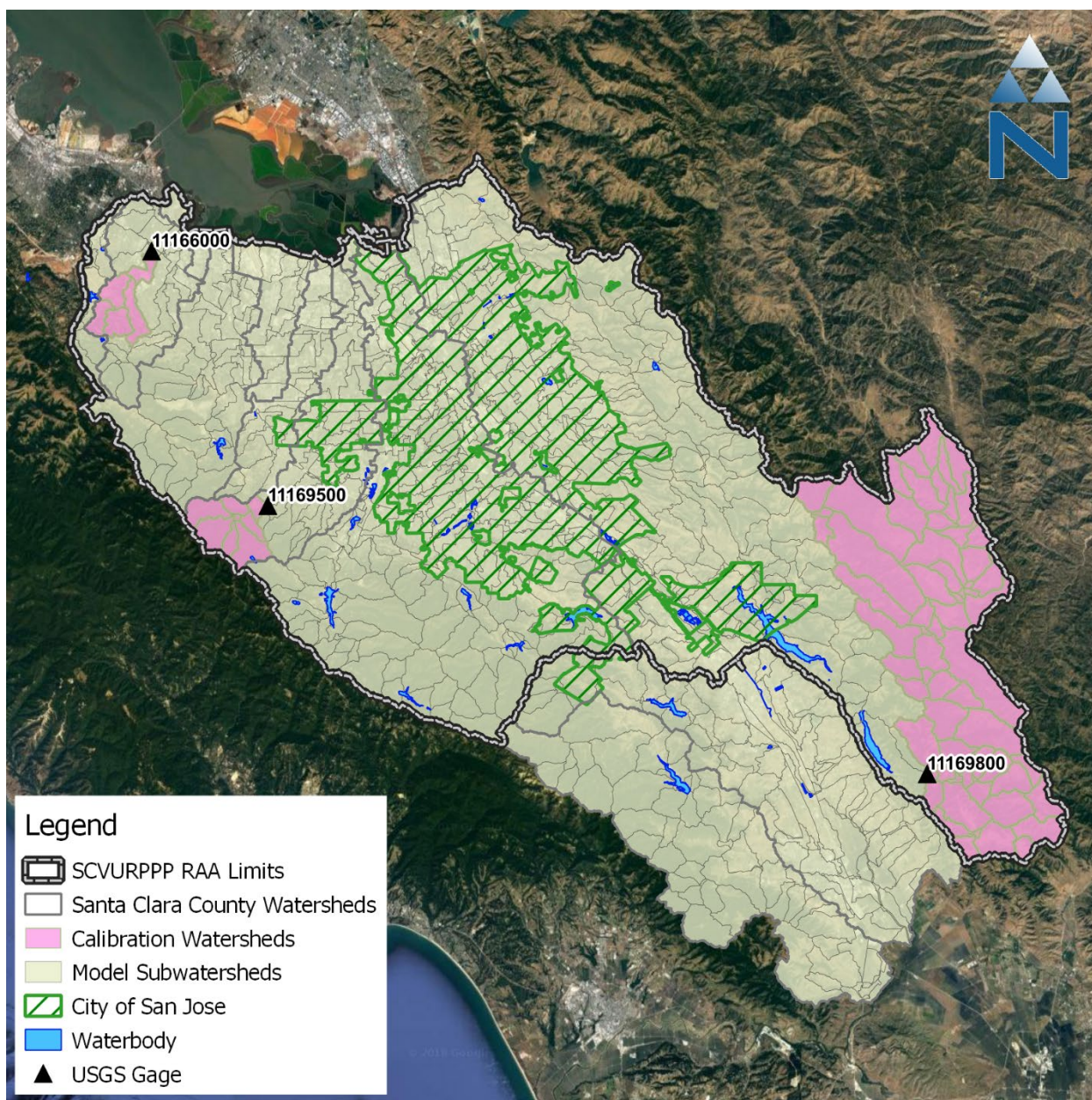


Figure 3-18. Locations of the three USGS headwater calibration gages and corresponding drainage areas.

As previously discussed in **Section 3.5.1**, initial hydrology parameters were selected based on guidance from BASINS Technical Note 6: *Estimating Hydrology and Hydraulic Runoff Parameters* (USEPA 2000) often using land cover, soil type, or annual precipitation as the basis for selecting the starting values. Specific attention was given to the most sensitive hydrology parameters which govern total annual volume including Lower Zone Nominal Soil Moisture Storage (LZSN), Nominal Upper Zone Soil Moisture Storage (UZSN), Index to Mean Soil Infiltration (INFILT), and Groundwater Recession Rate (AGWRC). The Groundwater Recession parameter describing non-linear groundwater recession rates (KVARY) was initially set to 0.0 globally and subsequently not changed during calibration. The ranges of individual parameter values correspond to the HRU differences and seasonal fluctuations. Monthly values were used for Interception Storage Capacity (CEPSC), Upper

Zone Nominal Storage (UZSN), and Lower Zone Evapotranspiration (LZETP) parameters for each HRU to adjust for seasonal variation.

Initial hydrology parameters were then refined in the model for each of the three gages while focusing on selecting appropriate parameters for the most dominant HRU elements contributing to flows at each gage. For instance, the drainage area upstream of the Saratoga USGS gage (USGS 11169500) is heavily forested and is also one of the only instances in the model where HSG-A dominates the mix of soils. This site provided an opportunity to then target the adjustment of parameters during calibration for both forested land cover and HSG-A soils, specifically INFILT and AGWRC.

Table 3-12 and

Table 3-13 present the quantitative and qualitative assessment of final model calibration at the three headwater USGS gages. **Figure 3-19** is a summary of modeled vs. observed monthly streamflow at headwater calibration sites. Error statistics were computed using only days during the evaluation period with observed data. (i.e., days with missing data were excluded from the calculation). The following provides a summary of observations of the model performance from evaluating the quantitative, qualitative, and visual comparisons against observed data:

- At all three sites, results of these simulations meet the RAA guidance criteria requiring the error in model prediction of total annual volume within 10% of the observed data.
- The model performs well for both Matadero Creek and Coyote Creek when compared with observed data, achieving a *Very Good* assessment across all six error statistics.
- The model performs well at the Saratoga Creek monitoring location when evaluating the total annual volume, highest 10% of flows, and winter total volume; The annual storm volume and winter storm volume show error greater than the 15% threshold used to distinguish *Good* from *Very Good* performance. This could result from missing the timing or magnitude of an individual storm event.

Table 3-12. Summary of quantitative hydrology calibration performance by gage (modeled vs. observed)

Model Statistic	Matadero Creek at Palo Alto CA (USGS 11166000)	Saratoga Creek at Saratoga CA (USGS 11169500)	Coyote Creek near Gilroy CA (USGS 11169800)
Error in Total Volume	1.0%	3.4%	4.0%
Error in 10% Highest Flow Volumes	-5.3%	-9.9%	0.8%
Error in Annual Storm Volumes	-9.9%	19.3%	9.0%
Winter Total Volume Error	6.3%	2.3%	-4.2%
Winter Storm Volume Error	-5.0%	15.7%	-0.8%
R ² Monthly	0.96	0.91	0.92

Table 3-13. Summary of qualitative hydrology calibration performance by gage (modeled vs. observed)

Model Statistic	Matadero Creek at Palo Alto CA (USGS 11166000)	Saratoga Creek at Saratoga CA (USGS 11169500)	Coyote Creek near Gilroy CA (USGS 11169800)
Error in Total Volume	Very Good	Very Good	Very Good
Error in 10% Highest Flow Volumes	Very Good	Very Good	Very Good

Model Statistic	Matadero Creek at Palo Alto CA (USGS 11166000)	Saratoga Creek at Saratoga CA (USGS 11169500)	Coyote Creek near Gilroy CA (USGS 11169800)
Error in Annual Storm Volumes	Very Good	Good	Very Good
Winter Total Volume Error	Very Good	Very Good	Very Good
Winter Storm Volume Error	Very Good	Good	Very Good
R ² Monthly	Very Good	Very Good	Very Good

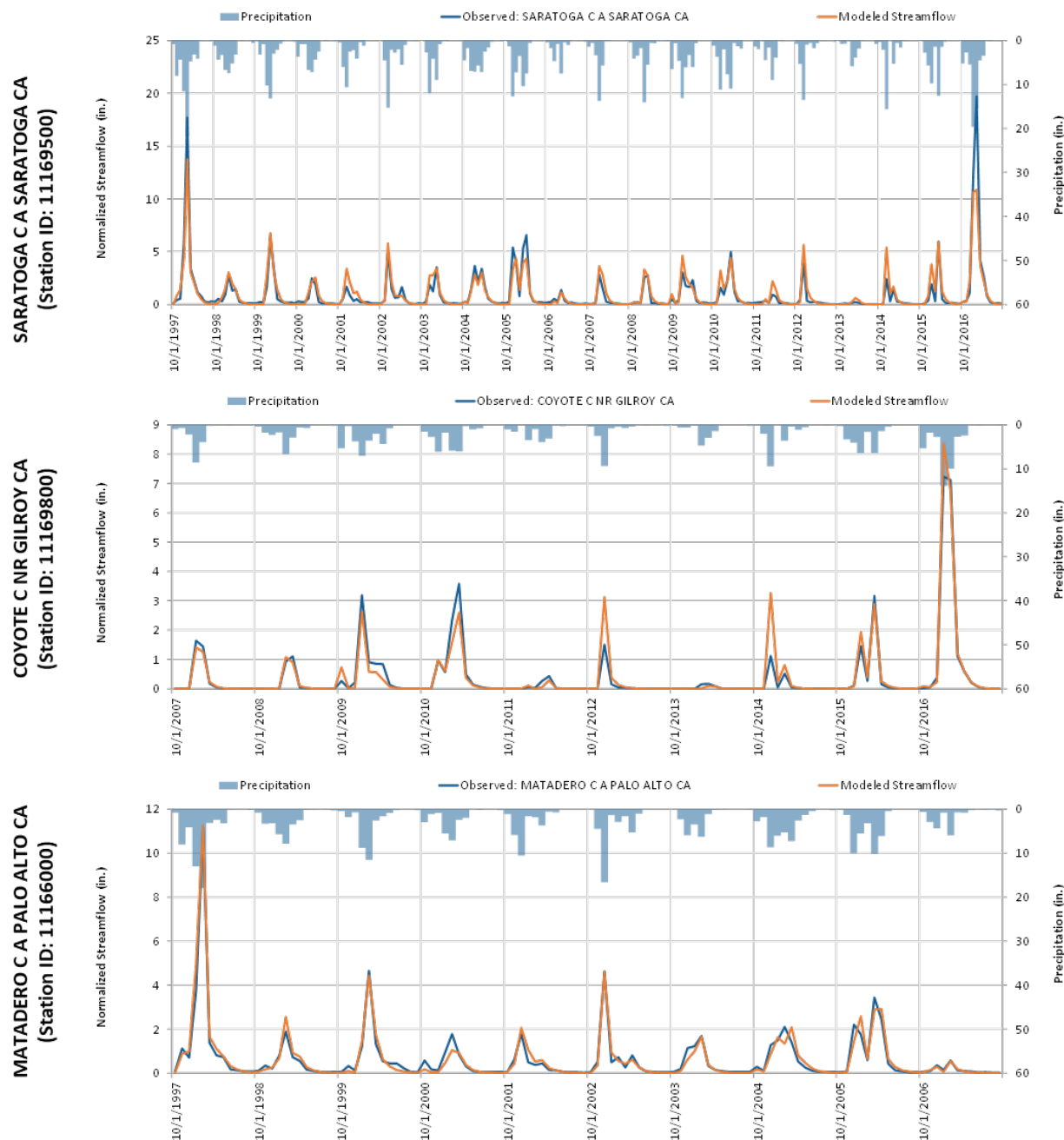


Figure 3-19. Summary of modeled vs. observed monthly streamflow at headwater calibration sites.

3.5.4 Model Validation: Headwaters

Model validation is often defined as a quantitative comparison of model results independently derived from experiments or observations of the environment (USEPA 2015). Sometimes validations are performed using independent points in space (i.e., observed data at different locations) while other times validation assesses independent periods of time (i.e., different years at the same locations used for calibration). An important distinction from model calibration is that no elements of the model physical or process representation are changed during the validation process.

Figure 3-20 presents a map showing the location of each of the three headwater SCVWD gages selected for model validation. These gages are located on smaller, urban tributaries with isolated upstream drainage areas and no major impoundments that were visible during a desktop analysis of aerial photography and readily-available GIS data. Some of these gages are described as only monitoring during high-flow periods, therefore, the validation statistics were calculated using only days when observed data were available. **Table 3-14** and **Table 3-15** present quantitative and qualitative assessments of model validation performance. **Figure 3-21** is a summary of modeled vs. observed monthly streamflow at headwater validation sites. Error statistics were computed using only days during the evaluation period with observed data. (i.e., days with missing data were excluded from the calculation). This is most relevant to these validation comparisons as several SCVWD stations, including Thompson Creek and Hale Creek, are noted as monitoring only during high flow periods.

The following provides a summary of observations of the model performance from evaluating the quantitative, qualitative, and visual comparisons against observed data:

- Model performance meets the RAA guidance criteria requiring the error in model prediction of total annual volume to be within 10% of the observed data at all three sites.
- The model performs well when compared with observed data for San Tomas Aquino Creek, achieving a *Very Good* assessment across five of six metrics. Several notable years in the graphs (i.e., Water Years 2009, 2009, 2017) were missing observed data and therefore were excluded from the calculation of performance metrics.
- Hale Creek and Thompson Creek achieve a *Very Good* assessment across all but two metrics. Error in annual storm volumes still achieves a *Good* assessment based on criteria from **Table 3-9**. The winter total volume error also includes periods of lower flow which were not a focus of the calibration.

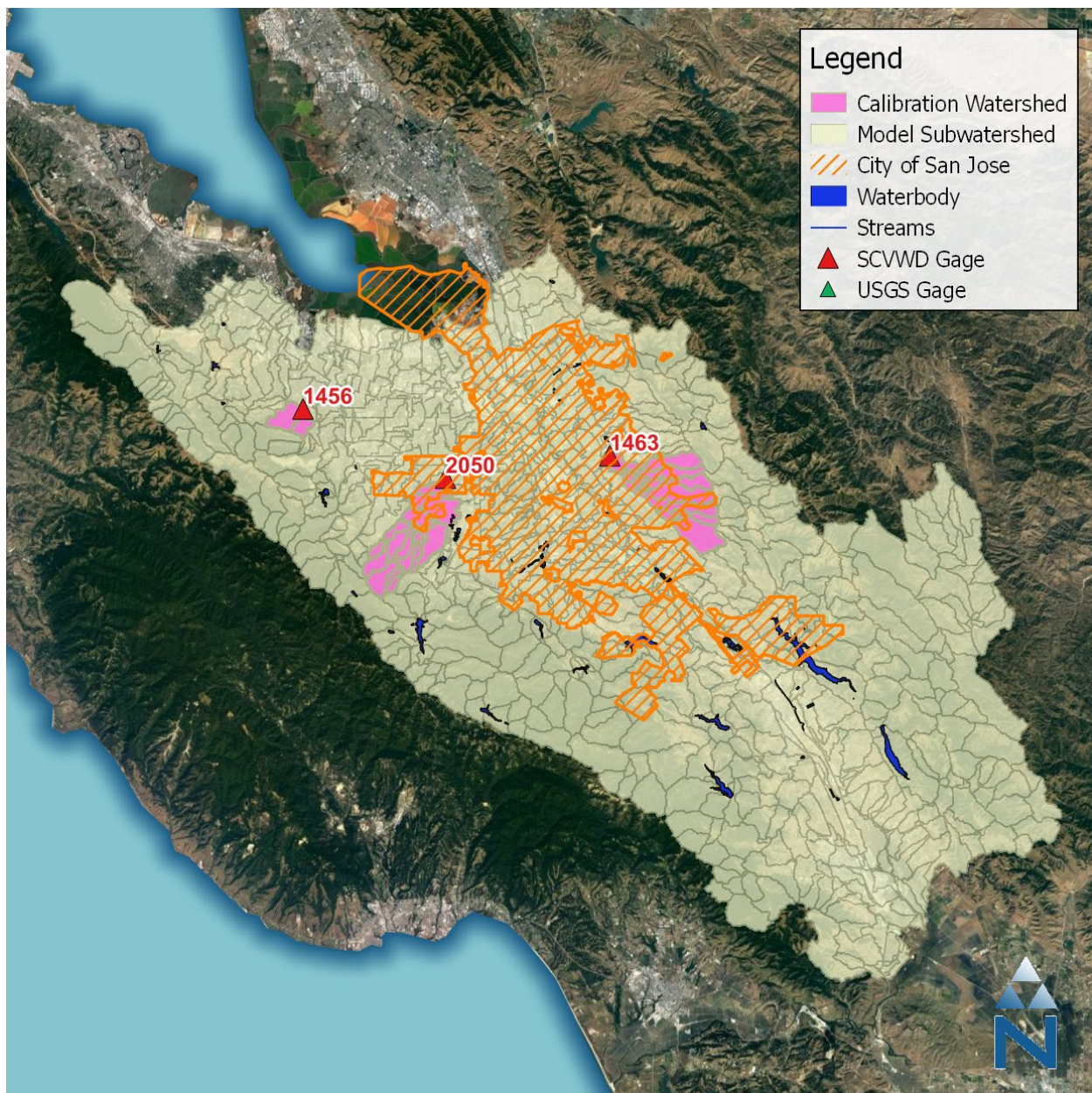


Figure 3-20. Locations of the three SCWD headwater validation gages and corresponding drainage areas.

Table 3-14. Summary of quantitative headwater validation performance by gage (modeled vs. observed)

Model Statistic	Hale Creek below Magdalena Ct (SCVWD 1456)	San Tomas Creek at Williams Rd (SCVWD 2050)	Thompson Creek at Quimby Rd. (SCVWD 1463)
Error in Total Volume	2.6%	2.7%	0.5%
Error in 10% Highest Flow Volumes	-4.3%	-15.6%	-5.5%
Error in Annual Storm Volumes	-12.4%	-4.7%	-9.6%
Winter Total Volume Error	13.6%	-1.9%	12.2%
Winter Storm Volume Error	-3.9%	-7.4%	3.9%
R ² Monthly	0.88	0.94	0.72

Table 3-15. Summary of qualitative headwater validation performance by gage (modeled vs. observed)

Model Statistic	Hale Creek below Magdalena Ct (SCVWD 1456)	San Tomas Creek at Williams Rd (SCVWD 2050)	Thompson Creek at Quimby Rd. (SCVWD 1463)
Error in Total Volume	Very Good	Very Good	Very Good
Error in 10% Highest Flow Volumes	Very Good	Fair	Very Good
Error in Annual Storm Volumes	Good	Very Good	Very Good
Winter Total Volume Error	Good	Very Good	Good
Winter Storm Volume Error	Very Good	Very Good	Very Good
R ² Monthly	Very Good	Very Good	Fair

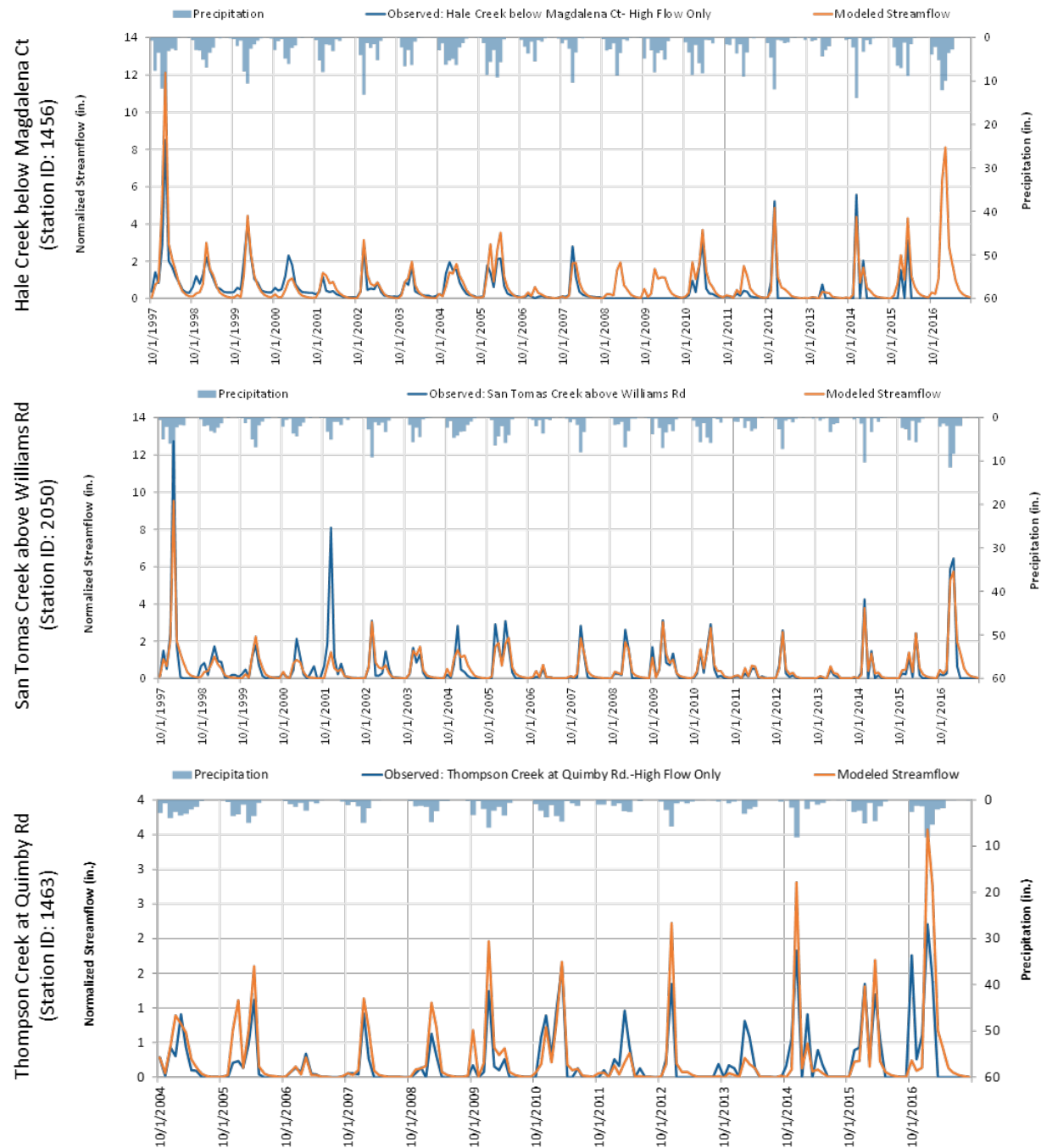


Figure 3-21. Summary of modeled vs. observed monthly streamflow at headwater validation sites.

3.5.5 Model Validation: Downstream

After performing calibration and validation for isolated headwater gages presented in **Section 3.5.3** and **Section 3.5.4**, two downstream USGS gages on Coyote Creek and Guadalupe River were assessed as a final validation of the full model domain for those two watersheds. **Figure 3-22** presents a map showing the location of the two downstream USGS gages selected for model validation.

Modeling these two watersheds required the representation of large reservoirs/impoundments in the routing network, including Guadalupe Reservoir, Coyote Reservoir, and Anderson Reservoir. The drainage area to Coyote and Anderson Reservoirs represents approximately 61% of the total drainage area at the downstream USGS gage on Coyote Creek. In 2011, restrictions were implemented for Anderson Reservoir that reduced the operating storage levels below full capacity of approximately 90,000 acre-feet (SCVWD 2018a). These restrictions were then adjusted in July 2011, increasing the currently allowed storage capacity by 11% (SCVWD 2018b). Since the watershed model is not capable of simulating this impoundment with dynamic changes in storage capacity, the validation at the Coyote Creek gage was evaluated for the three-year period from 10/1/2006 through 9/30/2009, prior to when these storage restrictions took effect.

Because reservoir releases are mostly mechanical, observed streamflow data from Coyote Creek at Madrone (SCVWD #1498) were used to develop a timeseries of operational releases for Anderson Reservoir. This process was primarily visual and involved establishing a threshold under which the observed streamflow was considered an operational release. Those releases were added to the model as a point withdrawal/diversion. Extreme events were allowed to naturally overflow the modeled reservoir spillway.

Table 3-16 and **Table 3-17** present the quantitative and qualitative assessment of validation performance at the two downstream USGS gages on Coyote Creek and Guadalupe River. Error statistics were computed using only days during the evaluation period with observed data (i.e., days with missing data were excluded from the calculation). The following provides a summary of observations of the model performance from evaluating the quantitative, qualitative, and visual comparisons against observed data:

- For both gages, results of the model met the RAA guidance criteria requiring the error in model prediction of total annual volume to be within 10% of the observed streamflow.
- The model performs well when compared with observed data for Coyote Creek, achieving a *Very Good* assessment across all six metrics. Close to 40% of the drainage area to this streamflow gage is downstream of Anderson Reservoir which reflects the outcome of the LSPC model setup and calibration primarily within the City of San José.
- The model performs well for Guadalupe River when comparing against the total annual volume (critical to the Bay Area RAA Guidance) and highest 10% of flows metrics (most important for predicting wet weather flows relevant to the RAA for FIB, described in detail in **Section 4**). However, the annual storm volume and wet season metrics achieved a *Poor* and *Fair* performance. There are other known hydraulic controls in the watershed that may not be fully represented in terms of timing and volume impacts on modeled instream flow. These include the Almaden-Calero diversion channel, recharge operations at Los Alamitos ponds, and the inflatable Kirk Dam on Los Gatos Creek (**Figure 3-23**). Sometimes water from behind Kirk Dam is also diverted out of the Guadalupe River watershed into recharge ponds in the neighboring watershed. Nevertheless, because differences in model performance are most likely attributable to instream hydraulic controls and not modeled stormwater flow, the predicted runoff at the HRU level is considered suitable and representative for use as boundary conditions for GSI modeling for the RAA.

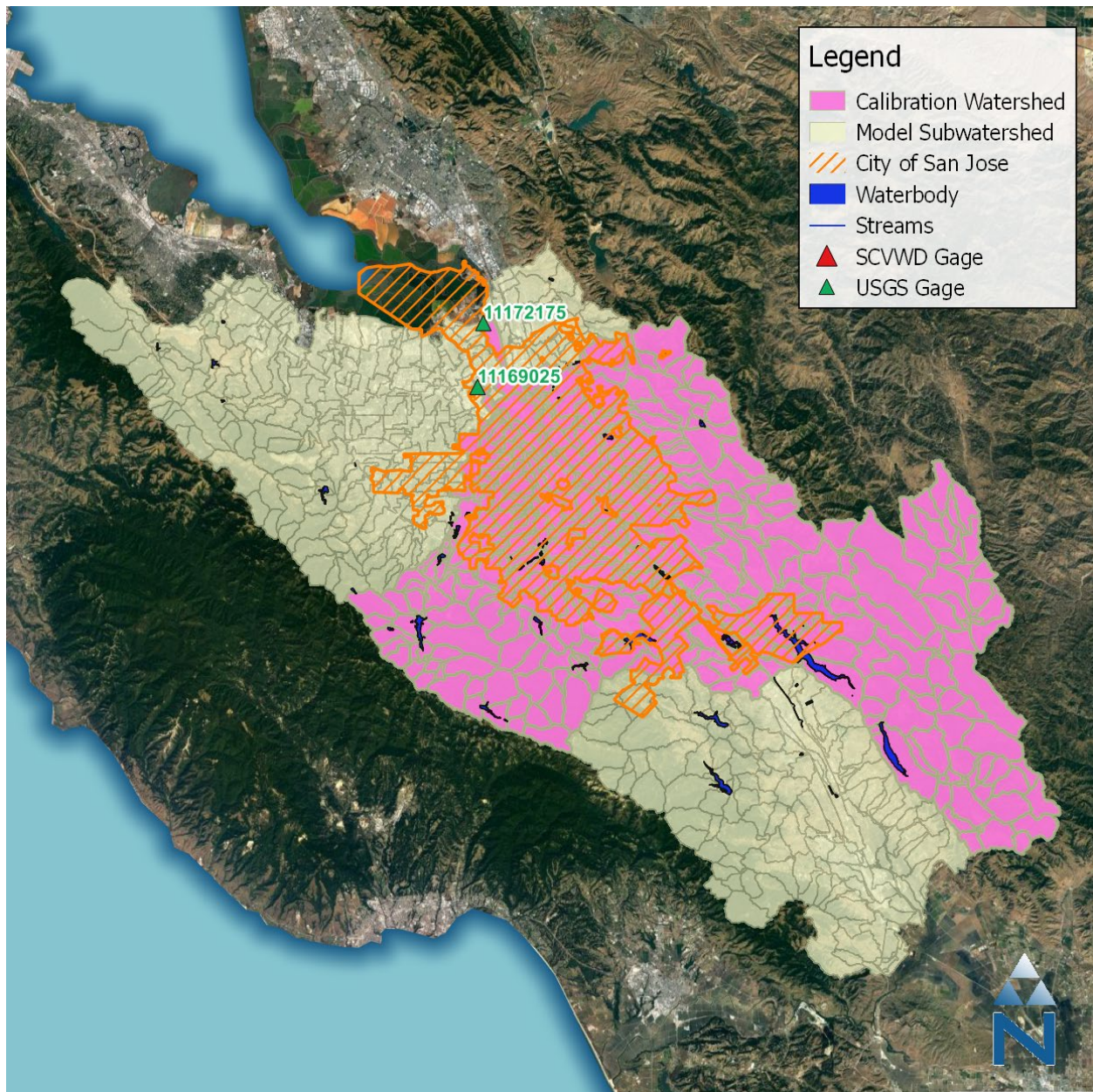


Figure 3-22. Locations of the two USGS downstream validation gages and corresponding drainage areas.

Table 3-16. Summary of quantitative downstream validation performance by gage (modeled vs. observed)

Model Statistic	Coyote Creek above Highway 237 at Milpitas CA (USSG 11172175)	Guadalupe River above Highway 101 at San José CA (USGS 11169025)
Error in Total Volume	2.7%	-3.1%
Error in 10% Highest Flow Volumes	1.2%	8.9%
Error in Annual Storm Volumes	5.6%	34.7%
Winter Total Volume Error	9.7%	13.3%
Winter Storm Volume Error	5.6%	31.2%
R ² Monthly	0.87	0.81

Table 3-17. Summary of qualitative downstream validation performance by gage (modeled vs. observed)

Model Statistic	Coyote Creek above Highway 237 at Milpitas CA (USSG 11172175)	Guadalupe River above Highway 101 at San José CA (USGS 11169025)
Error in Total Volume	Very Good	Very Good
Error in 10% Highest Flow Volumes	Very Good	Very Good
Error in Annual Storm Volumes	Very Good	Poor
Winter Total Volume Error	Very Good	Good
Winter Storm Volume Error	Very Good	Fair
R ² Monthly	Very Good	Good

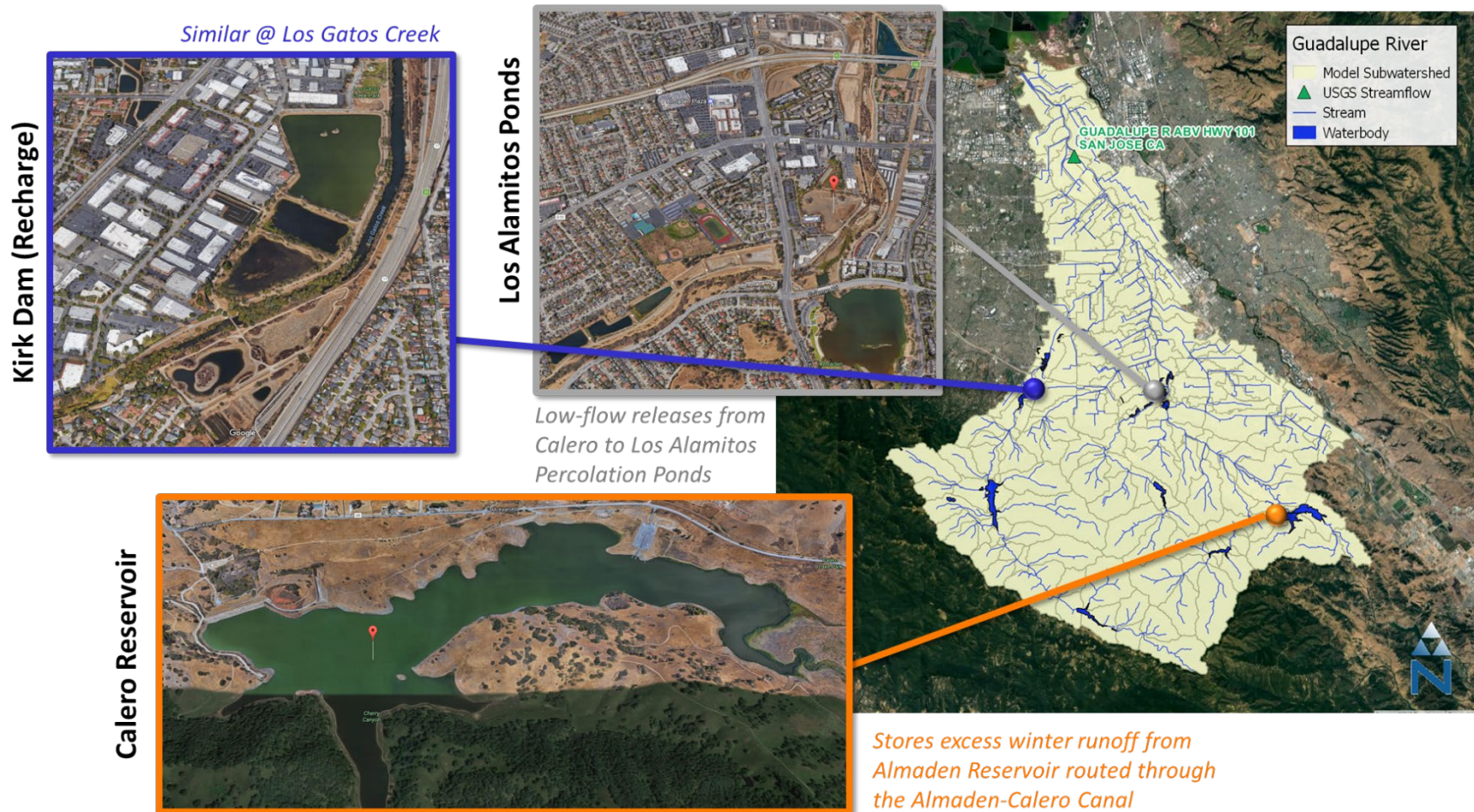


Figure 3-23. Guadalupe River watershed delineation, reservoir segments, and hydromodification features.

4 STORMWATER IMPROVEMENT GOAL

The FIB Load Reduction Standard specified in the Consent Decree requires the reduction in flows associated with a Critical Bacteria Storm. The methods used to calculate the Critical Bacteria Storm were consistent with approaches used in the Ballona Creek EWMP (Ballona Creek Watershed Management Group 2016) and Appendix I of the San Diego Bacteria TMDL (SDRWQCB 2010). The calculation assumes that allowable exceedance days is equal to 22 percent of the total wet days during the critical wet year. This number is derived from a study by the LARWQCB that used the Arroyo Sequit Watershed as a reference undeveloped watershed, consisting primarily of unimpacted land use (98 percent open space) discharging to Leo Carillo Beach (LARWQCB 2002, LARWQCB 2004). The study found that 22 percent of wet-weather FIB samples (10 of 46 samples) for that watershed exceeded water quality objectives (WQOs).

In addition to the studies referenced above, the Consent Decree requires that the City's RAA is consistent with the Los Angeles RAA Guidelines (LARWQCB 2014). The Los Angeles RAA Guidelines state that baseline pollutant loading estimates shall be based on two components: the "90th percentile of long term estimated/modeled flow rates..." and the "90th percentile of estimated/modeled long term pollutant concentration (considering the most recent 10 years of available data)..." (LARWQCB 2014; Section B, p.3). Translated from the two components described in the Los Angeles RAA Guidelines, a Critical Bacteria Storm calculation consists of:

1. Allowable exceedance days determined by multiplying an exceedance probability from a reference watershed by the number of wet days in a critical reference year over a **historical** period of record. The *Total Maximum Daily Loads for Bacterial Indicator Densities in Ballona Creek, Ballona Estuary, and Sepulveda Channel* (LARWQCB 2006), the basis for the bacteria critical condition in the *Enhanced Watershed Management Program for Ballona Creek Watershed*, defines the critical reference year as the 90th percentile storm year in terms of wet days over a historical record.
2. 90th percentile precipitation depth from the next wettest day after the allowable exceedance days for each year over the **most recent 10 years** of available data. Evaluating the most recent 10-year period is consistent with both the methods used in the Ballona EWMP and the second component of the baseline loading estimates as described by the Los Angeles RAA Guidelines.

The methods described in the following sections for calculating the Critical Bacteria Storm are consistent with the Los Angeles RAA Guidelines, the Ballona Creek EWMP, and San Diego Bacteria TMDL referenced in the Consent Decree. The stormwater improvement goal of the RAA is specified as the capture and/or treatment (hereafter referred to as "management") of the Critical Bacteria Storm.

4.1 Allowable Exceedance Days

The Critical Bacteria Storm was estimated based on analysis of historical rainfall records at the NOAA Global Historical Climatology Network (GHCN) Station ID USC00047821 (Station Name: San José). The San José station has a period of record from January 1, 1893 to September 30, 2007. Another station, GHCN ID USW00023293, was installed about 1.3 miles from the original location and has a period of record from July 4, 1998 to present. This station was used to extend the record of USC00047821 through the end of Water Year 2018 (September 30, 2018). An annual period in this analysis was defined as a Water Year (WY) (October 1st of the previous calendar year to September 30th of the following year). According to the San Diego Bacteria TMDL, the allowable exceedance

days are calculated based on the probability of exceeding WQOs from a reference natural watershed and the number of wet days in a critical reference year.

Since no bacteria studies have been performed on a reference watershed near the City of San José, a value of 22 percent wet-weather exceedance days from the Ballona Creek EWMP and San Diego Bacteria TMDL was assumed. To provide consistency with the Los Angeles RAA Guidelines (LARWQCB 2014), the Ballona Creek EWMP defines the critical reference year as the 90th percentile storm year in terms of wet days over the historical period of record (Ballona Creek Watershed Management Group 2016). A wet day is defined as 24-hour period with greater than or equal to 0.2 inches of precipitation or any day during the following 72 hours, regardless of rainfall amount. The critical reference year for the San José station (USC00047821/USW00023293) based on these definitions is WY 2017 with 91 wet days. The result is 20 allowable exceedance days, calculated by multiplying 91 wet days by 22 percent.

4.2 Critical Bacteria Storm Depth

The allowable wet-weather exceedance days calculated in **Section 4.1** was used in the calculation of the Critical Bacteria Storm depth. In addition to the stations used in **Section 4.1**, two additional stations were included in the analysis to account for precipitation variability across the City. The stations are summarized in **Table 4-1**.

Table 4-1. Precipitation stations used in Critical Bacteria Storm calculation

Station Name	Station ID	Period of Record	Elevation (m)	Latitude / Longitude
San José	USC00047821	1/1/1893 – 9/30/2007	20.4	37.350, -121.903
	USW00023293	7/4/1998 – Present	15.5	37.359, -121.924
Los Gatos	USC00045123	1/1/1893 – Present	111.3	37.232, -121.959
San José 4.6 NE	US1CASC0007	11/25/2008 – Present	96.9	37.354, -121.796

Critical Bacteria Storm depths were calculated for each of the three locations. The critical storm depth is based on the most recent 10 years of available data according to the Los Angeles RAA Guidelines (LARWQCB 2014; p.3). For each of the last 10 WYs on record, wet days were ranked by total daily precipitation. The precipitation depth from the 21st wettest day (20 allowable exceedance days from **Section 4.1**) was identified for each WY. The 90th percentile value over the 10-year period, as used in the Ballona Creek EWMP, is the Critical Bacteria Storm depth. The critical storm depth for each of the three stations is presented in **Table 4-2**.

Table 4-2. Critical Bacteria Storm precipitation depths for each station

Station ID	90 th Percentile Critical Bacteria Storm Depth (in)	Analysis Period (WY)
USC00047821 /USW00023293	0.324	2009 - 2018
USC00045123	0.461	2008 – 2017*
US1CASC0007	0.337	2009 - 2018

*USC00045123 only reported 46 days during WY 2018 and was not considered a complete annual record. The 10-year period that was evaluated at this station begins a year earlier than the other stations, in WY 2008.

To adequately represent precipitation variability across the City, the Critical Bacteria Storm depth was distributed spatially using PRISM. The critical depth for each station was normalized by the historical annual average precipitation depth of the PRISM grid cell in which the station is located. The remaining grid cells were then scaled by the normalized value of the nearest station. The result is a spatial distribution of critical depth across the City with the same 4-km resolution of the PRISM grids. Using the PRISM methodology to interpolate spatially allows for consideration of orographic influence on rainfall variability across the City and addresses the challenges with associating point-sampled weather gauge data with complex terrain. The resulting spatial distribution of the Critical Bacteria Storm depth, as well as the stations used in the analysis, are depicted in **Figure 4-1**.

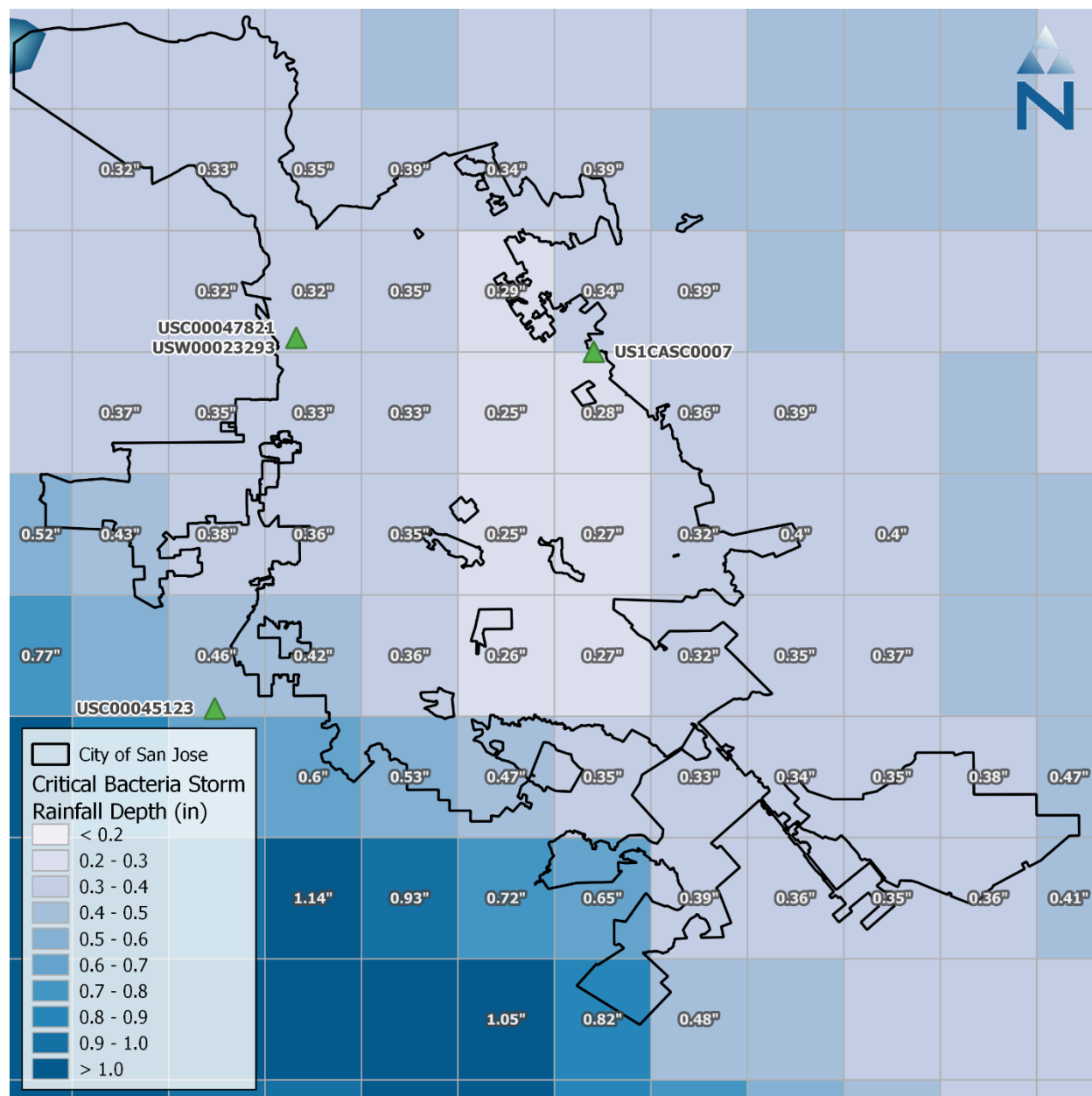


Figure 4-1. PRISM-distributed Critical Bacteria Storm precipitation depths.

4.3 Volume Estimates

A temporal distribution was applied to the Critical Bacteria Storm depths to generate precipitation timeseries to use as weather input for modeling of runoff volumes. The Critical Bacteria Storm distribution was developed using the methods described in the Santa Clara County Drainage Manual (Drainage Manual) (Santa Clara County 2007) for a 24-hour design storm in an area experiencing a mean annual precipitation totaling 15 inches. The rainfall distribution in the Drainage Manual was originally designed for 24-hour storm depths with recurrence intervals of 2-, 10-, and 100-year storm frequencies but can be applied to any storm with a 24-hour duration. The temporal distribution in **Figure 4-2** was applied to the Critical Bacteria Storm depth for each grid cell intersection in the City, resulting in 59 precipitation timeseries.

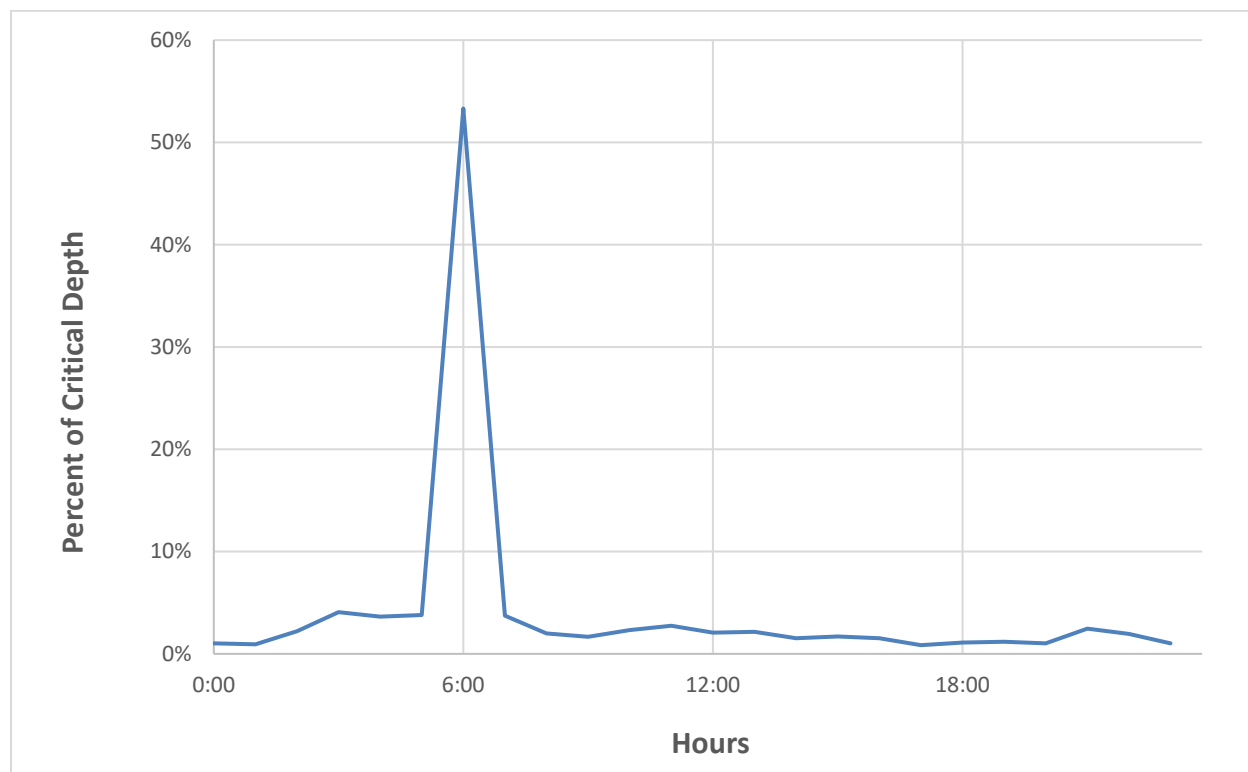


Figure 4-2. Precipitation 24-hour distribution (Santa Clara County 2007).

The calibrated hydrology model (**Section 3**) was used to model runoff volume from the Critical Bacteria Storm. Each model subwatershed was assigned a PRISM grid according to nearest grid centroid to determine which of the 59 precipitation timeseries was used as model input for that subwatershed. The resulting modeled runoff volume across the City is 893.2 acre-feet. **Figure 4-3** shows the spatially-variable runoff volumes from the Critical Bacteria Storm, reported as depths of runoff in inches.

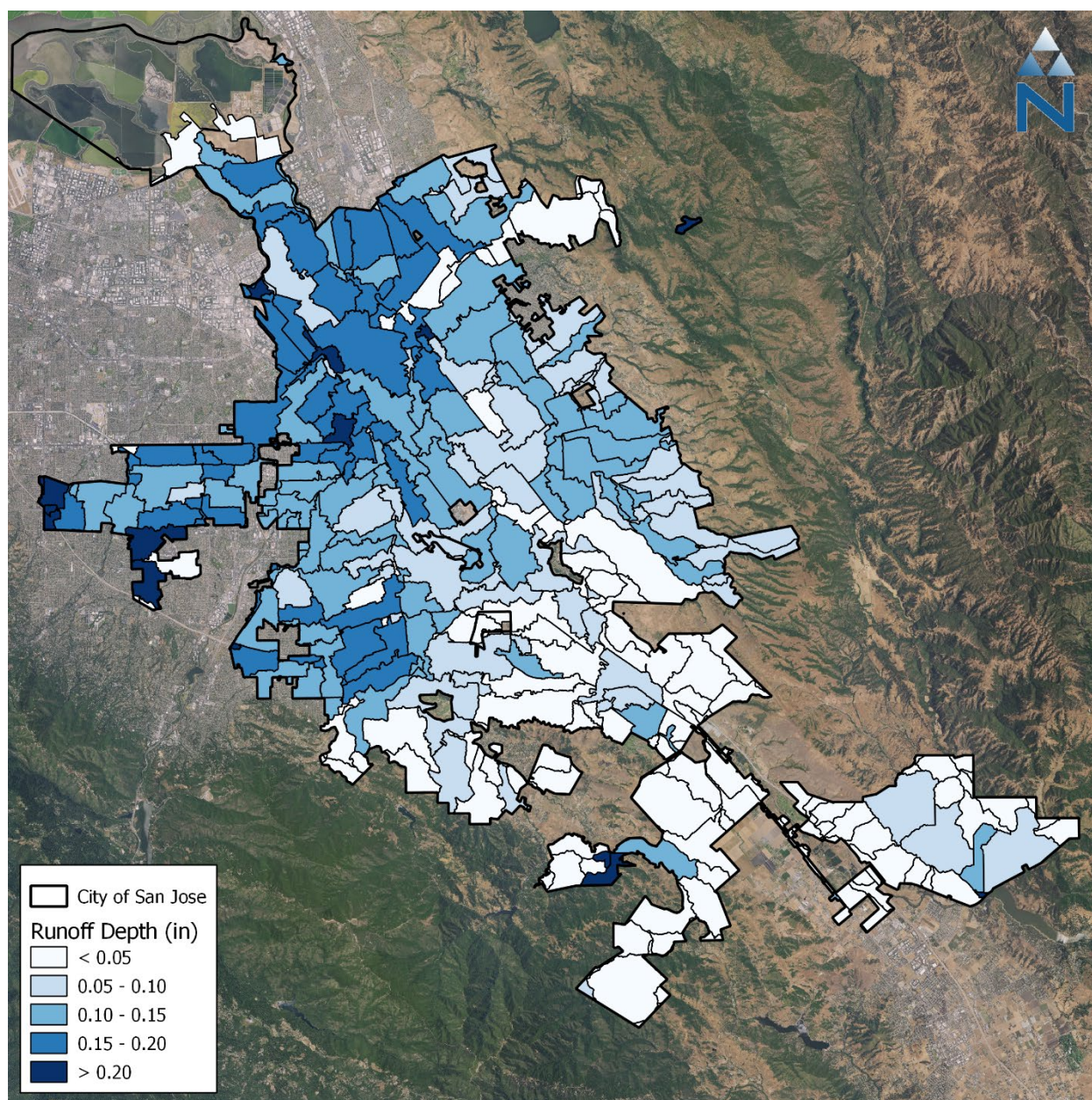


Figure 4-3. Normalized runoff volume by subwatershed.

4.4 Identification of the Stormwater Improvement Goal

To identify the goal for improving the management of municipal stormwater discharges from the City to address the FIB Load Reduction Standard, the modeled Critical Bacteria Storm volumes associated with non-MS4 land areas identified in **Section 2** were separated from volumes addressed by the MS4 permit. **Table 4-3** summarizes the MS4 and non-MS4 areas and their modeled Critical Bacteria Storm volumes. Consistent with the Ballona Creek EWMP, the MS4 permitted area's volume of 832.9 acre-feet in **Table 4-3** forms the basis of the stormwater improvement goal addressed by the RAA. Management of this volume will theoretically result in attainment of the FIB Load Reduction Standard defined by the Consent Decree.

Table 4-3. Summary of total area and Critical Bacteria Storm volume for MS4 and non-MS4 areas.

Permitted and Other Areas		Area (acres)	Runoff Volume (ac-ft)
<i>MS4 Permit</i>		94,621.1	832.9
<i>Other NPDES Permitted Areas and Non-Urban Areas</i>	<i>Open Space/Agriculture</i>	3.7	6.5
	<i>Caltrans</i>	10.4	14.3
	<i>Industrial (NPDES)</i>	27.2	1.5
	<i>Industrial (General)</i>	1.1	38.0
Total		94,663.5	893.2

5 ESTIMATION OF VOLUMES MANAGED THROUGH GSI IMPLEMENTATION

The Consent Decree and Los Angeles RAA Guidelines specify that the RAA shall be supported by “a process-based Best Management Practice (BMP) Performance Model to demonstrate that implementation of prescribed structural and nonstructural BMPs shall, with a reasonable level of assurance, address the FIB Load Reduction Standard by October 1, 2050” (US District Court, Northern District of California 2016). While the RAA is a quantitative demonstration that control measures will be effective, the RAA also promotes a modeling process to support the selection of control measures. In particular, the RAA was used to evaluate the many different scenarios/combinations of GSI projects (described in the GSI Plan) that could potentially be used to capture and/or treat stormwater, and was then used to select a cost-optimal solution to GSI project implementation that could provide management of the Critical Bacteria Storm volume by 2050. The following sections provide an overview of the process-based BMP Performance Model used to estimate the volume reduction achieved by GSI implementation, modeling assumptions for various types of GSI projects, and model results in terms of volumes potentially managed through GSI implementation.

5.1 Overview of BMP Performance Model

The BMP Performance Model selected for the RAA is EPA’s System of Urban Stormwater Treatment & Analysis Integration (SUSTAIN). Developed by EPA’s Office of Research and Development, SUSTAIN was primarily designed as a decision-support system for selection and placement of GSI projects at strategic locations in urban watersheds (**Figure 5-1**). It includes a process-based continuous project simulation module for representing flow and pollutant transport routing through various types of GSI projects. A distinguishing feature of SUSTAIN is a robust cost-benefit optimization model that incorporates dynamic, user-specified project unit-cost functions to quantify the implementation costs associated with various types of GSI projects. The cost-benefit optimization model runs iteratively to generate a cost-effectiveness curve that is sometimes comprised of millions of GSI project scenarios representing different combinations of projects throughout a watershed. Those results are used to make cost-effective management recommendations by evaluating the trade-offs between different scenarios. The “benefit” component can be represented in several ways: (1) reduction in flow volume (2) reduction in load of a specific pollutant or (3) other conditions including numeric water quality targets, frequency of exceedances of numeric water quality targets, or minimizing the difference between developed and pre-developed flow-duration curves (USEPA 2009, Riverson et al. 2014).

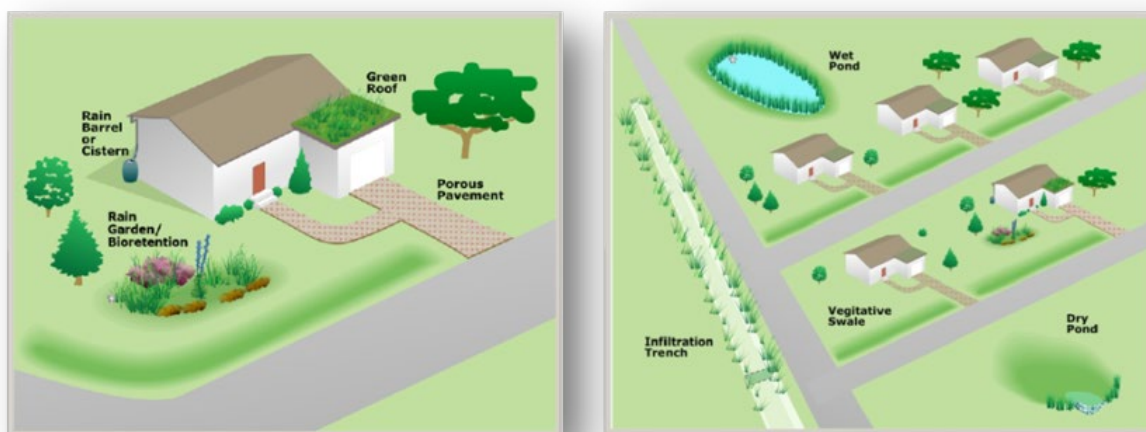


Figure 5-1. SUSTAIN figure illustrating GSI opportunities in watershed settings (USEPA 2009).

The SUSTAIN model was linked to the LSPC baseline hydrology model (**Section 3**) to simulate the combination of hydrology and the processes associated with GSI. The LSPC model was used to simulate the Critical Bacteria Storm as inputs to the SUSTAIN model. SUSTAIN was then used to simulate the GSI response in terms of stormwater capture, infiltration, and routing through the GSI project designs (e.g., underdrain or overflow). SUSTAIN was used to perform the analysis of alternative implementation scenarios and costs to determine cost-optimal solutions for City-wide management of the Critical Bacteria Storm associated with MRP areas (**Section 4.4**). **Figure 5-2** provides an overview of the linked LSPC-SUSTAIN modeling system and the approach for determining the amount of GSI needed to manage the Critical Bacteria Storm.

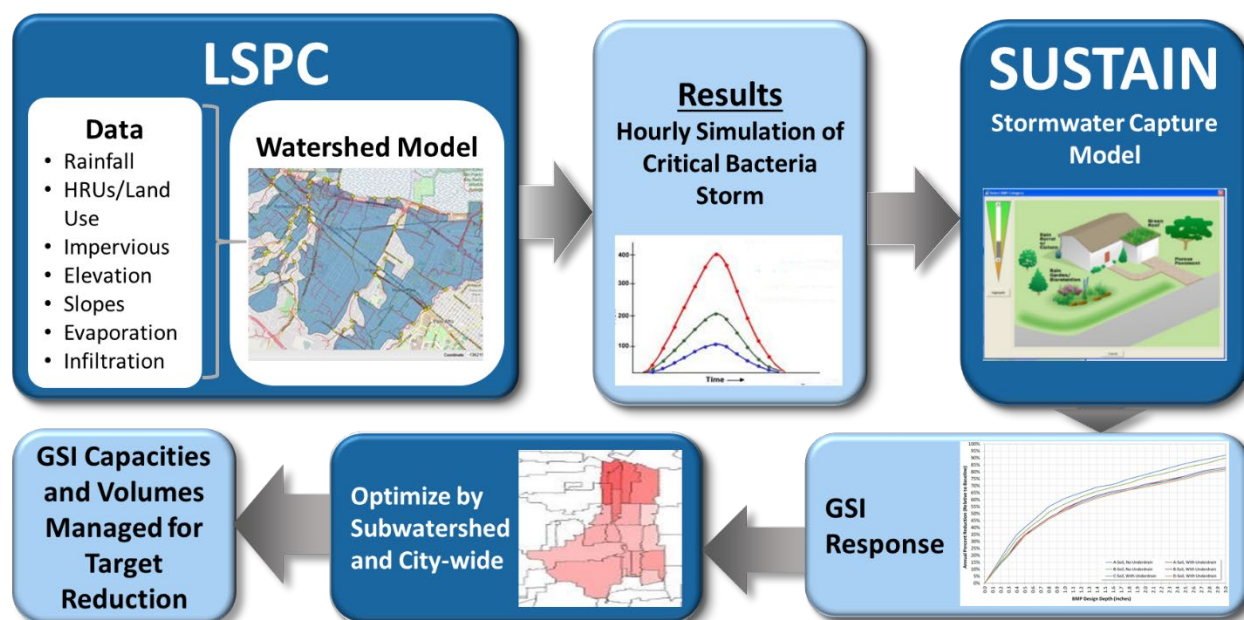


Figure 5-2. Linked modeling system supporting the RAA.

The above modeling system is consistent with the modeling approach currently used in the parallel RAA led by SCVURPPP (including the City) to address PCB and mercury load reductions to meet

requirements of the MRP (SCVURPPP 2018). This consistency will ensure that the GSI Plan meets the dual purpose of addressing FIB, PCBs, and mercury. The modeling approach is also consistent with the RAA for the Ballona Creek EWMP, and meets recommendations of both the Los Angeles RAA Guidelines and Bay Area RAA Guidelines.

The RAA modeling system currently does not account for FIB load reductions associated with nonstructural/source controls such as activities that address homeless encampments, public education, catch basin cleaning, etc. Since the FIB Load Reduction Standard is based on the capture of a Critical Bacteria Storm, FIB load reductions associated with nonstructural/source controls cannot usually be translated to a volume reduction target. However, through the adaptive management process discussed in **Section 7**, further study of the benefits of nonstructural/source controls in terms of FIB load reductions, in combination with the determination of a FIB load reduction target that is comparable to these benefits (i.e., focus on FIB loads instead of volume capture), may justify future updates of the RAA to better inform cost-effective BMP implementation including both GSI and nonstructural/source controls.

5.2 GSI Modeling Assumptions

The representation of GSI projects in the model is an important element of the RAA, as it provides the link between future GSI implementation, model-predicted water quality improvement, and, ultimately, address the FIB Load Reduction Standard. Since the GSI modeling parameters will greatly influence the outcome of the RAA, it is imperative that the suite of GSI assumptions are based on the best available data and represent the latest understanding in GSI project designs and effectiveness. Further, the technical rigor of the analysis must be appropriately balanced with the resolution of the modeling system and the accuracy of the key datasets.

The RAA utilizes GSI project opportunities identified in Chapter 6 of the GSI Plan to simulate the capture of the Critical Bacteria Storm and perform optimization to select the most cost-effective implementation strategy for the 2050 final schedule milestone. As depicted in **Figure 5-3**, the SUSTAIN optimization approach provides estimates GSI effectiveness, in terms of volumes reduced or managed, and costs to select the most cost-optimal combination of GSI projects to meet the FIB load reduction target. This section presents and reviews the following three primary elements for representing GSI projects in the RAA model:

- **Opportunity** – Where can the GSI projects be located and how many can be accommodated?
- **System Configuration** – How is the runoff routed to and through the GSI projects and what is the maximum GSI project size?
- **Cost Functions** – What is the relationship between GSI project volume/footprint/design elements and costs?

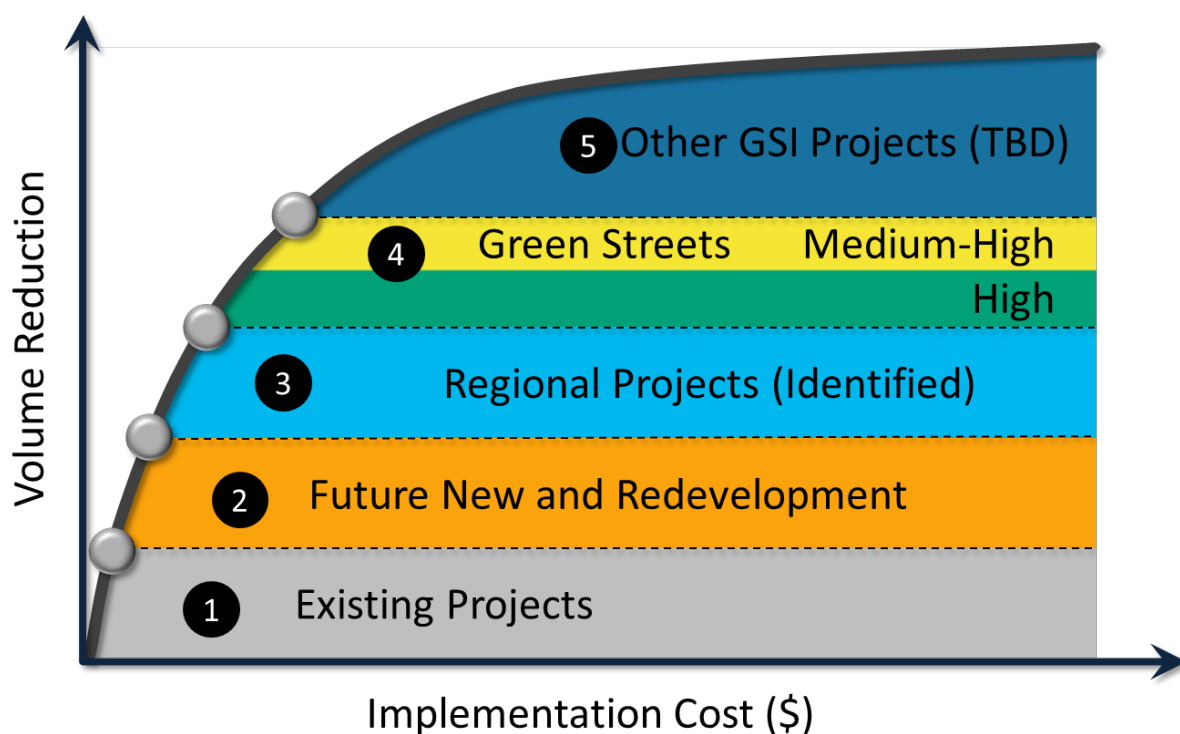


Figure 5-3. Overview of cost-optimization approach and sequencing of GSI projects.

5.2.1 GSI Project Opportunities

Chapter 6 of the GSI Plan identifies the long-term strategy to transition from a gray stormwater collection network to an integrated system that includes GSI. BMPs can only feasibly be implemented at certain locations in the watershed. While physical constraints may limit implementation in some areas (e.g., high slopes, insufficient space), practical or preferential constraints are also an important consideration (e.g., parcel ownership, redevelopment rates). To ensure that the spatial and temporal extent of GSI project opportunities were accurately accounted for in the model, the GSI Plan provided an opportunity assessment that was customized for each individual GSI project category and type. **Table 5-1** provides a summary of the categories of GSI projects included in the RAA, and assumptions in terms of the opportunities for each GSI project category as reported in the GSI Plan.

Table 5-1. Summary of GSI project opportunities included in the RAA.

GSI Project Category	GSI Type	Opportunity Identified
Existing Projects*	Low Impact Development (LID) and Green Streets	Chapter 6.2 of the GSI Plan identifies multiple existing and early implementation green street projects. Chapter 6.3 of the GSI Plan also identifies the “C.3 Regulated Projects” which includes GSI retrofits implemented under Provision C.3 of the MRP and reported on an annual basis to the SFBRWQCB (City of San José 2018). The combination of these projects represents the “Existing Projects” category in the RAA model.
Future New and Redevelopment	LID	As stated in Chapter 6.3 of the GSI Plan, Provision C.3 of the MRP (implemented through City Council Policy 6-29) requires new development and redevelopment projects that create and/or replace

GSI Project Category	GSI Type	Opportunity Identified
		defined amounts of impervious surface to implement post-construction control measures to address stormwater runoff generated on-site and comply with other applicable elements of the provision. The City worked with SCVURPPP to develop and apply a methodology, based on historic development trends and the City's General Plan, to predict the amount of land area that will be redeveloped in the City and for which stormwater runoff will be addressed via GSI installed on privately owned parcels from 2018 to 2050 (see Appendix F of the GSI Plan for more detail). For model configuration, these areas are assumed to include LID to capture stormwater runoff onsite.
Regional Projects (Identified)	Regional Projects	Chapter 6.4 of the GSI Plan identifies six priority regional projects for which concept designs were developed. These projects were configured in the RAA model to match their concept designs.
Green Streets	Green Streets	Chapter 6.5 of the GSI Plan presents prioritized green street opportunities throughout the City. These opportunities are subject to further investigations regarding the feasibility of GSI integration into streetscape improvement projects. For the RAA, the green street opportunities that prioritized in the GSI plan as "High" and "Medium-High" were included in the RAA model. Lower priority green streets are considered to be included in the below GSI Project Category for "Other GSI Projects (To Be Determined [TBD])."
Other GSI Projects (TBD)	LID, Green Streets, or Regional Projects	In the case that the above projects are insufficient to provide full capture of the Critical Bacteria Storm, or are determined to not be cost-efficient through the model optimization, an additional category of "Other GSI Projects (TBD)" was considered (see Chapter 6.6 of GSI Plan). This category serves as a placeholder to set goals in terms of needed storage capacity of GSI projects throughout the City, in addition to the above identified project opportunities. Further investigation can determine how these goals can be met, either through: (1) increased incentives for LID on private land or increased future development resulting in more C.3 Regulated Projects; (2) additional regional projects for which concept designs can be developed; and/or (3) additional green streets, possibly including lower prioritized green streets reported in Chapter 6.5 of the GSI Plan (i.e., "Medium," "Medium-Low," or "Low" prioritizations).

* The existing projects and associated acreage included in this category should be viewed as preliminary.

5.2.2 GSI Model Configuration

For each of the GSI type of projects outlined in **Table 5-1** (i.e., LID, green streets, regional projects), design and modeling assumptions were developed to represent the projects in SUSTAIN and simulate their effectiveness in terms of managing stormwater. The following provides a summary of the design and modeling assumptions for each GSI type.

5.2.2.1 Regional Projects

Regional projects can consist of both subsurface and above-ground systems that manage stormwater runoff through any combination of infiltration, filtration, and reuse. In the SUSTAIN model, both subsurface and above-ground systems are functionally the same and will use the same assumptions. Depending on specific site constraints, these facilities can capture stormwater diverted from adjacent channels or storm drains, which often results in greater captured drainage area compared to other GSI measures. Regional projects typically require a diversion structure and may require pumping, increasing capital and operation and maintenance (O&M) costs. Modeling assumptions for the six

identified regional projects in the GSI Plan were based on configurations outlined in each project's concept design (see Appendix C of the GSI Plan).

5.2.2.2 Green Streets

Green streets are implemented in public rights-of-way and typically capture runoff from the street and adjacent parcels. Green streets were represented in the model using bioretention either with or without an underdrain, depending on infiltration rates. The modeling assumptions for both the bioretention components of green streets are listed in **Table 5-2**.

The footprint for green street bioretention is estimated by assuming available length and width for GSI improvements. Fifty percent of the street segment length is assumed to be available for bioretention. The other 50 percent of length is assumed to be unavailable due to constraints like driveways, fire hydrants, and utilities. The available width for bioretention is assumed to be 8 feet (4 feet on each side of the street).

Bioretention consists of three components: a surface layer, a media layer, and an aggregate/underdrain layer. The surface layer is typically vegetated and provides storage through ponding and removal of runoff volume through evapotranspiration. The media layer typically consists of an engineered soil mixture designed to support plant growth and promote adequate infiltration. The media layer provides storage in pore space and pollutant reduction through filtration and plant root uptake. The media layer was assumed a minimum of 18 inches for bioretention (SCVURPPP 2016). The aggregate/underdrain layer provides additional storage in the aggregate pore space and was assumed 12 inches in depth. A perforated pipe underdrain was included when the native soil infiltration rate was less than 0.5 inches per hour. The underdrain was placed at the top of the aggregate layer to promote infiltration into native soil as conditions allow. Captured runoff that cannot be fully treated through infiltration was filtered through the media layer before being conveyed back to the storm drain system through the underdrain.

Underdrains are typically required for bioretention when the underlying soils have low infiltration below a specific threshold. In most of Santa Clara County, underdrains will generally be required unless exempted by the local jurisdiction on a case-by-case basis depending on soil permeability (SCVURPPP 2016). According to several regional design resources across the United States, underdrains should be included when underlying soils have an infiltration rate below 0.5 inches per hour (DOEE 2013; VA DEQ 2011; SF DPW Order No. 178,493). This value was used in the model to determine which projects include underdrains. The aggregate/underdrain layer was assumed to be 12 inches for bioretention (SCVURPPP 2016; SFPUC 2016). Underdrains are typically placed at the top of the aggregate/underdrain layer to maximize infiltration (BASMAA 2015; SCVURPPP 2016) and was the default configuration used by SUSTAIN.

Table 5-2. Modeling assumptions for green streets (bioretention).

Groups	Item Description	Value	Units	Source
Surface	Design Drainage Area	<i>Sized for runoff from 0.2 inches per hour intensity rainfall event</i>		[1] C.3.d.i.(2).(c) pg.22
	Footprint Length	<i>50% of street segment length</i>		[3] Appendix A
	Footprint Width	<i>8 ft (4 ft each side of street)</i>		[3] Appendix A
	Ponding Depth	6	in	[2] Section 6.1 pg.6-4
Media	Depth	18	in	[2] Section 6.1 pg.6-5
	Media Porosity	0.35	-	[3] Appendix A
	Media Infiltration Rate	5	in/hr	[1] C.3.c.i.(2).(c).(ii) pg.20
Aggregate/ Underdrain	Depth	12	in	[2] Section 6.1 pg.6-5, [3]
	Media Porosity	0.4	-	[3] Appendix A
	Native Soil Infiltration	<i>Match underlying soils</i>		
	Underdrain is used when native soil infiltration is less than	< 0.5	in/hr	SF DPW Order No. 178,493

[1] Reference: SFBWQCB 2015

[2] Reference: SCVURPPP 2016

[3] Reference: ULAR WMG 2016

5.2.2.3 Low Impact Development

LID treatment measures typically treat runoff generated onsite so the drainage area for LID is typically no larger than the parcel size. Although LID includes various design options for a given site, in order to develop a process for modeling of City-wide LID implementation (as a function of new and redevelopment), all LID features were represented in SUSTAIN as bioretention. The components for bioretention are discussed in **Section 5.2.2.2**. The modeling assumptions for LID are the same as bioretention for green streets with the exception of project footprint. The project footprint for LID is estimated using 4 percent of the parcel's impervious area, specified in the SCVURPPP C.3 Stormwater Handbook (SCVURPPP 2016). Modeling assumptions for LID are presented in **Table 5-3**.

Table 5-3. Modeling assumptions for LID (bioretention).

Groups	Item Description	Value	Units	Source
Surface	Design Drainage Area	<i>Sized for runoff from 0.2 inches per hour intensity rainfall event</i>		[1] C.3.d.i.(2).(c) pg.22
	Project Footprint	<i>4% of impervious drainage area</i>		[2] Section 6.1 pg.6-4
	Ponding Depth	6	in	[2] Section 6.1 pg.6-4
Media	Depth	18	in	[2] Section 6.1 pg.6-5
	Media Porosity	0.35	-	[3] Appendix A
	Media Infiltration Rate	5	in/hr	[1] C.3.c.i.(2).(c).(ii) pg.20
Aggregate/ Underdrain	Depth	12	in	[2] Section 6.1 pg.6-5, [3]
	Media Porosity	0.4	-	[3] Appendix A
	Native Soil Infiltration	<i>Match underlying soils</i>		
	Underdrain is used when native soil infiltration is less than	< 0.5	in/hr	SF DPW Order No. 178,493

[1] Reference: SFBWQCB 2015

[2] Reference: SCVURPPP 2016

[3] Reference: ULAR WMG 2016

5.2.3 GSI Cost Functions

To support GSI project optimization, cost functions were developed for each GSI type to relate capital costs to physical GSI project characteristics such as depth, footprint, and configuration. The cost functions are primarily based on EWMPs developed in the Los Angeles Region (Ballona Creek Watershed Management Group 2016, ULAR WMG 2016). There will be some uncertainty regarding the true costs pertaining to GSI projects implemented in the City of San José, but the relative costs between project types are well represented for the optimization of project types in the RAA. In other words, although it would not be recommended to use these cost functions for projections of City-wide implementation costs, these functions are sufficient for optimization and comparison of alternative implementation scenarios that can be used to select the most cost-effective strategy and combination of GSI to meet necessary pollutant reductions. The cost functions used for the SUSTAIN optimization analysis are listed in **Table 5-4**.

Table 5-4. GSI project cost functions for SUSTAIN cost-optimization.

Project Type	Project Subtype	Cost Estimate Formula (\$)	User inputs
Regional Project	Infiltration basin w/o pump station	$10.01 (A_f) + 100,013.76 (S) + 2.8 (V_m)$	S - Capacity A _f - Footprint area V _m - Media volume
	Infiltration basin w/ pump station	$10.01 (A_f) + 100,013.76 (S) + 2.8 (V_m) + 56,227 (P) + 1,207,736$	S - Capacity A _f - Footprint area V _m - Media volume P - Pumping rate
Green Streets	Bioretention w/ underdrain	$17.688 (A_f) + 94,307.4 (S) + 2.64 (V_m) + 10.367 (R)^2 (U)$	S - Bioretention capacity A _f - Bioretention area V _m - Media volume R - Underdrain radius U - Underdrain length
	Bioretention w/o underdrain	$9.438 (A_f) + 94,307.4 (S) + 2.64 (V_m)$	S - Bioretention capacity A _f - Bioretention area V _m - Media volume
Low Impact Development	Bioretention retrofit w/ underdrain	$17.688 (A_f) + 94,307.4 (S) + 2.64 (V_m) + 10.367 (R)^2 (U)$	S - Bioretention capacity A _f - Bioretention area V _m - Media volume R - Underdrain radius U - Underdrain length
	Bioretention retrofit w/o underdrain	$9.438 (A_f) + 94,307.4 (S) + 2.64 (V_m)$	S - Bioretention capacity A _f - Bioretention area V _m - Media volume

Units: S [ac-ft], V_m [ft³], A_f [ft²], P [cfs], R [ft], U [ft]

5.3 GSI Project Optimization and Selection

The SUSTAIN model provides a powerful tool for considering millions of scenarios for alternative combinations of GSI projects throughout the City and recommending a cost-effective solution to serve as implementation goals for the GSI Plan. The cost functions described in the previous subsection are used to weigh the cost of different BMP scenarios with benefits in terms of management of stormwater volumes. The optimization modeling is conducted stepwise to determine the GSI projects located throughout the City for cost-effective management of the Critical Bacteria Storm, as follows:

1. **Determine the cost-effective GSI solutions for each subwatershed in the City:** an example set of “GSI solutions” is shown in **Figure 5-4**, which shows thousands of scenarios considered for an individual subwatershed. The scenarios are based on the available opportunity (*e.g.*, the available footprints for regional projects and length of right-of-way for green streets) and predicted performance in terms of managing the Critical Bacteria Storm. The most cost-effective GSI solutions for each of the subwatersheds provide the basis for City-wide cost optimization. To streamline the optimization, the 348 LSPC model subwatersheds within the City (**Figure 3-4**) were grouped into smaller hydrologic sets for optimization (based on receiving waterbody) to help manage the number of possible GSI combinations searched. The optimized curves from those receiving water groups within the City were then used to develop the aggregate citywide curve (**Figure 5-5**).
2. **Determine the cost-effective scenario for the City:** by rolling up the GSI solutions from the subwatershed level to the City level, the most cost-effective scenario can be determined

for increasing levels of City-wide capture of the Critical Bacteria Storm. **Figure 5-5** shows the resulting cost optimization curve for the City. The optimization curve demonstrates the capacity of each type of GSI project (colored layers corresponding to “GSI Project Capacity (acre-ft) for the primary y-axis) and resulting model-estimated capital costs (black line corresponding to the secondary y-axis). As noted in **Section 5.2.3**, caution should be exercised in interpreting model-predicted capital costs, as those cost functions are meant for comparison of model scenarios and are not meant for projections of capital improvement costs for City-wide GSI implementation.

3. **Extract the cost-effective scenarios for 100% management of the Critical Bacteria Storm:** **Figure 5-6** illustrates the process for extracting the City-wide GSI implementation strategy, providing 100% management of the Critical Bacteria Storm, from the cost optimization curve. The extracted GSI Implementation Strategy comprises a detailed “implementation recipe” with the cost-optimized amount of each GSI type within each City subwatershed.

The resulting GSI Implementation Strategy to address the FIB Load Reduction Standard is presented in **Section 6**.

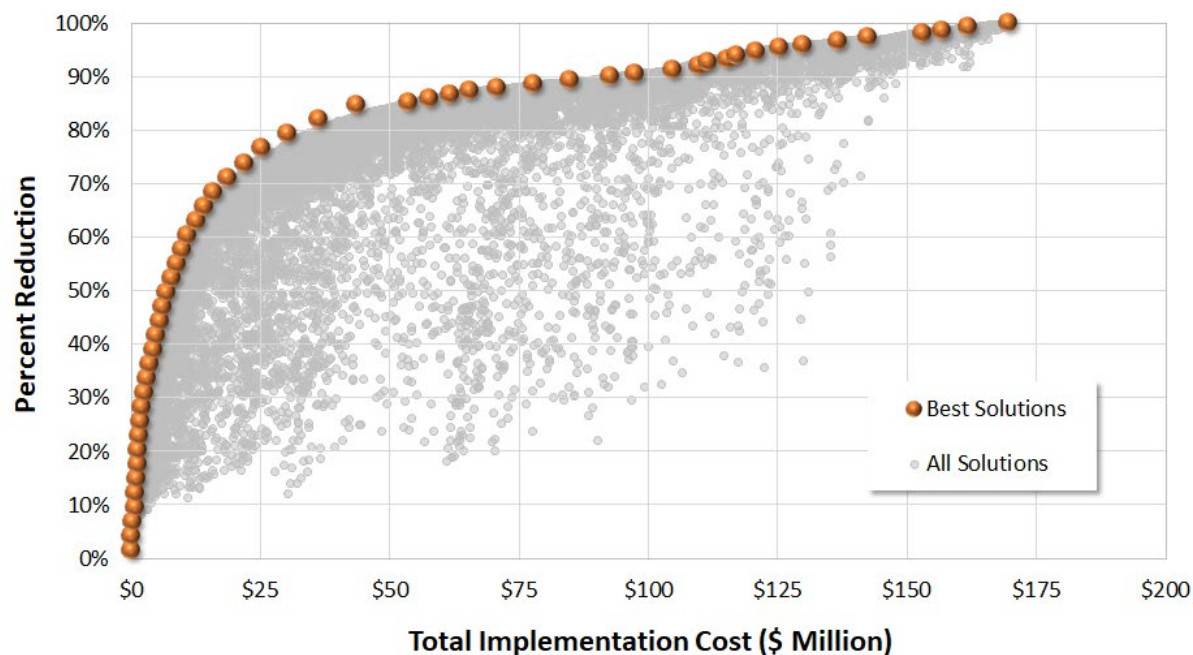


Figure 5-4. Example GSI solutions for a single subwatershed and the advantage of cost-benefit optimization.

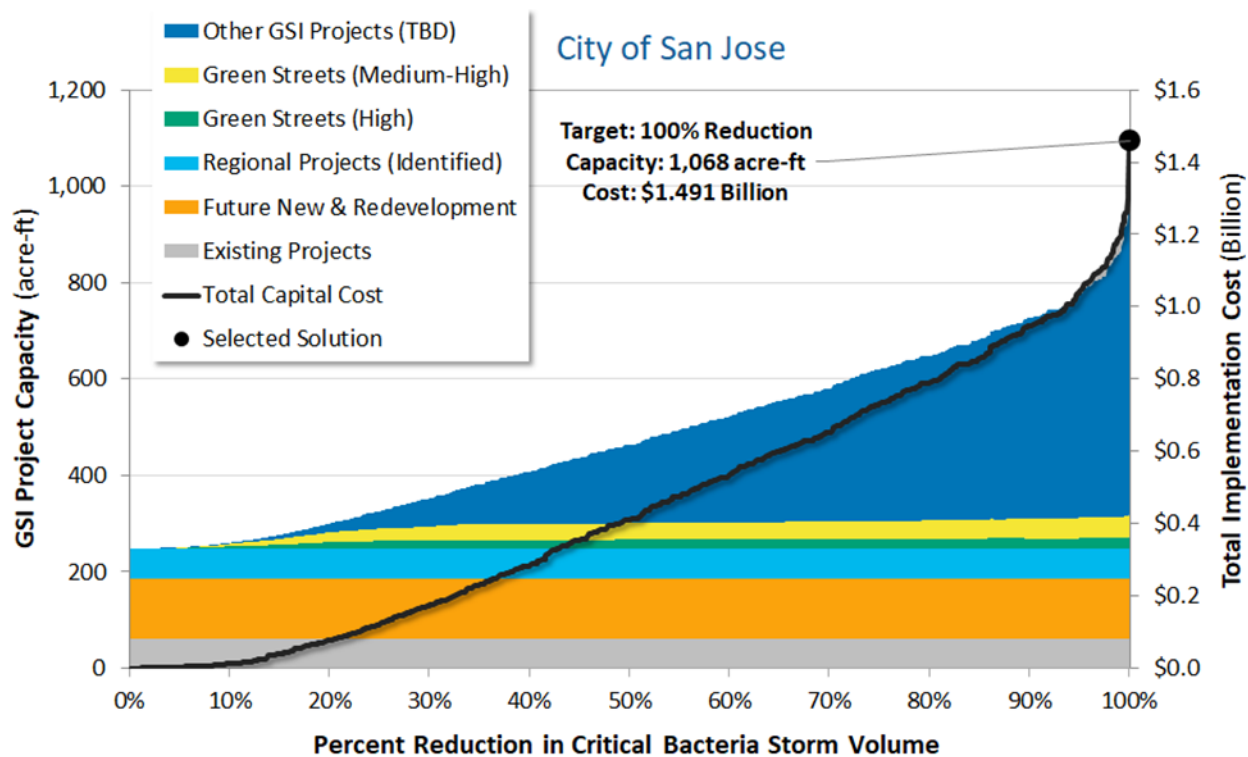


Figure 5-5. GSI optimization curve for the entire City of San José.

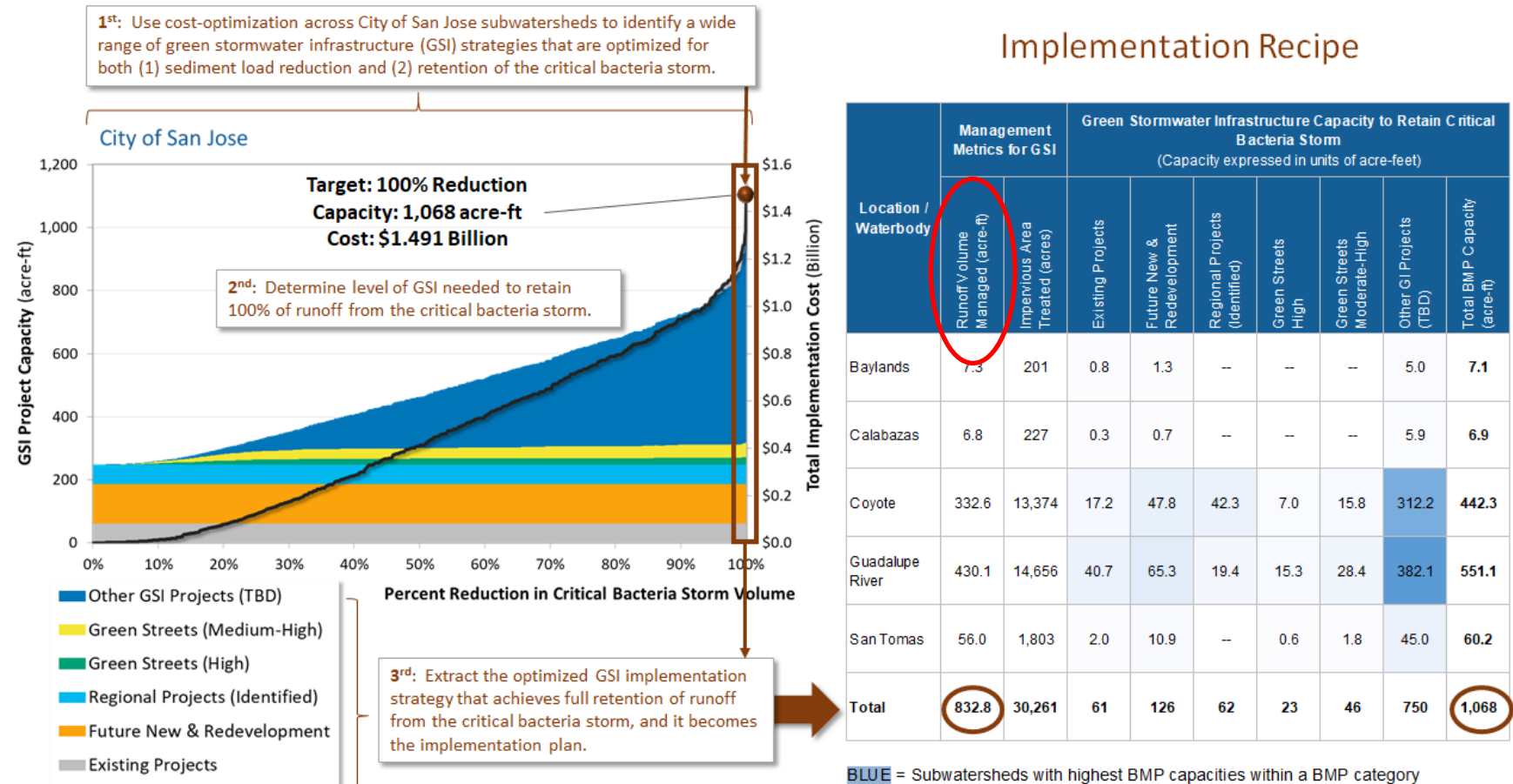


Figure 5-6. Relationship between RAA optimization curve and the GSI “implementation recipe” table for the City of San José.¹

¹ For the 1st step in the figure, sediment load reduction was considered in the optimization to ensure that Moderate-High green streets with lower infiltrating soils were properly utilized. With underdrain designs, these green streets can provide meaningful stormwater treatment, but rely less on full volume detention/infiltration. This ensures that the GSI Plan will provide a meaningful path for PCB and mercury load reductions that will likely focus on sediment capture. Without considering sediment, the optimization process would have selected GSI projects that only maximize volume capture, resulting in less green streets and more of the “Other GSI Projects (TBD).”

6 GSI IMPLEMENTATION STRATEGY

The GSI Implementation Strategy represents an “implementation recipe” for the City to address the FIB Load Reduction Standard via 100% management of the Critical Bacteria Storm. The GSI Implementation Strategy also provides the necessary prioritization of multibenefit projects, GSI, and LID to manage the Critical Bacteria Storm (considered the “limiting pollutant” as defined in the Consent Decree [US District Court, Northern District of California 2016] and the Los Angeles RAA Guidelines [LARWQCB 2014]). Through the RAA, a series of quantitative analyses were used to identify the capacities of existing projects, LID anticipated with new and redevelopment, regional projects identified with design concepts in the GSI Plan, green streets, and additional GSI projects (TBD) that comprise the GSI Implementation Strategy estimated to manage the Critical Bacteria Storm. The GSI Implementation Strategy includes individual, cost-optimized implementation recipes for each the City’s watersheds.

6.1 Elements of the GSI Implementation Strategy

The GSI Implementation Strategy is expressed in terms of (1) the volumes of stormwater to be managed spatially by GSI to address the Critical Bacteria Storm, (2) amount of impervious areas that GSI is planned to capture stormwater runoff, and (3) the amount of GSI that will be needed spatially to manage the stormwater volumes. The two primary elements of the GSI Implementation Strategy are as follows:

- **Implementation Goals:** in order to track implementation progress² over time, the primary metrics serving as goals for GSI implementation are (1) the volume³ of stormwater managed by implemented GSI projects, and (2) the amount of impervious area treated with GSI. To support future implementation and adaptive management, the performance metrics are reported along with the capacities of GSI to be implemented based on the GSI Implementation Strategy.
- **Implementation Recipe:** the network of GSI capacities that provides reasonable assurance of attainment of the FIB Load Reduction Standard is referred to as the Implementation Recipe. The identified GSI capacities (and GSI preferences) of the Implementation Recipe will likely evolve over the course of the implementation of the GSI Plan through an adaptive management process and in response to “lessons learned.” As such, it is anticipated the capacities specific to the various types of GSI will not be tracked explicitly. As GSI projects are substituted over the course of GSI Plan implementation (e.g., replace green street capacity in a subwatershed with additional regional project capacity), the City will show equivalency for achieving the corresponding Implementation Goals.

² The MRP requires the tracking of the implementation of GSI for GSI Plans addressing PCB and mercury load reductions. To provide consistency with those parallel tracking efforts, tracking metrics were also developed corresponding to FIB load reductions via similar metrics for stormwater volumes and/or impervious areas treated with GSI.

³ The reported volume is determined by estimating the amount of water that is retained (and/or infiltrated) by GSI over the course of a 24-hour period associated with the Critical Bacteria Storm. Additional volume would be *treated* by these BMPs, but that additional treatment is *implicit* to the reported volume. For the purposes of future tracking of GSI implementation, volumes metrics can be tracked in terms of the stormwater volumes that are either retained and/or treated to concentrations below WQOs for FIB.

6.2 Strategy to Address the FIB Load Reduction Standard by 2050

The GSI Implementation Strategy identifies the location and type of GSI projects within each the City's watersheds to address the FIB Load Reduction Standard by 2050. **Figure 6-1** is a map of the "density" of control measure capacities to address the FIB Load Reduction Standard by 2050. These results are also tabulated by major watersheds (**Figure 3-4**) within the City in **Table 6-1**. Those values are further broken down by each of the 348 modeled subwatershed in **Table 6-2** through **Table 6-6**, corresponding to GSI capacities presented in **Figure 6-2** through **Figure 6-6**. The tables present "Implementation Goals" for each subwatershed expressed as the volume of stormwater to be retained and the impervious area to be treated, along with the GSI capacities required to achieve those volume reductions ("Implementation Recipe").

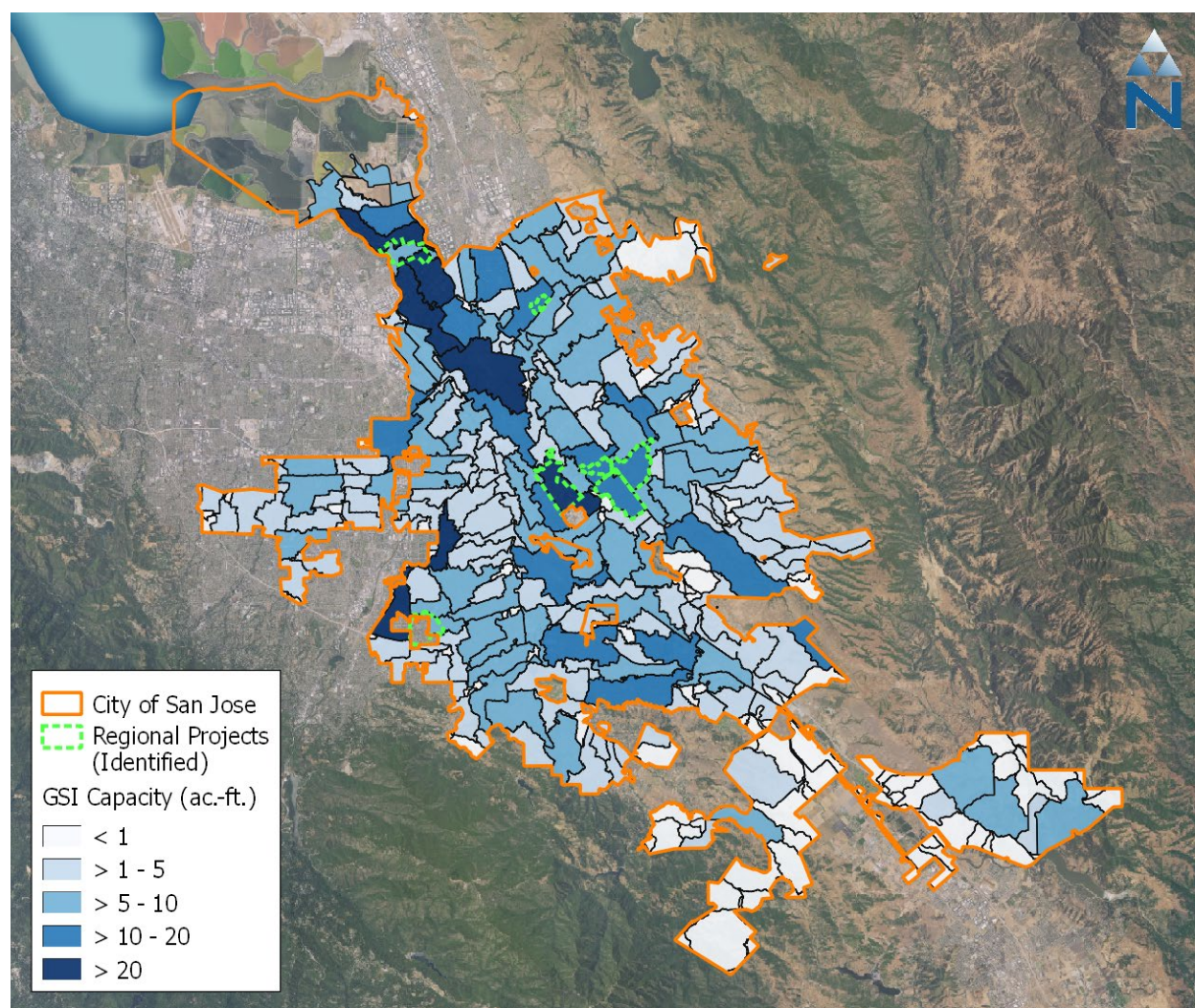


Figure 6-1. GSI Implementation Strategy by subwatershed in the City of San José.⁴

⁴ The figure presents the GSI Implementation Strategy as GSI "density" by subwatershed. The GSI density is higher in some areas [dark blue] because either (1) there were a number of GSI project opportunities identified in the GSI Plan, or (2) GSI in those areas were relatively cost-effective (e.g., due to high soil infiltration rates). The GSI capacities are normalized by area (i.e., the GSI capacity for each subwatershed [in units of acre-feet] was divided by the subwatershed area [in units of acres] to express the GSI capacity in units of depth [inches]).

Table 6-1. GSI Implementation Strategy for each watershed in the City of San José.

Location / Waterbody	Management Metrics for GSI		Green Stormwater Infrastructure Capacity to Retain Critical Bacteria Storm (Capacity expressed in units of acre-feet)						
	Runoff Volume Managed (acre-ft)	Impervious Area Treated (acres)	Existing Projects	Future New & Redevelopment	Regional Projects (Identified)	Green Streets High	Green Streets Moderate-High	Other GI Projects (TBD)	Total BMP Capacity (acre-ft)
Baylands	7.26	200.55	0.76	1.33	--	--	--	4.99	7.1
Calabazas	6.77	227.41	0.34	0.67	--	--	--	5.89	6.9
Coyote	332.58	13,373.61	17.21	47.81	42.27	7.02	15.77	312.20	442.3
Guadalupe River	430.15	14,656.22	40.70	65.28	19.38	15.28	28.38	382.13	551.1
San Tomas	56.00	1,803.01	1.98	10.85	--	0.55	1.82	44.97	60.2
Total	832.8	30,264	61	126	62	23	46	750	1,068

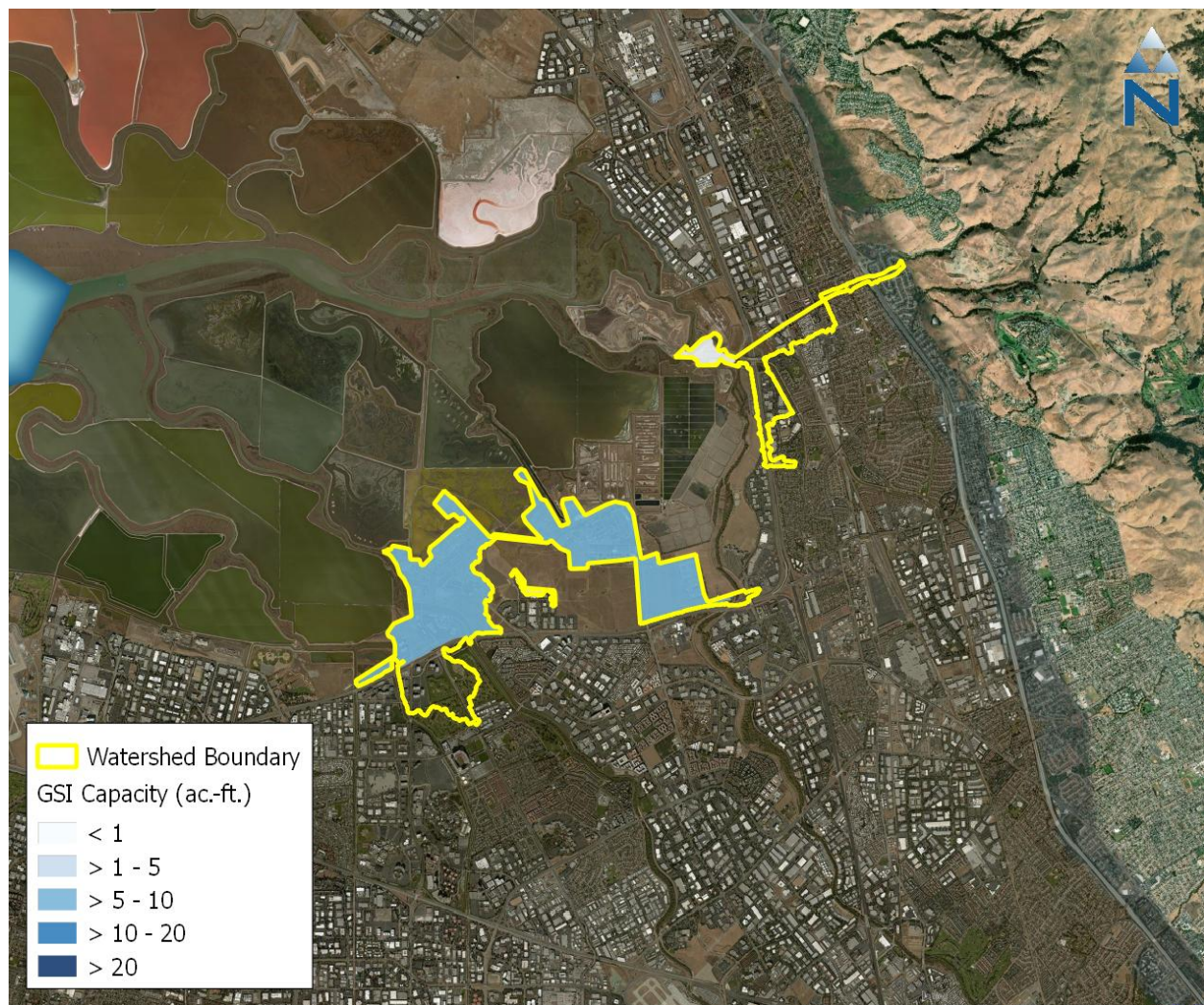


Figure 6-2. GSI Implementation Strategy by subwatershed for the City of San José portion of the Baylands.

Table 6-2 GSI Implementation Strategy by subwatershed for the City of San José portion of the Baylands.

Subwatershed ID	Management Metrics for GSI		Green Stormwater Infrastructure Capacity to Retain Critical Bacteria Storm (Capacity expressed in units of acre-feet)						
	Runoff Volume Managed (acre-ft)	Impervious Area Treated (acres)	Existing Projects	Future New & Redevelopment	Regional Projects (Identified)	Green Streets High	Green Streets Moderate-High	Other GI Projects (TBD)	Total BMP Capacity (acre-ft)
900302	6.74	185.17	0.76	0.88	--	--	--	4.68	6.3
900402	0.37	11.09	--	0.27	--	--	--	0.25	0.5
900502	0.14	4.29	--	0.18	--	--	--	0.06	0.2
Total	7.3	200.6	0.8	1.3	--	--	--	5.0	7.1

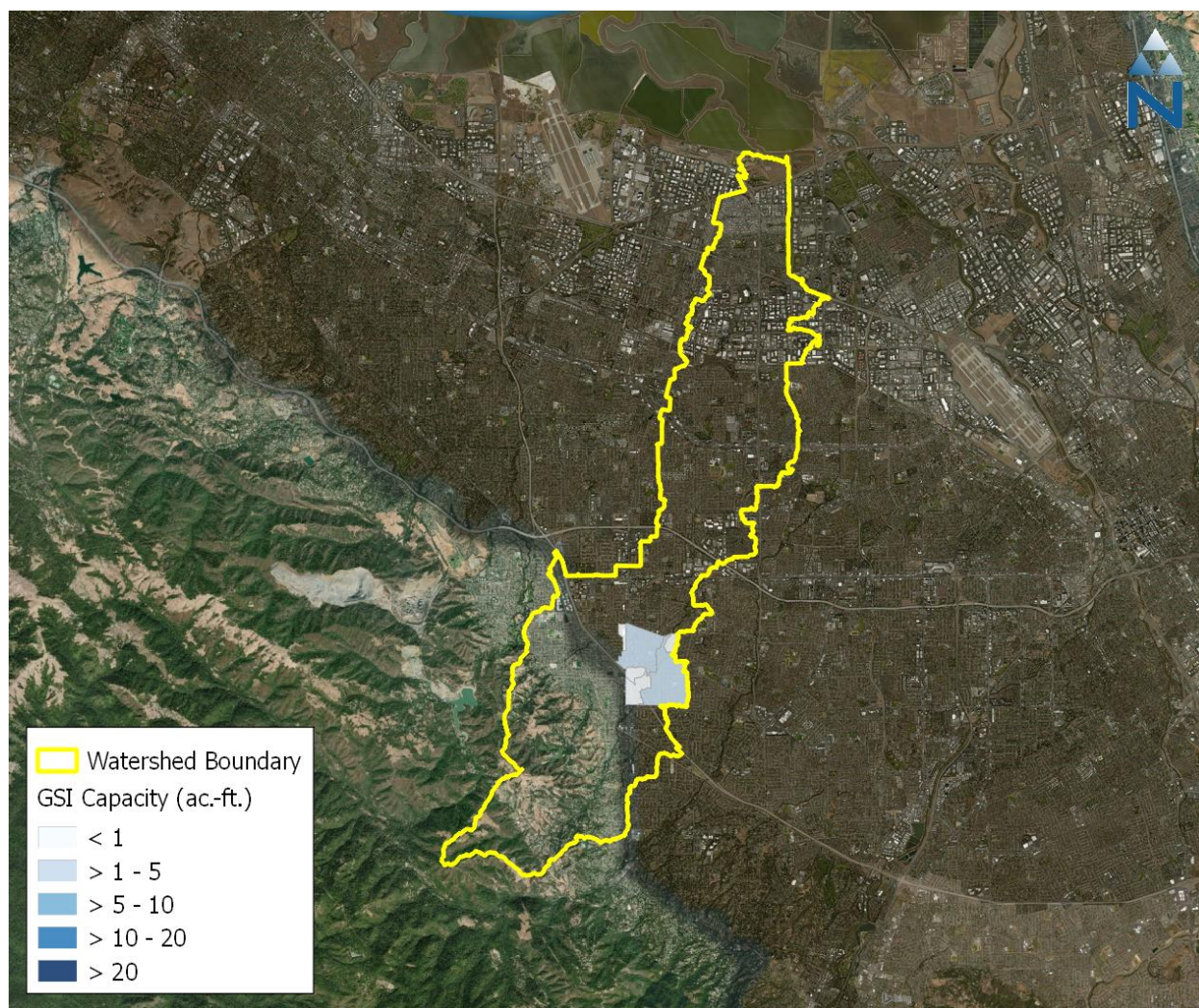


Figure 6-3. GSI Implementation Strategy by subwatershed for the City of San José portion of the Calabazas watershed.

Table 6-3. GSI Implementation Strategy by subwatershed for the City of San José portion of the Calabazas watershed.

Subwatershed ID	Management Metrics for GSI		Green Stormwater Infrastructure Capacity to Retain Critical Bacteria Storm (Capacity expressed in units of acre-feet)						
	Runoff Volume Managed (acre-ft)	Impervious Area Treated (acres)	Existing Projects	Future New & Redevelopment	Regional Projects (Identified)	Green Streets High	Green Streets Moderate-High	Other GI Projects (TBD)	Total BMP Capacity (acre-ft)
1300002	0.00	0.09	--	--	--	--	--	0.00	0.0
1301702	0.00	0.03	--	--	--	--	--	0.00	0.0

Subwatershed ID	Management Metrics for GSI		Green Stormwater Infrastructure Capacity to Retain Critical Bacteria Storm (Capacity expressed in units of acre-feet)						
	Runoff Volume Managed (acre-ft)	Impervious Area Treated (acres)	Existing Projects	Future New & Redevelopment	Regional Projects (Identified)	Green Streets High	Green Streets Moderate-High	Other GI Projects (TBD)	Total BMP Capacity (acre-ft)
1302002	0.43	12.12	0.02	0.15	--	--	--	0.29	0.5
1302102	0.22	8.27	--	--	--	--	--	0.22	0.2
1302202	2.32	65.13	0.29	0.45	--	--	--	1.61	2.4
1302302	0.41	15.34	0.01	0.07	--	--	--	0.41	0.5
1302402	0.96	35.73	0.02	--	--	--	--	0.95	1.0
1302902	2.42	90.70	--	--	--	--	--	2.41	2.4
Total	6.8	227.4	0.3	0.7	--	--	--	5.9	6.9

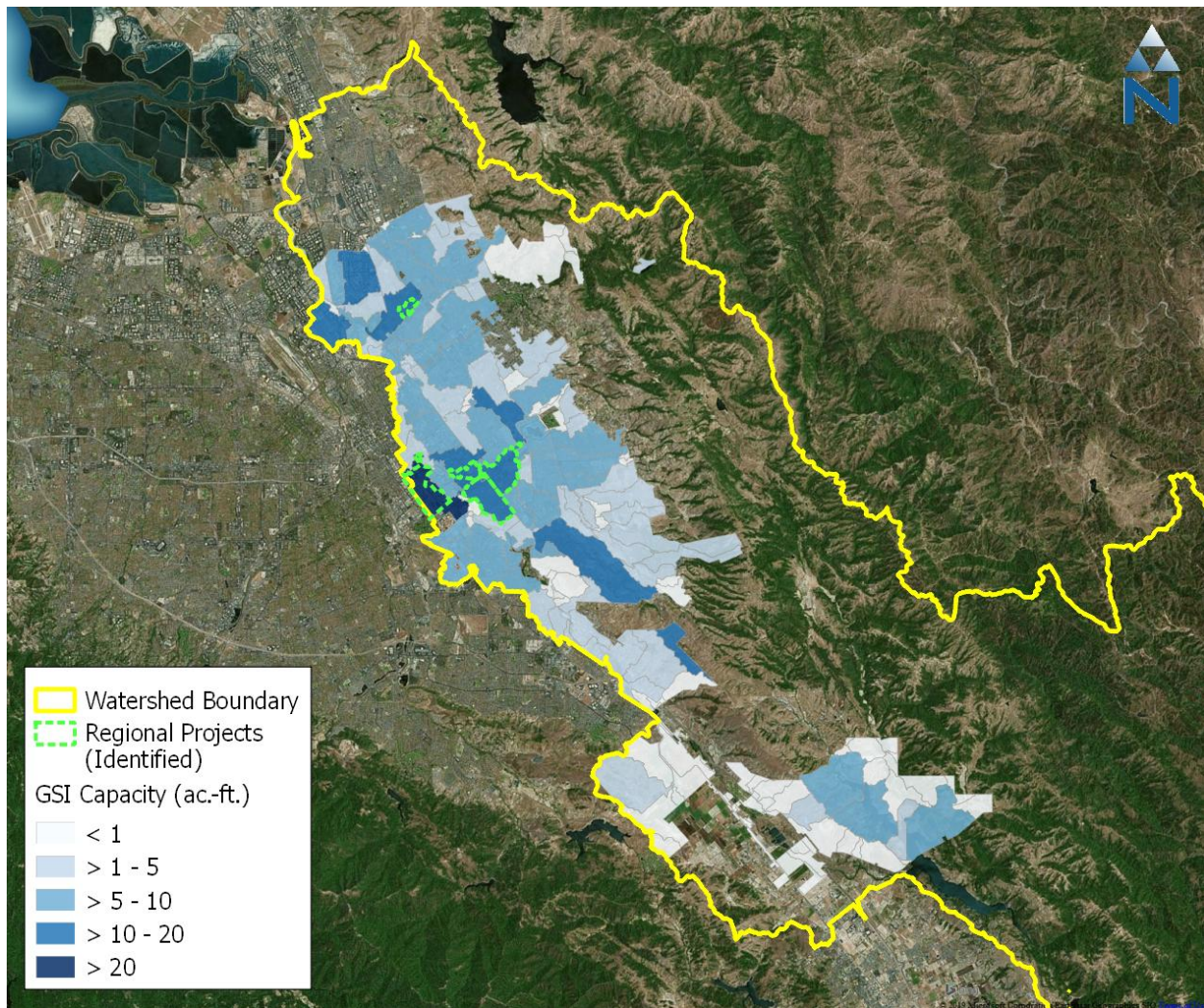


Figure 6-4. GSI Implementation Strategy by subwatershed for the City of San José portion of the Coyote watershed.

Table 6-4. GSI Implementation Strategy by subwatershed for the City of San José portion of the Coyote watershed.

Subwatershed ID	Management Metrics for GSI		Green Stormwater Infrastructure Capacity to Retain Critical Bacteria Storm (Capacity expressed in units of acre-feet)						
	Runoff Volume Managed (acre-ft)	Impervious Area Treated (acres)	Existing Projects	Future New & Redevelopment	Regional Projects (Identified)	Green Streets High	Green Streets Moderate-High	Other GI Projects (TBD)	Total BMP Capacity (acre-ft)
1001102	0.36	13.44	--	0.02	--	--	--	0.36	0.4
1001202	5.49	197.01	--	0.01	--	0.03	0.05	5.49	5.6

Subwatershed ID	Management Metrics for GSI		Green Stormwater Infrastructure Capacity to Retain Critical Bacteria Storm (Capacity expressed in units of acre-feet)						
	Runoff Volume Managed (acre-ft)	Impervious Area Treated (acres)	Existing Projects	Future New & Redevelopment	Regional Projects (Identified)	Green Streets High	Green Streets Moderate-High	Other GI Projects (TBD)	Total BMP Capacity (acre-ft)
1001302	0.14	4.89	--	--	--	--	--	0.13	0.1
1001402	1.53	43.38	--	--	--	0.17	0.10	1.06	1.3
1001602	0.01	0.01	--	--	--	--	--	0.01	0.0
1001702	2.95	84.55	--	--	--	0.13	0.39	2.05	2.6
1001802	6.82	192.05	0.01	0.05	--	0.39	0.89	4.73	6.1
1002202	0.00	0.43	--	--	--	--	--	0.00	0.0
1002402	9.85	262.45	1.20	7.03	--	--	--	4.37	12.6
1002502	0.18	5.73	--	0.28	--	--	--	0.04	0.3
1002602	8.14	229.68	0.12	0.22	--	0.26	0.47	5.65	6.7
1002702	3.87	145.10	0.12	0.28	--	--	0.08	3.86	4.3
1002802	5.29	154.94	0.83	1.70	--	--	--	3.67	6.2
1003002	1.15	74.94	--	2.40	--	0.03	0.17	0.28	2.9
1003102	9.91	319.32	0.87	8.47	--	0.44	0.71	4.40	14.9
1003202	0.47	11.31	0.23	0.07	--	--	--	0.20	0.5
1003302	3.21	89.88	0.71	0.21	--	0.07	0.03	2.22	3.2
1003402	3.43	98.03	0.57	3.02	--	--	0.00	1.52	5.1
1003502	1.60	44.77	0.05	1.66	--	0.25	--	0.40	2.4
1003602	1.08	26.85	--	0.62	--	0.30	--	0.27	1.2
1003702	3.76	115.51	1.15	2.23	--	0.18	0.11	1.67	5.3
1003802	1.12	32.96	0.18	0.48	--	--	0.02	0.77	1.5
1003902	1.14	30.94	0.13	0.83	--	--	--	0.50	1.5
1004002	5.26	368.29	1.03	2.13	--	0.06	0.76	3.65	7.6
1004102	4.77	377.30	1.23	0.70	--	0.24	0.75	3.31	6.2
1004202	2.34	169.96	0.09	0.12	--	0.10	0.42	1.62	2.4
1004302	0.20	19.22	--	0.00	--	--	--	0.19	0.2
1004402	2.64	184.65	0.39	1.04	--	0.40	0.02	1.83	3.7
1004502	1.92	121.31	0.15	0.51	--	0.02	0.30	1.33	2.3
1004602	0.71	50.77	0.15	0.05	--	--	0.12	0.49	0.8
1004702	1.61	60.06	0.02	--	--	--	--	1.60	1.6
1004902	0.00	--	--	--	--	--	--	0.00	0.0
1005002	4.78	170.65	--	--	--	0.04	0.34	4.78	5.2
1005102	0.68	25.40	0.01	--	--	--	0.01	0.68	0.7
1005202	0.13	4.51	--	--	--	--	--	0.12	0.1

Subwatershed ID	Management Metrics for GSI		Green Stormwater Infrastructure Capacity to Retain Critical Bacteria Storm (Capacity expressed in units of acre-feet)						
	Runoff Volume Managed (acre-ft)	Impervious Area Treated (acres)	Existing Projects	Future New & Redevelopment	Regional Projects (Identified)	Green Streets High	Green Streets Moderate-High	Other GI Projects (TBD)	Total BMP Capacity (acre-ft)
1005302	0.75	28.23	--	--	--	--	--	0.75	0.8
1005402	1.40	52.31	--	--	--	--	--	1.39	1.4
1005502	1.31	49.23	0.01	--	--	--	--	1.31	1.3
1005602	6.32	237.81	0.05	0.05	--	--	--	6.32	6.4
1005702	0.36	13.47	0.03	--	--	--	--	0.36	0.4
1005802	0.07	285.78	0.06	--	0.02	--	--	8.32	8.4
1005902	0.00	0.01	--	--	--	--	--	0.00	0.0
1006002	0.09	44.30	0.08	--	0.03	--	--	1.18	1.3
1006102	5.89	221.16	0.00	0.81	--	--	0.09	5.88	6.8
1006202	0.06	234.82	0.01	0.06	0.02	--	0.39	6.27	6.8
1006302	7.59	285.45	0.24	0.43	--	--	--	7.59	8.3
1006402	2.14	80.10	0.11	--	--	--	--	2.13	2.2
1006502	1.24	46.19	0.01	0.15	--	--	--	1.23	1.4
1006602	3.74	138.25	0.04	0.13	--	0.04	0.23	3.73	4.2
1006702	1.07	40.27	--	--	--	--	--	1.07	1.1
1006802	0.64	24.08	0.01	--	--	--	--	0.64	0.6
1006902	0.44	16.56	--	--	--	--	--	0.44	0.4
1007002	2.10	78.93	0.04	--	--	--	--	2.10	2.1
1007102	2.19	82.41	--	--	--	--	--	2.19	2.2
1007202	0.29	10.86	0.03	--	--	--	--	0.29	0.3
1007302	0.74	27.34	0.01	--	--	--	--	0.73	0.7
1007402	1.25	46.27	--	--	--	--	--	1.24	1.2
1007502	3.25	120.84	--	--	--	--	--	3.24	3.2
1007602	1.55	58.26	--	0.24	--	--	--	1.55	1.8
1007702	4.23	158.77	--	0.41	--	--	--	4.22	4.6
1007802	6.86	192.56	0.12	0.28	--	0.04	0.66	4.76	5.9
1007902	0.10	2.93	--	0.04	--	--	--	0.06	0.1
1008002	0.19	7.10	--	0.10	--	--	0.02	0.19	0.3
1008102	0.01	315.79	0.05	0.11	0.01	0.24	1.09	10.06	11.6
1008202	0.13	9.01	0.02	0.10	--	--	--	0.08	0.2
1008302	0.44	444.22	0.01	0.21	0.16	0.11	0.42	5.03	5.9
1008402	1.47	116.56	0.59	0.19	--	0.20	0.24	1.01	2.2
1008502	0.19	8.23	0.02	--	--	--	0.01	0.08	0.1

Subwatershed ID	Management Metrics for GSI		Green Stormwater Infrastructure Capacity to Retain Critical Bacteria Storm (Capacity expressed in units of acre-feet)						
	Runoff Volume Managed (acre-ft)	Impervious Area Treated (acres)	Existing Projects	Future New & Redevelopment	Regional Projects (Identified)	Green Streets High	Green Streets Moderate-High	Other GI Projects (TBD)	Total BMP Capacity (acre-ft)
1008602	5.75	173.43	0.46	1.03	--	0.02	0.30	3.99	5.8
1008702	1.75	46.06	0.09	0.01	--	--	0.01	1.21	1.3
1008802	7.89	225.63	0.45	0.01	--	0.35	0.87	5.47	7.2
1008902	0.08	127.36	0.06	0.07	0.08	0.13	0.22	3.94	4.5
1009002	22.08	554.08	0.35	0.98	23.03	0.03	0.78	18.69	43.9
1009102	7.03	360.21	0.00	0.00	6.32	--	--	9.57	15.9
1009202	0.03	13.54	--	--	0.02	--	--	0.36	0.4
1009302	4.01	108.53	1.07	1.73	--	0.06	0.73	1.78	5.4
1009402	0.00	0.13	--	--	--	--	--	0.00	0.0
1009502	0.07	65.24	0.00	--	0.05	0.17	0.07	1.98	2.3
1009602	5.20	191.92	0.01	--	--	0.48	0.15	5.19	5.8
1009702	0.86	31.91	--	--	--	--	--	0.86	0.9
1009802	0.30	10.83	--	--	--	--	0.06	0.29	0.4
1009902	0.33	11.55	--	--	--	--	0.11	0.32	0.4
1010002	0.24	8.65	--	--	--	--	0.00	0.23	0.2
1010102	3.64	136.94	--	--	--	--	--	3.64	3.6
1010202	0.42	10.92	--	--	--	--	0.07	0.29	0.4
1010302	1.16	42.86	--	0.22	--	--	0.22	1.15	1.6
1010402	1.53	57.11	0.01	0.20	--	--	--	1.52	1.7
1010502	2.39	66.42	0.17	0.56	--	0.54	0.90	1.06	3.2
1010602	2.82	92.66	0.21	0.32	--	0.01	0.04	2.82	3.4
1010702	1.30	47.68	--	--	--	--	--	1.30	1.3
1010802	1.33	49.65	--	--	--	--	--	1.32	1.3
1010902	0.34	8.65	--	--	--	--	--	0.23	0.2
1011002	0.14	4.89	--	--	--	--	--	0.13	0.1
1011102	0.84	30.65	--	--	--	--	--	0.83	0.8
1011202	0.00	0.01	--	--	--	--	--	0.00	0.0
1011302	0.74	27.34	--	--	--	--	--	0.73	0.7
1011402	0.80	29.61	--	--	--	--	--	0.79	0.8
1011502	1.78	64.92	0.02	--	--	--	--	1.77	1.8
1011602	0.10	3.72	--	--	--	--	--	0.10	0.1
1011702	0.49	18.43	--	--	--	--	--	0.49	0.5
1012002	0.00	0.08	--	--	--	--	--	0.00	0.0

Subwatershed ID	Management Metrics for GSI		Green Stormwater Infrastructure Capacity to Retain Critical Bacteria Storm (Capacity expressed in units of acre-feet)						
	Runoff Volume Managed (acre-ft)	Impervious Area Treated (acres)	Existing Projects	Future New & Redevelopment	Regional Projects (Identified)	Green Streets High	Green Streets Moderate-High	Other GI Projects (TBD)	Total BMP Capacity (acre-ft)
1012102	0.22	8.28	--	--	--	--	--	0.22	0.2
1012302	0.17	6.39	--	--	--	--	--	0.17	0.2
1012402	0.03	0.75	--	--	--	--	--	0.02	0.0
1012602	0.49	17.61	--	--	--	--	--	0.48	0.5
1012702	0.05	1.50	--	--	--	--	--	0.04	0.0
1012802	0.04	1.13	--	--	--	--	--	0.03	0.0
1012902	0.11	4.12	--	--	--	--	--	0.11	0.1
1013002	0.39	14.16	--	--	--	--	--	0.39	0.4
1013102	0.02	0.38	--	--	--	--	--	0.01	0.0
1013202	0.01	0.21	--	--	--	--	--	0.01	0.0
1013302	0.57	21.42	--	--	--	--	--	0.57	0.6
1013402	0.33	12.37	--	--	--	--	--	0.33	0.3
1013902	0.04	1.29	--	--	--	--	--	0.04	0.0
1014002	0.09	3.29	--	--	--	--	--	0.09	0.1
1014102	0.01	0.25	--	--	--	--	--	0.01	0.0
1014202	0.17	6.38	--	--	--	--	--	0.17	0.2
1014302	0.01	0.37	--	--	--	--	--	0.01	0.0
1014402	1.26	47.06	--	--	--	--	--	1.26	1.3
1014502	0.38	14.15	--	--	--	--	--	0.38	0.4
1014602	0.06	2.07	--	--	--	--	--	0.06	0.1
1014802	0.17	6.38	--	--	--	--	--	0.17	0.2
1014902	0.03	0.69	--	--	--	--	--	0.02	0.0
1015002	0.64	22.35	--	--	--	--	--	0.63	0.6
1015102	0.42	7.46	--	--	--	--	--	0.29	0.3
1015202	4.30	76.53	--	--	--	--	--	2.98	3.0
1015302	0.76	19.50	--	--	--	--	--	0.76	0.8
1015402	9.31	242.98	--	--	--	--	--	9.30	9.3
1015502	6.75	175.23	--	--	--	--	--	6.74	6.7
1015602	0.01	0.21	--	--	--	--	--	0.01	0.0
1015702	0.00	0.05	--	--	--	--	--	0.00	0.0
1015802	0.00	0.00	--	--	--	--	--	0.00	0.0
1015902	0.00	--	--	--	--	--	--	0.00	0.0
1016502	0.00	--	--	--	--	--	--	0.00	0.0

Subwatershed ID	Management Metrics for GSI		Green Stormwater Infrastructure Capacity to Retain Critical Bacteria Storm (Capacity expressed in units of acre-feet)						
	Runoff Volume Managed (acre-ft)	Impervious Area Treated (acres)	Existing Projects	Future New & Redevelopment	Regional Projects (Identified)	Green Streets High	Green Streets Moderate-High	Other GI Projects (TBD)	Total BMP Capacity (acre-ft)
1017802	0.00	--	--	--	--	--	--	--	0.0
1017902	0.00	--	--	--	--	--	--	--	0.0
1018002	0.00	--	--	--	--	--	--	0.00	0.0
1018102	0.00	0.01	--	--	--	--	--	0.00	0.0
1018402	0.00	0.08	--	--	--	--	--	0.00	0.0
1018602	0.16	3.85	--	--	--	--	--	0.15	0.2
1018702	6.46	165.52	--	--	--	--	--	6.45	6.5
1018802	0.00	--	--	--	--	--	--	0.00	0.0
1019102	0.00	--	--	--	--	--	--	0.00	0.0
1019202	0.01	0.25	--	--	--	--	--	0.01	0.0
1026902	0.53	19.41	--	--	--	--	--	0.53	0.5
1027002	0.18	6.44	--	--	--	--	--	0.18	0.2
1027102	1.77	63.57	0.02	--	--	0.06	--	1.77	1.9
1027202	10.29	384.50	0.02	--	--	--	--	10.28	10.3
1027302	0.39	14.68	--	--	--	--	--	0.39	0.4
1027402	7.11	220.31	0.64	2.61	--	0.18	0.35	4.94	8.7
1027502	8.84	332.56	0.19	0.73	--	--	0.07	8.84	9.8
1027602	0.03	123.60	0.41	0.46	0.03	0.58	0.61	3.90	6.0
1027702	23.00	699.06	0.21	0.07	8.71	0.01	0.25	8.39	17.6
1027802	0.39	230.26	1.23	0.51	0.15	0.09	0.39	2.80	5.2
1027902	2.22	49.53	0.00	0.11	--	0.40	0.12	1.53	2.2
1028002	1.79	50.10	--	--	--	0.07	0.03	1.24	1.3
1028102	0.97	34.31	--	--	--	--	--	0.96	1.0
1028202	0.01	0.14	--	--	--	--	--	0.01	0.0
1028302	2.17	38.49	--	--	--	--	--	1.50	1.5
1028502	0.01	--	--	--	--	--	--	0.01	0.0
1029402	9.33	392.35	0.80	0.75	3.64	0.10	0.53	12.28	18.1
Total	332.6	13,373.61	17.2	47.8	42.3	7.0	15.8	312.2	442.3

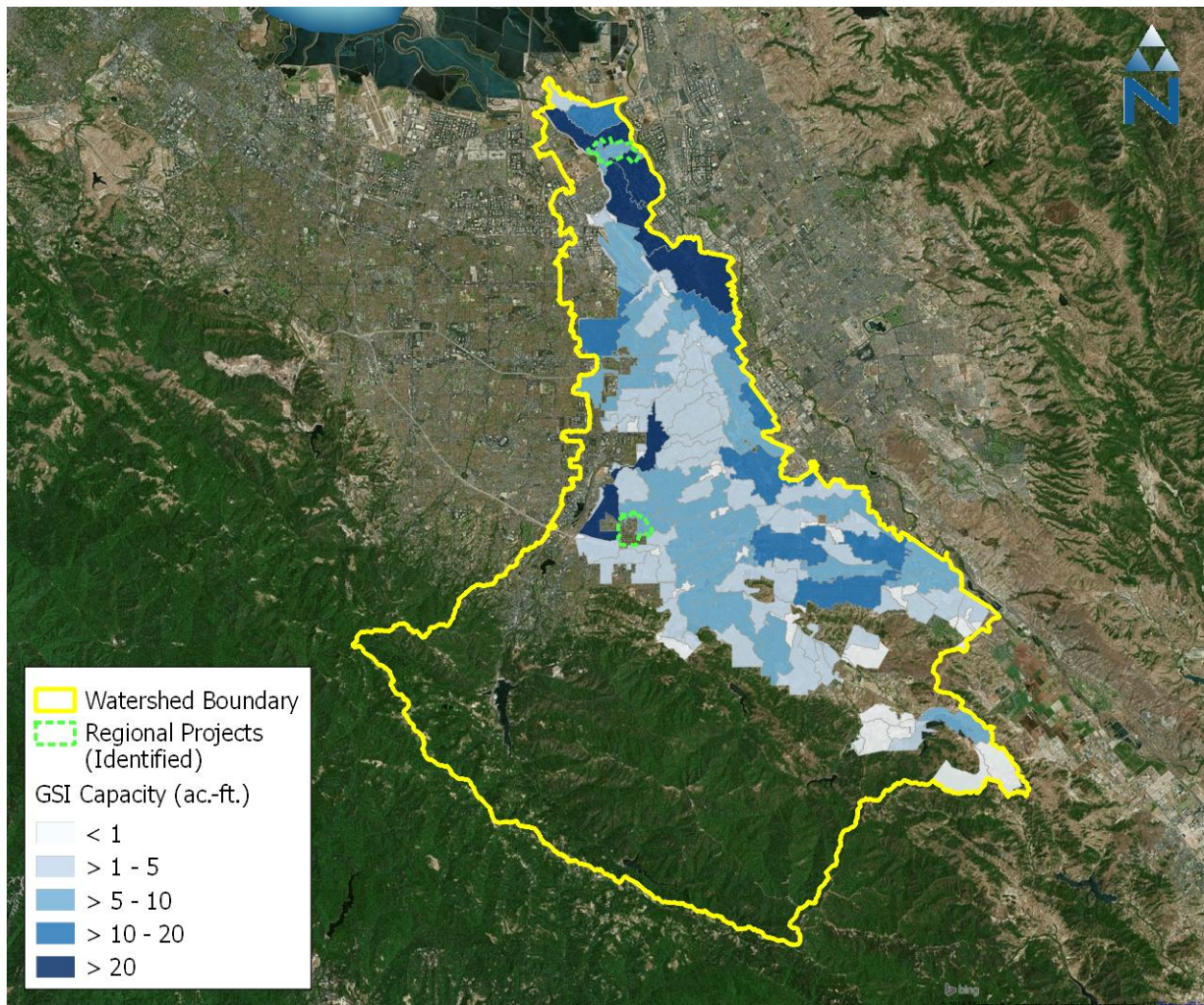


Figure 6-5. GSI Implementation Strategy by subwatershed for the City of San José portion of the Guadalupe River watershed.

Table 6-5. GSI Implementation Strategy by subwatershed for the City of San José portion of the Guadalupe River watershed.

Subwatershed ID	Management Metrics for GSI		Green Stormwater Infrastructure Capacity to Retain Critical Bacteria Storm (Capacity expressed in units of acre-feet)						
	Runoff Volume Managed (acre-ft)	Impervious Area Treated (acres)	Existing Projects	Future New & Redevelopment	Regional Projects (Identified)	Green Streets High	Green Streets Moderate-High	Other GI Projects (TBD)	Total BMP Capacity (acre-ft)
1100002	2.11	59.73	0.82	1.60	--	--	--	0.93	3.4
1100102	3.90	469.96	1.73	4.17	1.15	--	--	14.72	21.8

Subwatershed ID	Management Metrics for GSI		Green Stormwater Infrastructure Capacity to Retain Critical Bacteria Storm						
	Runoff Volume Managed (acre-ft)	Impervious Area Treated (acres)	(Capacity expressed in units of acre-feet)						
			Existing Projects	Future New & Redevelopment	Regional Projects (Identified)	Green Streets High	Green Streets Moderate-High	Other GI Projects (TBD)	Total BMP Capacity (acre-ft)
1100202	7.81	240.72	1.76	4.02	--	--	--	5.42	11.2
1100302	0.08	1.90	--	0.01	--	--	--	0.05	0.1
1100402	0.03	1.88	--	--	0.01	--	--	0.05	0.1
1100502	0.00	0.00	--	--	--	--	--	0.00	0.0
1100602	0.08	1.90	0.02	0.01	--	--	--	0.05	0.1
1100702	0.31	11.29	--	--	--	--	--	0.30	0.3
1100802	0.06	1.53	--	0.01	--	--	--	0.04	0.0
1100902	1.91	58.29	0.89	0.37	--	--	--	1.32	2.6
1101002	0.09	2.59	0.03	0.10	--	--	--	0.06	0.2
1101102	6.06	173.94	2.23	--	--	--	--	4.21	6.4
1101202	3.04	83.63	0.32	0.29	--	--	--	2.11	2.7
1101302	9.89	371.74	1.22	0.32	--	--	0.15	9.88	11.6
1101402	1.01	37.65	--	--	--	--	0.01	1.00	1.0
1101502	6.65	250.11	0.19	0.39	--	--	0.14	6.65	7.4
1101602	0.16	3.76	--	--	--	--	--	0.10	0.1
1101702	4.52	122.90	0.40	0.35	--	--	0.14	3.13	4.0
1101802	0.02	0.38	--	--	--	--	--	0.01	0.0
1101902	6.49	191.34	1.75	1.56	--	--	0.05	4.50	7.9
1102002	3.91	124.97	1.25	0.90	--	0.00	0.12	2.71	5.0
1102102	4.32	129.57	0.71	1.26	--	0.04	0.08	3.00	5.1
1102202	2.90	85.68	0.90	1.19	--	0.03	0.37	1.28	3.8
1102302	9.37	274.82	0.32	1.51	--	0.55	1.06	6.50	9.9
1102402	3.54	69.59	0.50	0.58	--	0.53	0.14	1.57	3.3
1102502	0.13	553.22	0.27	0.73	0.03	1.97	1.33	16.92	21.3
1102602	3.39	89.38	--	0.76	--	0.89	--	2.35	4.0
1102702	1.86	67.69	--	0.04	--	0.11	--	1.86	2.0
1102802	0.01	0.35	--	--	--	--	--	0.01	0.0
1102902	0.91	27.09	--	0.33	--	0.04	0.13	0.63	1.1
1103002	0.24	8.94	0.03	--	--	--	--	0.24	0.3
1107302	0.82	21.59	--	0.04	--	--	--	0.57	0.6
1107402	2.61	77.67	0.34	1.09	--	--	--	1.81	3.2
1107502	3.33	88.66	0.04	0.24	--	--	0.21	2.31	2.8
1107602	0.02	0.75	--	0.00	--	--	--	0.02	0.0

Subwatershed ID	Management Metrics for GSI		Green Stormwater Infrastructure Capacity to Retain Critical Bacteria Storm						
	Runoff Volume Managed (acre-ft)	Impervious Area Treated (acres)	(Capacity expressed in units of acre-feet)						
			Existing Projects	Future New & Redevelopment	Regional Projects (Identified)	Green Streets High	Green Streets Moderate-High	Other GI Projects (TBD)	Total BMP Capacity (acre-ft)
1107702	2.86	80.13	0.34	0.56	--	--	--	1.98	2.9
1107802	1.28	169.11	0.68	1.18	1.33	0.13	0.42	5.37	9.1
1107902	0.94	184.38	2.09	1.54	0.97	0.13	0.95	5.73	11.4
1108002	7.35	226.27	0.64	0.47	--	1.07	1.00	5.10	8.3
1108102	2.05	77.13	--	0.03	--	--	--	2.05	2.1
1108202	4.02	116.77	0.06	--	--	0.47	0.09	2.79	3.4
1108302	1.36	40.74	0.03	0.42	--	0.09	0.21	0.94	1.7
1108402	4.06	114.31	0.02	--	--	0.31	0.61	2.82	3.8
1108502	1.58	46.20	0.09	0.04	--	0.15	0.02	1.09	1.4
1108602	2.64	64.05	0.32	--	--	0.06	0.07	1.83	2.3
1108702	3.57	103.21	0.01	--	--	0.45	0.47	2.47	3.4
1108802	0.06	1.46	0.01	--	--	--	--	0.04	0.1
1108902	1.42	38.32	--	--	--	0.14	0.40	0.98	1.5
1109002	0.18	4.11	--	--	--	0.03	0.05	0.12	0.2
1109102	6.40	187.30	0.46	0.13	--	0.47	1.50	4.44	7.0
1109202	3.32	88.92	--	0.11	--	0.78	0.56	2.30	3.8
1109302	0.46	159.97	0.08	0.56	0.13	0.00	0.67	5.20	6.6
1109402	0.59	15.85	--	--	--	0.03	0.09	0.40	0.5
1109502	2.29	59.84	--	--	--	--	0.36	1.59	2.0
1109602	5.09	191.35	0.06	0.32	--	--	0.05	5.09	5.5
1109702	0.23	6.52	--	0.09	--	--	0.01	0.16	0.3
1109802	4.43	166.04	0.37	0.10	--	--	--	4.42	4.9
1109902	0.30	11.29	--	--	--	--	0.00	0.30	0.3
1110002	6.03	226.60	0.09	0.38	--	--	0.02	6.03	6.5
1110102	0.19	6.78	--	--	--	--	--	0.18	0.2
1110202	6.15	231.36	0.01	0.49	--	--	0.07	6.15	6.7
1110302	23.40	106.52	--	0.00	6.79	--	0.05	2.83	9.7
1110402	0.10	149.44	0.01	0.49	0.02	--	--	3.98	4.5
1110502	0.23	8.28	--	--	--	--	--	0.22	0.2
1110602	2.33	87.54	0.01	--	--	--	0.21	2.33	2.6
1111102	3.30	123.72	0.01	--	--	--	--	3.29	3.3
1111202	0.03	158.67	0.42	--	0.01	--	0.03	4.22	4.7
1111302	6.18	154.91	0.32	1.19	--	--	0.29	4.28	6.1

Subwatershed ID	Management Metrics for GSI		Green Stormwater Infrastructure Capacity to Retain Critical Bacteria Storm						
	Runoff Volume Managed (acre-ft)	Impervious Area Treated (acres)	(Capacity expressed in units of acre-feet)						
			Existing Projects	Future New & Redevelopment	Regional Projects (Identified)	Green Streets High	Green Streets Moderate-High	Other GI Projects (TBD)	Total BMP Capacity (acre-ft)
1111402	0.76	24.28	--	0.11	--	--	--	0.76	0.9
1111502	5.40	202.49	--	0.07	--	--	--	5.39	5.5
1111602	1.49	55.93	0.31	--	--	--	--	1.49	1.8
1111702	0.00	--	--	--	--	--	--	0.00	0.0
1111802	5.72	160.24	0.40	1.41	--	--	--	3.97	5.8
1111902	0.00	--	--	--	--	--	--	--	0.0
1112002	0.00	0.01	--	--	--	--	--	0.00	0.0
1112102	0.00	0.00	--	--	--	--	--	0.00	0.0
1112202	0.00	0.01	--	--	--	--	--	0.00	0.0
1113002	0.48	17.69	--	--	--	--	--	0.47	0.5
1113102	12.45	467.84	0.64	1.02	--	--	0.19	12.44	14.3
1113202	5.34	142.17	0.68	--	--	0.02	0.23	3.70	4.6
1113302	1.55	57.84	0.01	--	--	--	--	1.54	1.6
1113402	2.21	82.78	0.03	--	--	--	0.00	2.21	2.2
1113502	12.69	389.44	0.31	3.63	--	0.86	2.36	8.81	16.0
1113602	1.73	45.17	--	--	--	--	0.26	1.20	1.5
1113702	6.18	158.80	--	--	--	0.06	0.60	4.28	4.9
1113802	2.67	100.09	0.03	--	--	--	--	2.66	2.7
1113902	5.76	216.76	--	--	--	--	0.37	5.76	6.1
1114002	0.62	22.94	--	--	--	--	--	0.61	0.6
1114102	1.07	39.87	--	--	--	--	--	1.06	1.1
1114202	1.32	49.53	--	--	--	--	--	1.32	1.3
1114302	0.63	23.13	--	--	--	--	--	0.63	0.6
1114402	0.06	2.24	--	--	--	--	--	0.06	0.1
1114502	0.22	7.80	--	--	--	--	--	0.22	0.2
1114602	1.40	24.91	--	--	--	--	--	0.97	1.0
1114702	0.15	3.81	--	--	--	--	--	0.15	0.2
1114802	3.02	77.26	--	--	--	--	--	3.01	3.0
1114902	6.95	179.68	--	--	--	--	--	6.94	6.9
1115002	0.19	6.17	--	--	--	--	--	0.18	0.2
1115102	0.05	1.72	--	--	--	--	--	0.05	0.1
1115202	1.45	54.03	0.02	--	--	--	--	1.44	1.5
1115302	0.05	1.63	--	--	--	--	--	0.05	0.1

Subwatershed ID	Management Metrics for GSI		Green Stormwater Infrastructure Capacity to Retain Critical Bacteria Storm						
	Runoff Volume Managed (acre-ft)	Impervious Area Treated (acres)	(Capacity expressed in units of acre-feet)						
			Existing Projects	Future New & Redevelopment	Regional Projects (Identified)	Green Streets High	Green Streets Moderate-High	Other GI Projects (TBD)	Total BMP Capacity (acre-ft)
1115402	0.00	0.13	--	--	--	--	--	0.00	0.0
1115502	0.00	0.02	--	--	--	--	--	0.00	0.0
1115602	0.00	--	--	--	--	--	--	0.00	0.0
1116702	4.47	116.82	0.04	--	--	--	0.84	3.10	4.0
1116802	6.99	262.96	0.12	0.04	--	--	0.53	6.99	7.7
1116902	1.64	61.18	--	--	--	--	--	1.63	1.6
1117002	9.94	366.32	0.17	0.20	--	0.25	0.49	9.94	11.1
1117102	0.07	1.66	--	0.02	--	--	--	0.04	0.1
1117202	6.09	183.35	1.23	0.24	--	0.50	0.05	4.22	6.2
1117302	0.91	33.80	0.01	0.05	--	--	--	0.90	1.0
1117402	0.62	23.17	--	0.11	--	--	--	0.62	0.7
1117502	3.42	105.81	0.04	2.60	--	--	--	2.37	5.0
1117602	4.26	122.67	0.49	1.32	--	--	--	2.95	4.8
1117702	1.24	46.66	--	--	--	--	--	1.24	1.2
1117802	0.43	16.18	--	--	--	--	--	0.43	0.4
1117902	0.31	11.29	--	--	--	--	--	0.30	0.3
1118002	0.72	27.02	--	--	--	--	--	0.72	0.7
1118102	2.10	79.03	--	--	--	--	--	2.10	2.1
1118202	1.38	51.93	0.00	0.01	--	--	--	1.38	1.4
1118302	5.76	169.96	0.46	0.07	--	0.37	1.28	4.00	6.2
1118402	0.28	7.15	0.00	--	--	--	0.09	0.19	0.3
1118502	3.97	112.19	0.04	--	--	0.13	0.83	2.75	3.8
1118602	1.00	27.60	--	0.00	--	0.05	0.12	0.69	0.9
1118702	3.43	94.30	0.01	0.81	--	--	0.04	2.37	3.2
1118802	7.36	208.91	3.06	0.34	--	1.14	1.41	5.10	11.1
1118902	7.77	229.66	0.30	0.33	--	1.26	1.52	5.39	8.8
1119002	4.48	139.37	0.51	2.55	--	0.55	0.23	3.11	7.0
1119102	13.05	360.39	0.57	2.35	--	--	0.12	9.06	12.1
1119202	22.66	685.10	2.15	2.58	--	0.18	1.55	15.73	22.2
1119302	7.96	228.09	3.00	--	--	--	--	5.52	8.5
1119402	0.00	0.11	--	--	--	--	--	0.00	0.0
1119502	0.03	1.13	--	0.00	--	--	--	0.03	0.0
1119602	22.18	219.00	0.14	0.33	6.57	0.05	0.01	2.62	9.7

Subwatershed ID	Management Metrics for GSI		Green Stormwater Infrastructure Capacity to Retain Critical Bacteria Storm (Capacity expressed in units of acre-feet)						
	Runoff Volume Managed (acre-ft)	Impervious Area Treated (acres)	Existing Projects	Future New & Redevelopment	Regional Projects (Identified)	Green Streets High	Green Streets Moderate-High	Other GI Projects (TBD)	Total BMP Capacity (acre-ft)
1119702	8.00	404.57	0.53	7.87	2.37	0.85	1.84	12.52	26.0
1119802	0.00	530.13	3.55	7.25	0.00	0.53	1.29	15.71	28.3
1119902	0.00	0.00	--	--	--	--	--	0.00	0.0
Total	430.1	14,656.22	40.7	65.3	19.4	15.3	28.4	382.1	551.1

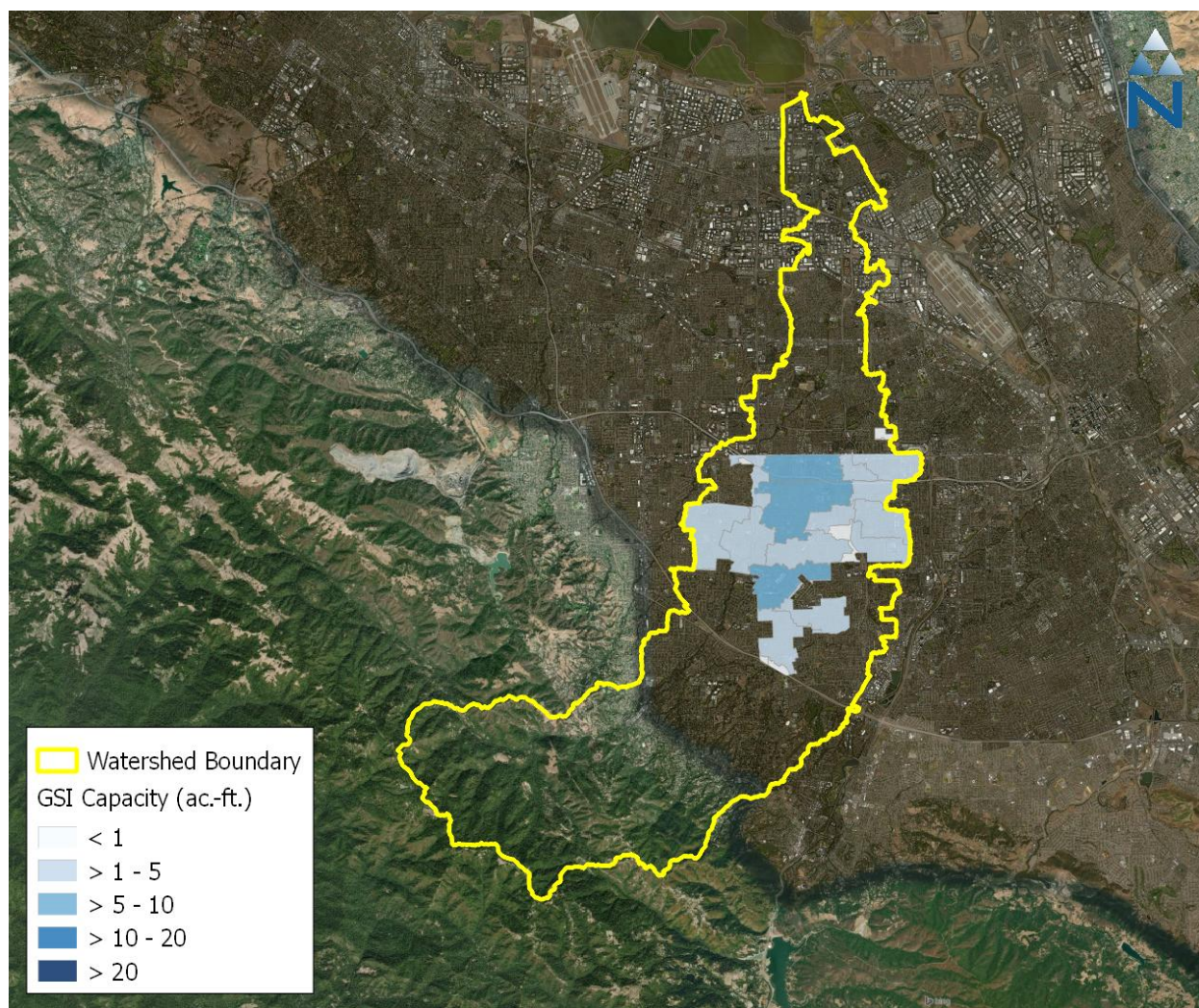


Figure 6-6. GSI Implementation Strategy by subwatershed for the City of San José portion of the San Tomas watershed.

Table 6-6. GSI Implementation Strategy by subwatershed for the City of San José portion of the San Tomas watershed.

Subwatershed ID	Management Metrics for GSI		Green Stormwater Infrastructure Capacity to Retain Critical Bacteria Storm (Capacity expressed in units of acre-feet)						
	Runoff Volume Managed (acre-ft)	Impervious Area Treated (acres)	Existing Projects	Future New & Redevelopment	Regional Projects (Identified)	Green Streets High	Green Streets Moderate-High	Other GI Projects (TBD)	Total BMP Capacity (acre-ft)
1200002	0.04	1.51	--	--	--	--	--	0.04	0.0
1200102	0.05	1.51	--	--	--	--	--	0.04	0.0

Subwatershed ID	Management Metrics for GSI		Green Stormwater Infrastructure Capacity to Retain Critical Bacteria Storm (Capacity expressed in units of acre-feet)						
	Runoff Volume Managed (acre-ft)	Impervious Area Treated (acres)	Existing Projects	Future New & Redevelopment	Regional Projects (Identified)	Green Streets High	Green Streets Moderate-High	Other GI Projects (TBD)	Total BMP Capacity (acre-ft)
1201102	0.95	25.68	--	0.76	--	--	--	0.42	1.2
1201202	0.19	5.70	--	0.21	--	--	--	0.08	0.3
1201302	1.19	44.75	0.01	0.03	--	--	--	1.19	1.2
1201402	4.46	167.62	0.01	--	--	--	--	4.46	4.5
1201502	2.71	101.84	0.02	0.02	--	--	--	2.71	2.8
1201602	0.07	2.63	--	--	--	--	--	0.07	0.1
1201702	0.01	0.36	--	--	--	--	--	0.01	0.0
1202802	0.32	12.04	--	--	--	--	--	0.32	0.3
1202902	0.02	0.75	--	--	--	--	--	0.02	0.0
1203002	0.00	0.07	--	--	--	--	--	0.00	0.0
1203102	6.07	174.27	0.72	1.69	--	--	--	4.21	6.6
1203202	1.53	57.55	--	0.17	--	--	--	1.53	1.7
1203302	1.79	66.82	0.12	0.12	--	--	--	1.78	2.0
1203402	2.96	83.74	--	1.03	--	--	0.43	2.05	3.5
1203502	2.20	73.24	0.01	0.09	--	0.06	0.06	2.19	2.4
1203602	3.69	105.46	0.03	1.31	--	--	0.10	2.56	4.0
1203702	0.67	24.83	--	--	--	--	--	0.66	0.7
1203802	3.73	140.20	--	0.26	--	--	0.07	3.73	4.1
1203902	0.34	12.41	--	--	--	--	--	0.33	0.3
1204002	5.46	148.22	0.07	2.97	--	0.46	0.96	2.42	6.9
1204102	2.99	112.47	--	--	--	0.00	0.13	2.99	3.1
1204202	3.41	126.68	--	--	--	0.03	0.01	3.40	3.4
1204302	0.13	4.51	--	--	--	--	--	0.12	0.1
1205002	0.03	0.75	--	--	--	--	--	0.02	0.0
1205102	0.00	0.00	--	--	--	--	0.00	0.00	0.0
1205902	0.01	0.38	--	--	--	--	--	0.01	0.0
1206002	6.62	181.53	0.11	1.29	--	--	--	4.59	6.0
1206102	4.36	125.48	0.88	0.90	--	--	0.06	3.02	4.9
Total	56.0	1,803.0	2.0	10.9	--	0.6	1.8	45.0	60.2

7 ADAPTIVE MANAGEMENT FRAMEWORK

Given the relatively small scale of most GSI projects (e.g., LID on an individual parcel, single street block converted to green street), thousands of GSI projects would be needed throughout the City to fully address the FIB Load Reduction Standard. Although GSI projects will require site investigations to assess feasibility and costs, the RAA provides a preliminary investigation of the amount of GSI needed spatially (e.g., by subwatershed) to fully address the City-wide FIB Load Reduction Standard. The RAA sets the Implementation Goals and Recipe in terms of the amount of GSI implementation, which can inform implementation of the City's GSI Plan. As the GSI Plan is implemented and more comprehensive municipal engineering analyses (e.g., master planning, capital improvement planning) are performed, the adaptive management process will be key to ensuring that goals are met. In summary, the RAA can inform GSI implementation goals, but the pathway to meeting those goals is subject to adaptive management and can potentially change based on new information or engineering analysis performed over time.

Future studies can also inform refinements to the FIB Load Reduction Standard, which can change the GSI Implementation Strategy and the amount of GSI projects needed to fully address the goal. For instance, calculation of Critical Bacteria Storm (basis of the FIB Load Reduction Standard) is based on assumptions for allowable exceedances of WQOs for FIB based on reference watershed studies performed in Los Angeles. Local reference watershed monitoring could determine that the number of allowable exceedances of WQOs are different for watersheds in the San Francisco Bay region or within the City. In addition, recent studies performed in southern California have provided new insights regarding fecal contamination and risks to human health (e.g., Steele et al. 2018, Arnold et al. 2017), which can guide more risk-based approaches for establishing more appropriate goals for water ways. As a result, the RAA may need to be revisited in the future to address revisions to WQOs or reference conditions or incorporate other risk-based frameworks for a revised FIB Load Reduction Standard. The adaptive management approach allows for future updates of the RAA over time to incorporate new information and revised approaches to protecting human health from fecal contamination, and better inform GSI implementation and other strategies to reduce human pathogens transported via stormwater to the City's creeks and San Francisco Bay.

The FIB Load Reduction Standard, based on the capture of the Critical Bacteria Storm, does not accommodate load reductions achieved through BMPs that do not result in capture of stormwater. Specifically, nonstructural BMPs and source control activities can potentially reduce FIB loads, without reducing the stormwater volumes that transport those loads. For example, the City participates in an Illicit Discharge Detection and Elimination Program (IDDE) that can potentially address many illicit discharges of FIB in stormwater via inspection and outreach procedures. The City also has a robust public information and outreach program to deliver stormwater pollution prevention and watershed protection messages to diverse audiences (City of San José 2018). More monitoring or research can be performed to quantify the benefits of these and other nonstructural BMPs and source control activities in terms of reducing FIB loads. The FIB Load Reduction Standard can also be tailored to provide accounting of these FIB load reductions. The adaptive management framework can allow for modifications of the RAA over time to incorporate FIB load reduction assumptions associated with nonstructural BMPs and source controls, and reduce the need for excessive GSI to provide 100% of the FIB load reduction.

The adaptive management framework allows for flexibility to provide updates of the RAA and GSI Plan over time. The framework provides opportunities to incorporate lessons learned from GSI implementation and resulting engineering analyses; conduct scientific studies that can guide updates

to the FIB Load Reduction Standard; provide mechanisms for accounting for FIB load reductions from non-structural control measures; and include other advancements in science and engineering practices. The overall goal of the adaptive management process is to continue to better inform strategic and cost-conscious implementation strategies for GSI and to best address water quality improvements and the protection of beneficial uses of the City's receiving waters.

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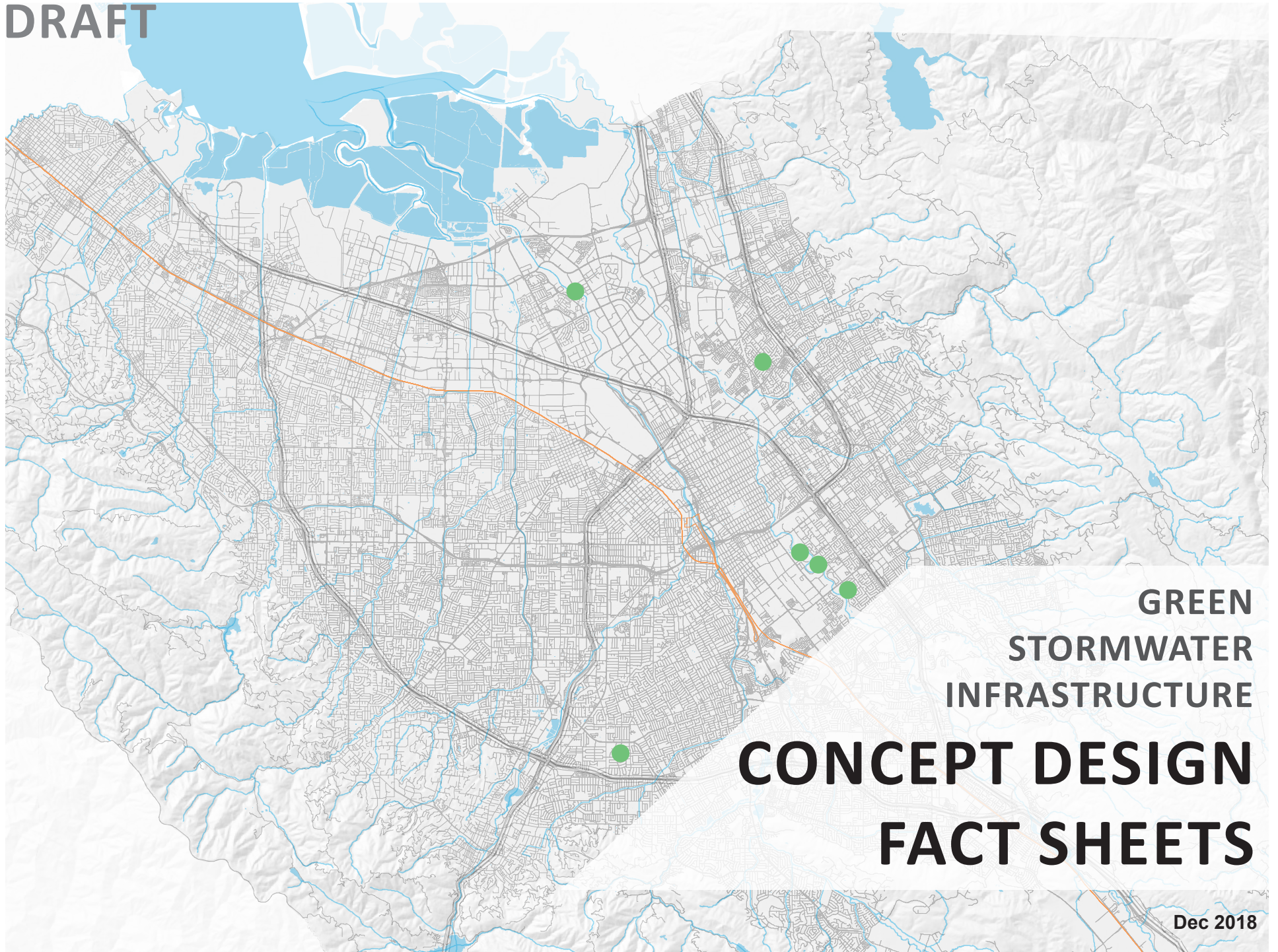
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PROJECT CONCEPTS

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**GREEN
STORMWATER
INFRASTRUCTURE**

CONCEPT DESIGN FACT SHEETS

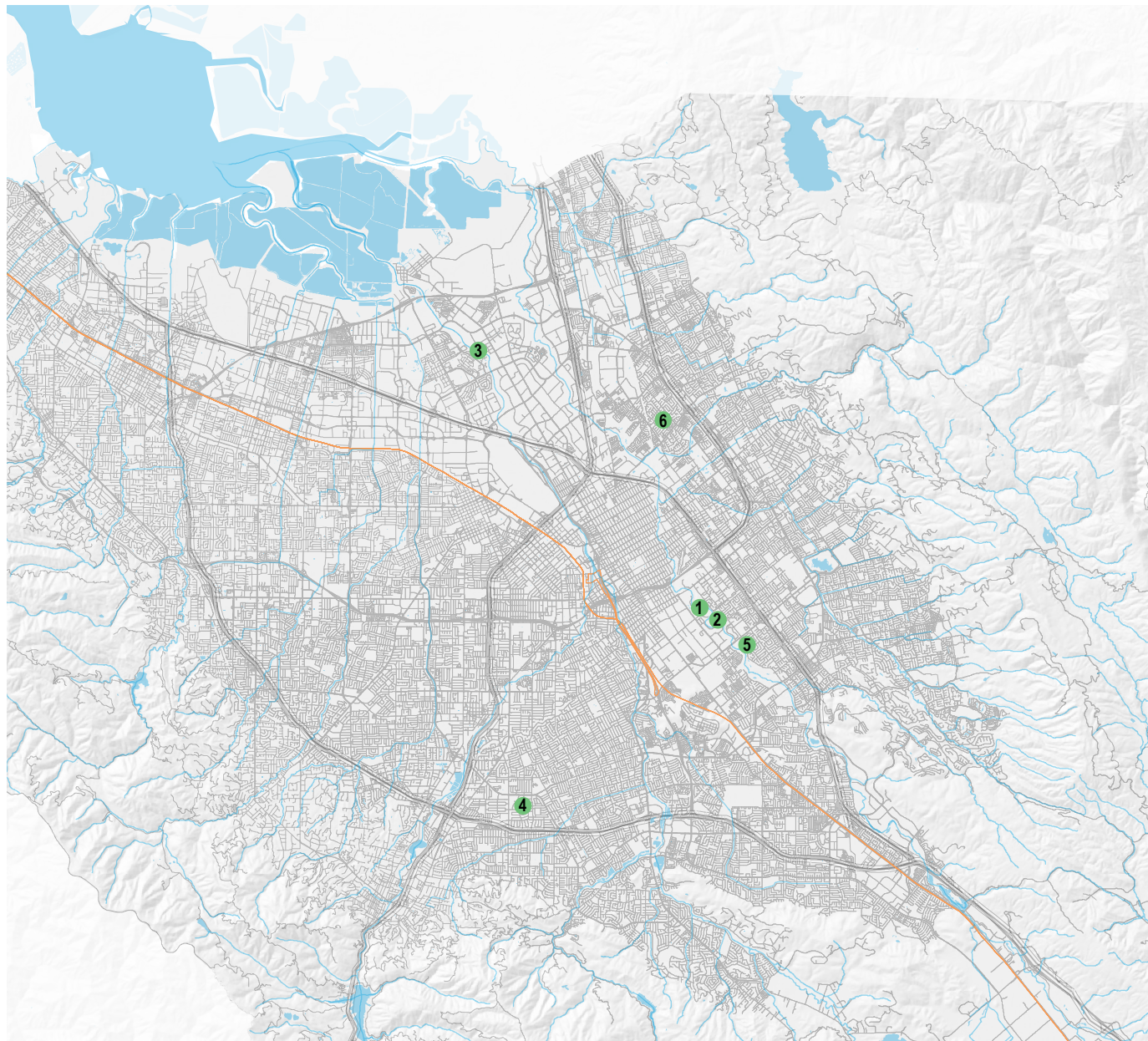
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ALL PROJECT SITES BASEMAP



- 1 Kelley Park Disc Golf Regional Stormwater Capture Project
- 2 Kelley Park Stables Regional Stormwater Capture Project
- 3 River Oaks Pump Station Regional Stormwater Capture Project
- 4 Roy M Butcher Park Regional Stormwater Project
- 5 Tully Community Ballfields Regional Stormwater Capture Project
- 6 Vinci Park Regional Stormwater Capture Project

KELLEY PARK DISC GOLF REGIONAL STORMWATER CAPTURE CONCEPT

San José

CONCEPT DESCRIPTION

The Kelley Park Disc Golf Course is an 8-acre naturalized recreation area nestled into a bend in Coyote Creek in San José. There are several storm drain outfalls to Coyote Creek within Kelley Park. The disc golf course is an ideal setting to house a system of integrated wetlands and percolation ponds to manage diverted storm drain flows from 522 acres of drainage area. A portion of this drainage area is currently planned to be rerouted to a large trash capture device. Thus, the feasibility of capturing the full 522 acres is contingent on successful coordination with the trash capture project.

Flows to the existing 66-inch storm drain outfall located just east of the Japanese Friendship Garden will be diverted 650 feet to the southeast into the large existing basin in the center of the disc golf course. The basin is currently used to store and percolate runoff from the parking lot and adjacent roadway. With additional grading, planting, soil amendments, and hydraulic connections, the basin can be greatly expanded to receive rerouted flows into a series of bioretention basins. The basins may include some engineered low areas to accommodate sustained wet conditions due to the presence of dry-weather flows. The basins can be aesthetically enhanced with new well-suited grasses, trees, and shrubs. Adjoining floodable space can provide additional detention storage during storm events and contact area for expanded percolation. The basins and floodable spaces are anticipated to occupy about half of the disc golf course area. The topography will be re-formed to create raised plateaus that define the disc course, interwoven with low-lying basins to accommodate native landscaping and stormwater

function. The regional capture project will be designed for maximum runoff capture during a typical year (i.e., 85th percentile storm or greater). However, if the concept moves forward to design, sizing to capture larger design storms to improve flood reduction benefits can be evaluated.

Following a storm, detained flows will fully drain within 24 hours, and the disc course will retain full recreational function all other times of the year. The hydraulically sequenced basins in the treatment area will be partitioned by a network of berms that will support pathways on top and provide pedestrian circulation throughout the site, as well as a link to the Coyote Creek Trail.

A pump station will be constructed at the storm drain outfall to intercept flows and reroute them to the treatment area. The City is receiving funds from FEMA to repair the existing outfall which will continue to support the pipe flow that exceeds the diverted treatment design flows. Diverted flows will pass through a pretreatment device (e.g., hydrodynamic separator) to remove trash, floatables, and coarse solids. This will provide a concentrated maintenance point and ease the burden on the downstream treatment system. Once daylighted in the park, flows will infiltrate to the maximum extent possible, taking advantage of highly infiltrative soil conditions, while captured water will receive treatment via natural biological processes. The system will meter detained flows back to Coyote Creek through subsurface cartridge filters to remove all particles down to 10 microns.

CONCEPT METRICS

WATERSHED CHARACTERISTICS

Watershed	COYOTE CREEK
Drainage Management Area	522 AC
% Impervious of DMA	81
Total Runoff Volume	255 AC-FT/YR

FACILITY INFORMATION

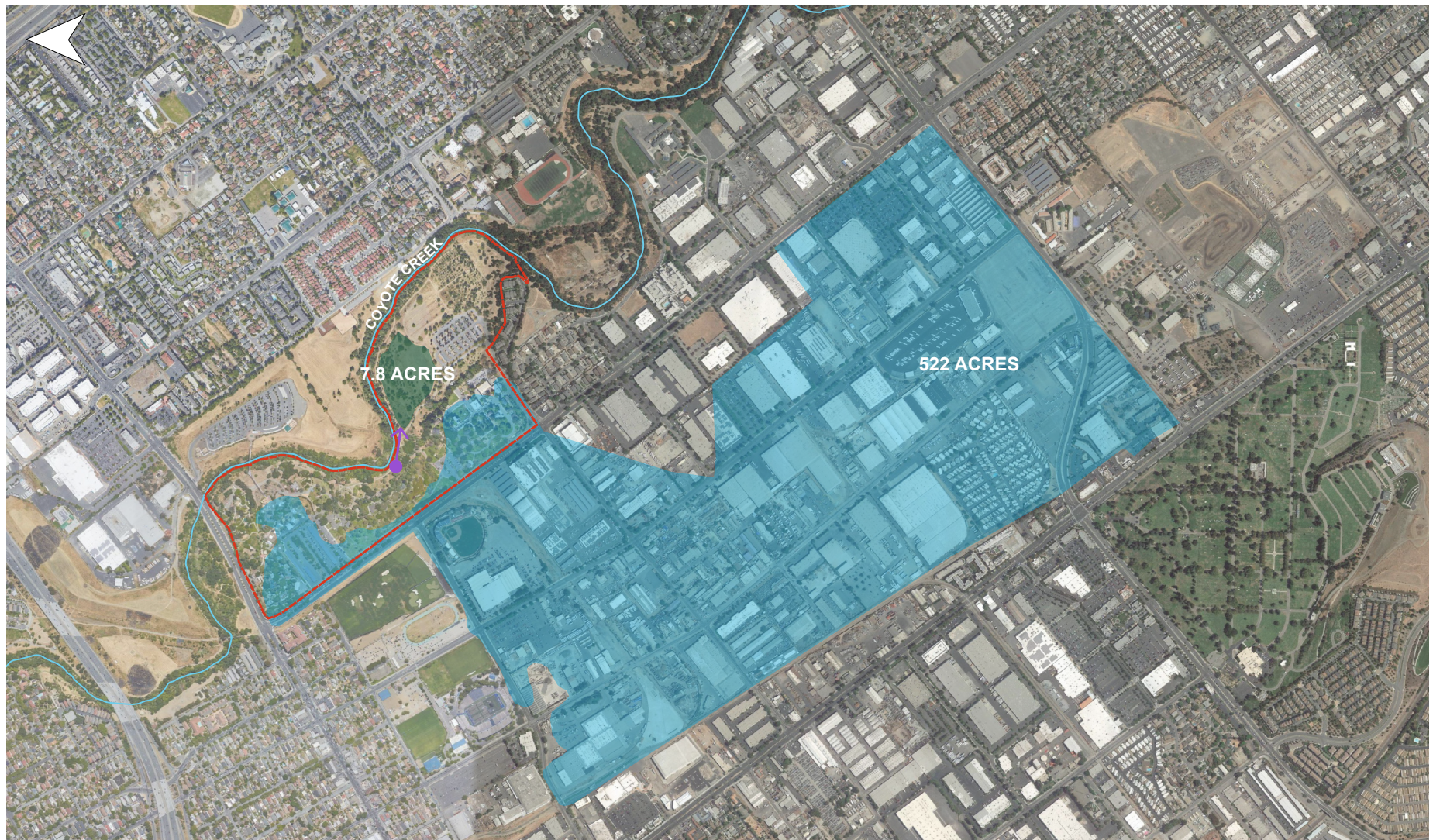
BIORETENTION & WETLAND AREAS

Total Facility Area	3.9 AC
Maximum Surface Ponding	3 FT
Detention Capacity	11.7 AC-FT

DESIGN CRITERIA

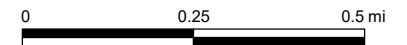
Diversion Rate	23 CFS
Infiltration Rate	2.0 IN/HR
Total Runoff Captured	240 AC-FT/YR (94%)

CONCEPT SITE DRAINAGE AREA



LEGEND

- Site Parcel
- Creek / Channel
- Potential Drainage Area
- Pump Station and Diversion Pipe
- Detention Basin / Wetland



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KELLEY PARK DISC GOLF REGIONAL STORMWATER CAPTURE CONCEPT

CONCEPT BASEMAP



Preliminary concept for discussion purposes only



Jane Irwin Landscape Architecture

Example of Treatment and Ponding Area Integrated into Park at Hassett Park in Campbell, Australia



Simon Wood

Example of Vibrant Recreation and Environmental Asset Together in One Landscape at Sydney Park in Sydney, Australia



Before

Conceptual Rendering - Kelley Park Disc Course Looking Southeast toward Parking Lot



After

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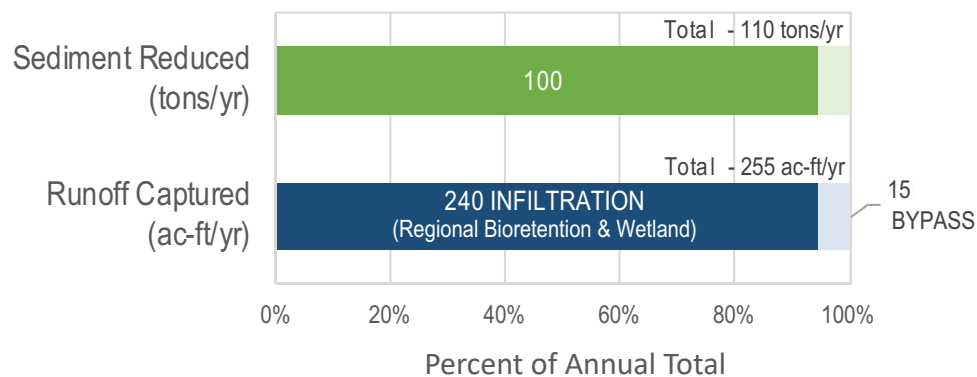
KELLEY PARK DISC GOLF REGIONAL STORMWATER CAPTURE CONCEPT

BUDGET-LEVEL COST ESTIMATES

DESCRIPTION	UNIT COST	UNIT	QUANTITY	SUBTOTAL
Utilities Protection/Relocation	\$20,000	LS	1	\$20,000
Pump Station (23 CFS) w/ Outfall	\$5.86M	LS	1	\$5,862,400
Diversion Pipe (30" RCP)	\$350	LF	650	\$227,500
Hydrodynamic Separator	\$150,000	EA	1	\$150,000
Earthwork Land Forming	\$50	CY	18,900	\$945,000
Inter-basin Hydraulic Connections	\$15,000	EA	6	\$90,000
Bio-soil Media	\$200	CY	4,700	\$940,000
Surface Restoration & Planting	\$8	SF	170,000	\$1,360,000
Cartridge Filtration Units	\$200,000	EA	3	\$600,000
Overflow Outlet to Coyote Creek	\$150,000	EA	1	\$150,000
CONSTRUCTION SUBTOTAL				\$10,345,000
Mobilization (10% Construction)				\$1,035,000
Contingency (30% Construction)				\$3,104,000
Design (12% Total)				\$1,738,000
TOTAL PROJECT COST (DESIGN + CONSTRUCTION)				\$16,222,000

* These are planning-level cost estimates (\$2018) for design and construction. Soft costs for City administration and project management and post-construction operations and maintenance are not included. Other factors that may affect the cost of future construction include escalation and market conditions.

CONCEPT EFFECTIVENESS (ANNUAL AVERAGE)



* Effectiveness is defined as the modeled ability of the proposed project to capture stormwater runoff from the management area, remove the identified constituents from that stormwater, and infiltrate or reuse the captured water.

* Modeling and performance estimates are based on an historical rainfall time series from water year 2007 through water year 2015.

ADDITIONAL POTENTIAL BENEFITS



ADDITIONAL CONSIDERATIONS

This project concept is planning-level and subject to revision as additional information becomes available. Factors to be considered include but are not limited to the following:

- » Community Enhancement. The project area is adjacent to a neighborhood that was defined as a Disadvantaged Community per the 2010-2014 American Community Survey data, as well as a Community of Concern per the Metropolitan Transportation Commission. Enhancing the trail network through the project area and connecting it to the Coyote Creek Trail will provide additional recreational and educational opportunities for local neighborhoods.
- » Infiltration Potential. The Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO) database lists soils within the disc golf course as having an infiltration capacity of 1.98 to 5.95 inches-per-hour. A geotechnical investigation will be conducted to verify infiltration rates prior to design. Site-specific borings and infiltration tests will be performed during design development to ensure facilities are designed appropriately.
- » Stakeholder Coordination. Outreach should be conducted to the disc golf course users throughout the design development process to ensure that all improvements are compatible with the course's recreational function.
- » Master Plans. Features should be consistent with City Parks Master Plans and Coyote Creek Master Plans.
- » Flood Reduction. Flood control design considerations and potential flood reduction benefits will be coordinated with Santa Clara Valley Water District (SCVWD).

KELLEY PARK STABLES REGIONAL STORMWATER CAPTURE PROJECT

San José

PROJECT DESCRIPTION

The Kelley Park Stables is a 13-acre clearing currently occupied by the Cooksy Family Stables south of Kelley Park behind Yerba Buena High School. The site is bounded on three sides by Coyote Creek, which flows around the site from south to north. The proposed project will transform the low-lying area of the site into a centralized stormwater system that filters and infiltrates runoff from an estimated 613-acre drainage area while providing surface water features and park amenities. Additionally, the project will construct a maintenance access trail that will take into consideration connectivity to the Coyote Creek trail which is part of the master planned Bay Area Ridge Trail.

The contributing drainage area is estimated to be 613 acres including 136 acres west of Highway 101 and 477 acres to the east of 101. The contributing area is comprised predominately of residential land use with some commercial and retail land uses.

The proposed design will intercept flows from a 72-inch storm sewer main from the south edge of Yerba Buena High School upstream of its outfall into Coyote Creek. The flows will enter a diversion structure that allows low and moderate flows to be pumped to the treatment and infiltration facility while larger flows will continue to drain to the existing outfall into Coyote Creek.

The proposed project will pump dry weather flow and moderate stormwater runoff flows, including the first flush, westerly for approximately 1,000 feet to

the stables area. The water will enter a pretreatment settling basin prior to gravity draining to the bioretention. The bioretention cells will filter pollutants and provide growing media for vegetation. Flows that do not infiltrate within the bioretention will overflow to a large infiltration basin. The basin and bioretention are anticipated to occupy about one quarter of the available 13-acre clearing. The topography will be re-formed to integrate the infiltration basin into the other park feature and uses. This infiltration basin will provide a surface water amenity during wet weather flow.

The infiltration basin will contain an overflow structure for when the inflow volumes exceeds the storage capacity. Overflows will pass through cartridge filters to remove particles down to 10 microns. This treated discharge will either flow over a spillway into the creek (if permit requirements are met for a new discharge point), or be routed back to the existing outfall via a pipe.

During the design of this project a geotechnical investigation will be conducted to verify infiltration rates. Site-specific borings and infiltration tests will be performed to ensure facilities are designed appropriately.

The proposed system is expected to divert and treat flows up to 40 cubic feet per second (cfs), provide approximately 8.9 acre-feet of storage, and infiltrate an estimated 148 acre-feet of runoff each year. An additional 29 acre-feet of runoff will be filtered and released on average each year.

PROJECT METRICS

WATERSHED CHARACTERISTICS

Watershed	COYOTE CREEK
Drainage Management Area	613 AC
% Impervious of DMA	57
Total Runoff Volume	213 AC-FT/YR

FACILITY INFORMATION

BIORETENTION

Total Facility Area	32,000 SF
Ponding Depth	12 INCH
Storage Volume	1.4 AC-FT

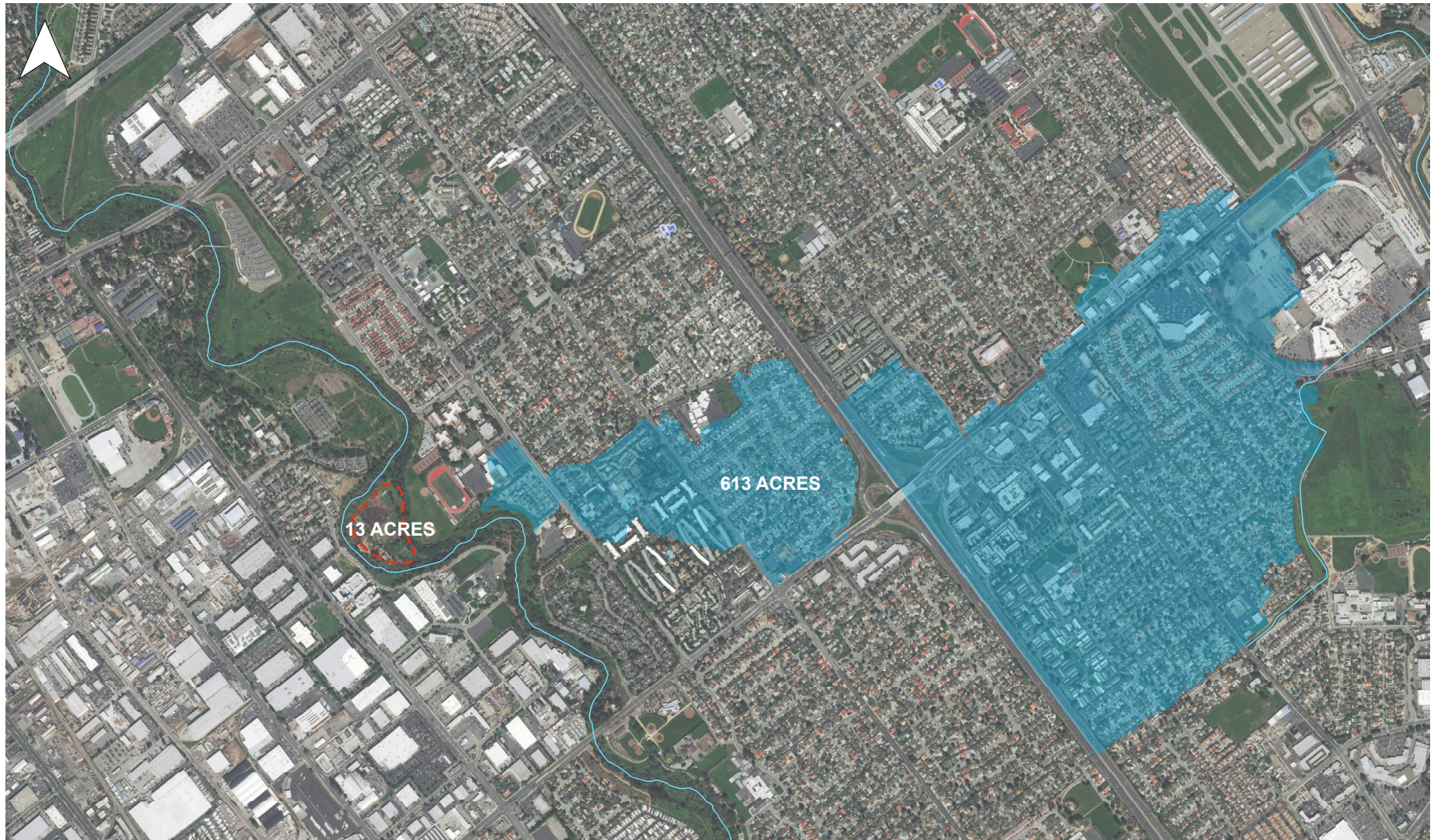
INFILTRATION BASIN

Total Facility Area	2.5 AC
Ponding Depth	3 FT
Total Storage Volume	7.5 AC-FT

DESIGN CRITERIA

Diversion Rate	40 CFS
Infiltration Rate	2.0 IN/HR
Total Storage Volume	8.9 AC-FT
Total Runoff Captured	176.7 AC-FT/YR (83%)

PROJECT SITE DRAINAGE AREA



LEGEND

- Project Footprint
- Potential Drainage Area

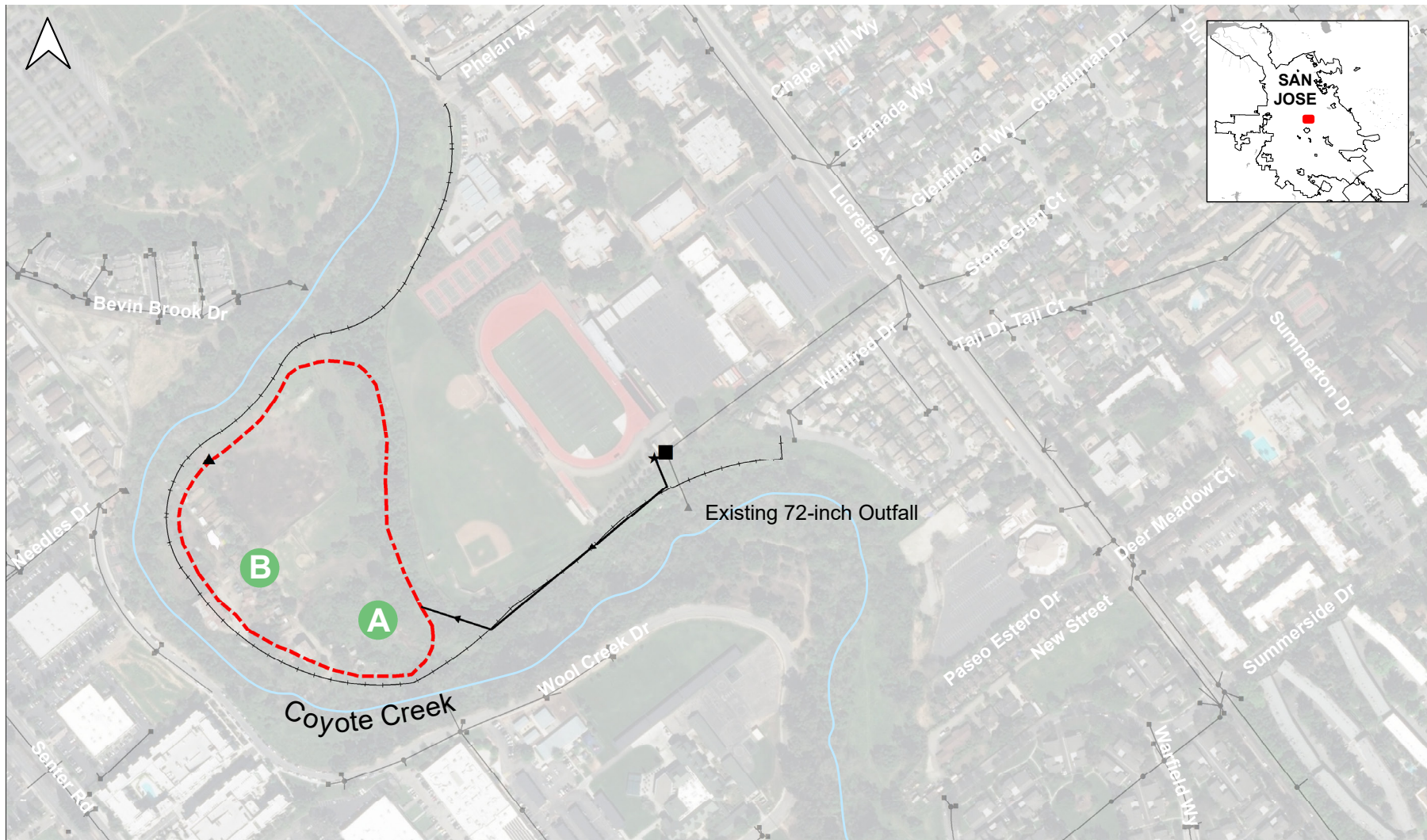
— Coyote Creek

0 500 1,000 ft

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KELLEY PARK STABLES REGIONAL STORMWATER CAPTURE PROJECT

PROJECT BASEMAP

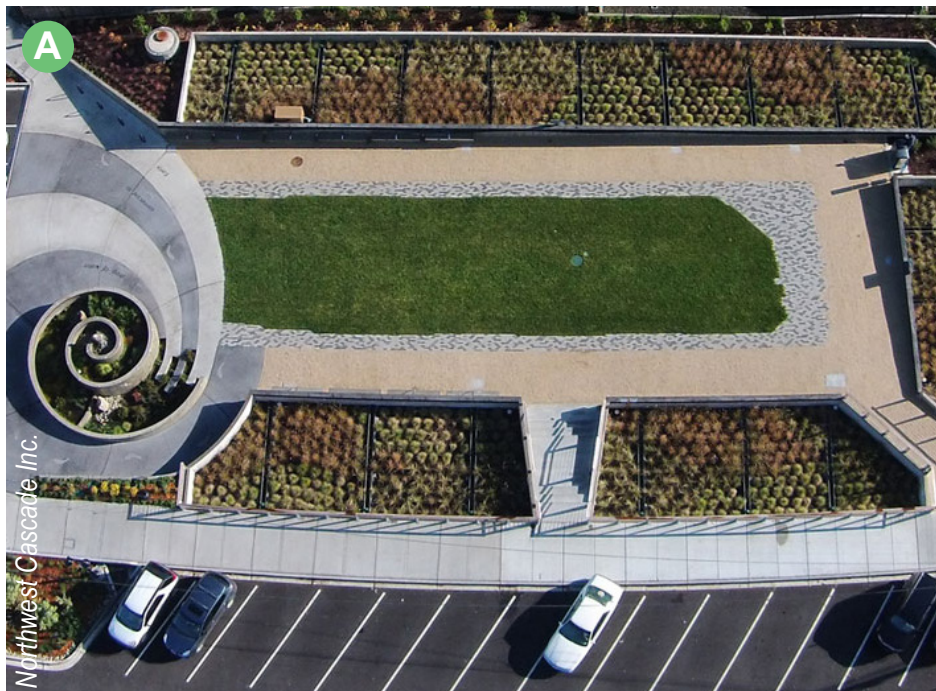


LEGEND

- | | | | | | |
|-----------------------|---------------|-----------------------|----------------------|----------------------------|----------------------------------|
| — Creek / Channel | ■ Catch Basin | ▲ Discharge Point | ▲ Emergency Overflow | — Force Main | — Project Footprint |
| — Storm Drain Network | ● Manhole | ■ Diversion Structure | ★ Pump | — Maintenance Access Trail | ● See Example Image on Next Page |

0 125 250
Feet

Preliminary concept for discussion purposes only



Example of Bioretention System Integrated into Park Setting at Manchester Park in Kitsap County, Washington



Example of Stormwater Treatment Basin at Qunli Stormwater Park in Heilongjiang Province, China



Conceptual Rendering - Kelley Park Stables Looking Northwest



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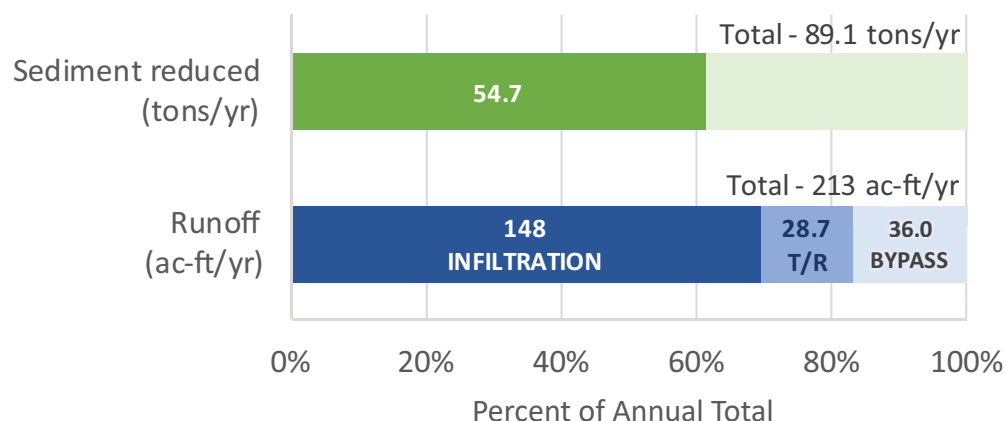
KELLEY PARK STABLES REGIONAL STORMWATER CAPTURE PROJECT

BUDGET-LEVEL COST ESTIMATES

DESCRIPTION	UNIT COST	UNIT	QUANTITY	SUBTOTAL
Utilities Protection and Relocation	\$10,000	LS	1	\$10,000
Hydrodynamic Separator	\$150,000	EA	1	\$150,000
Pump Station (40 CFS) & Diversion	\$6M	LS	1	\$6,000,000
Diversion Pipe (30" RCP)	\$350	LF	1,000	\$350,000
Excavation	\$40	CY	14,000	\$560,000
Offhaul	\$25	CY	11,000	\$275,000
Stockpile and Backfill	\$15	CY	3,000	\$45,000
Earthwork Land Forming	\$50	CY	10,000	\$500,000
Bioretention Soil	\$200	CY	4,800	\$960,000
Bioretention Planting and Mulch	\$22	SF	32,000	\$704,000
Surface Restoration and Planting	\$8	SF	108,900	\$871,200
Maintenance Access Trail	\$6	SF	24,000	\$144,000
Cartridge Filtration Units	\$200,000	EA	4	\$800,000
Overflow Outlet to Coyote Creek	\$150,000	EA	1	\$150,000
CONSTRUCTION SUBTOTAL				\$11,519,200
Mobilization (10% Construction)				\$1,151,920
Contingency (30% Construction)				\$3,455,760
Design (12% Total)				\$1,935,000
TOTAL PROJECT COST (DESIGN + CONSTRUCTION)				\$18,061,880

* These are planning-level cost estimates (\$2018) for design and construction. Soft costs for City administration and project management and post-construction operations and maintenance are not included. Other factors that may affect the cost of future construction include escalation and market conditions.

BMP EFFECTIVENESS (ANNUAL AVERAGE)



T/R - Treat & Release

- * Effectiveness is defined as the modeled ability of the proposed project to capture stormwater runoff from the management area, remove the identified constituents from that stormwater, and infiltrate or reuse the captured water.
- * Modeling and performance estimates are based on an historical rainfall time series from water year 2007 through water year 2015.

ADDITIONAL POTENTIAL BENEFITS



ADDITIONAL CONSIDERATIONS

This project concept is planning-level and subject to revision as additional information becomes available. Factors to be considered include but are not limited to the following:

- » Pumping. Stormwater will need to be pumped between the diversion point and the top of the treatment facility. The storm main is currently located 25 feet deep and is below the existing grade of the stables area.
- » Permitting. There is no existing outfall in proximity to the proposed treatment facility, therefore the treatment system will be designed with an overflow outlet, which could be a spillway into the creek if it meets permit requirements, or a pipe returning flows to the existing outfall.
- » Infiltration Potential. The site is comprised of mainly A-type soils, classified as fine sandy loam with a saturated hydraulic conductivity of 2 to 6 inches-per-hour. A geotechnical investigation will be conducted to verify infiltration rates prior to design. The depth to groundwater is 10 to 20 feet in the project area. Site-specific borings and infiltration tests will be performed during design development to ensure facilities are designed appropriately.
- » Community Enhancement. Enhancing the Coyote Creek Trail corridor through the project area could provide additional recreational and educational opportunities for local neighborhoods.
- » Stakeholder Coordination. Outreach should be conducted with neighborhood residents and potential park users.

RIVER OAKS PUMP STATION REGIONAL STORMWATER CAPTURE CONCEPT

San José

CONCEPT DESCRIPTION

The River Oaks Pump Station is located on a 5.5-acre parcel between the Guadalupe River and Riverview Parkway. The facility was constructed in 1979, consisting of a detention basin and a pump station housing three large pumps with a maximum discharge capacity of 67 cubic-feet-per-second (cfs). The pump station was retrofit with a trash rack in 2011. The 4-acre detention basin has a storage capacity of 9.83 ac-ft that provides offline storage to meet the flood control needs of the 100-year flood event. Stormwater runoff from the 344-acre drainage area enters the facility through an 84-inch storm drain pipe discharging directly into the 89,000-gallon wet well to the pump station. Each of the three pumps discharge into an outfall structure and then through a 42-inch pipe to the Guadalupe River. As inflows exceed the 67 cfs capacity of the pump station, the stormwater level rises within the wet well. Stormwater overflows a weir structure that discharges through an 84-inch drainage pipe into the detention basin. After storing excess runoff during the peak of the storm event, the detention basin returns flows to the pump station wet well via a perforated 24-inch french drain structure.

In 2014 Brown and Caldwell prepared a draft Regional Stormwater Facility Feasibility Study that evaluated different alternatives to modify the pump station configuration and operations in order to provide both hydromodification and water quality treatment. This project concept is based on the recommended alternative from that study.

This project will establish a new diversion structure inside the pump station and redirect flows into the detention basin at the beginning of a storm event (as opposed to solely providing flood control

at the peak of a storm event). A vertical trash rack will be installed immediately downstream of the new diversion structure to remove trash and debris. Allowing the system to divert flows at the beginning of a storm provides hydromodification benefits by delaying the discharge from the pump station, and the proposed improvements result in an overall increase in flood storage capacity above the current 100-year standard.

With additional grading, planting, and soil amendments, the detention basin will be converted into a large bioretention facility. Bioretention soil will be added to the site to enable stormwater treatment, and additional grading will occur to create a forebay near the inlet. Changes to the profile of the basin must account for the existing flood control function of the facility as well as excavation constraints posed by the shallow depth to groundwater. A portion of the facility may be designed to accommodate dry weather flows, functioning more as a wetland, with the vast majority of the facility continuing to function as bioretention. An overflow structure will be added to the basin to redirect flows back to the pump station during large storm events. Following a storm, detained flows will drain back to baseline conditions within 24 hours.

Recreational use of the site, which is currently fenced off with no public access, will be activated by restoring the perimeter pathway around the basin and constructing an interior raised path or boardwalk that connects to the existing Guadalupe River Trail and the adjacent park along Riverview Parkway. These paths will provide access for maintenance of the treatment facilities.

CONCEPT METRICS

WATERSHED CHARACTERISTICS

Watershed	
	GUADALUPE RIVER
Drainage Management Area	
	344 AC
% Impervious of DMA	
	62
Total Runoff Volume	
	133 AC-FT/YR

FACILITY INFORMATION

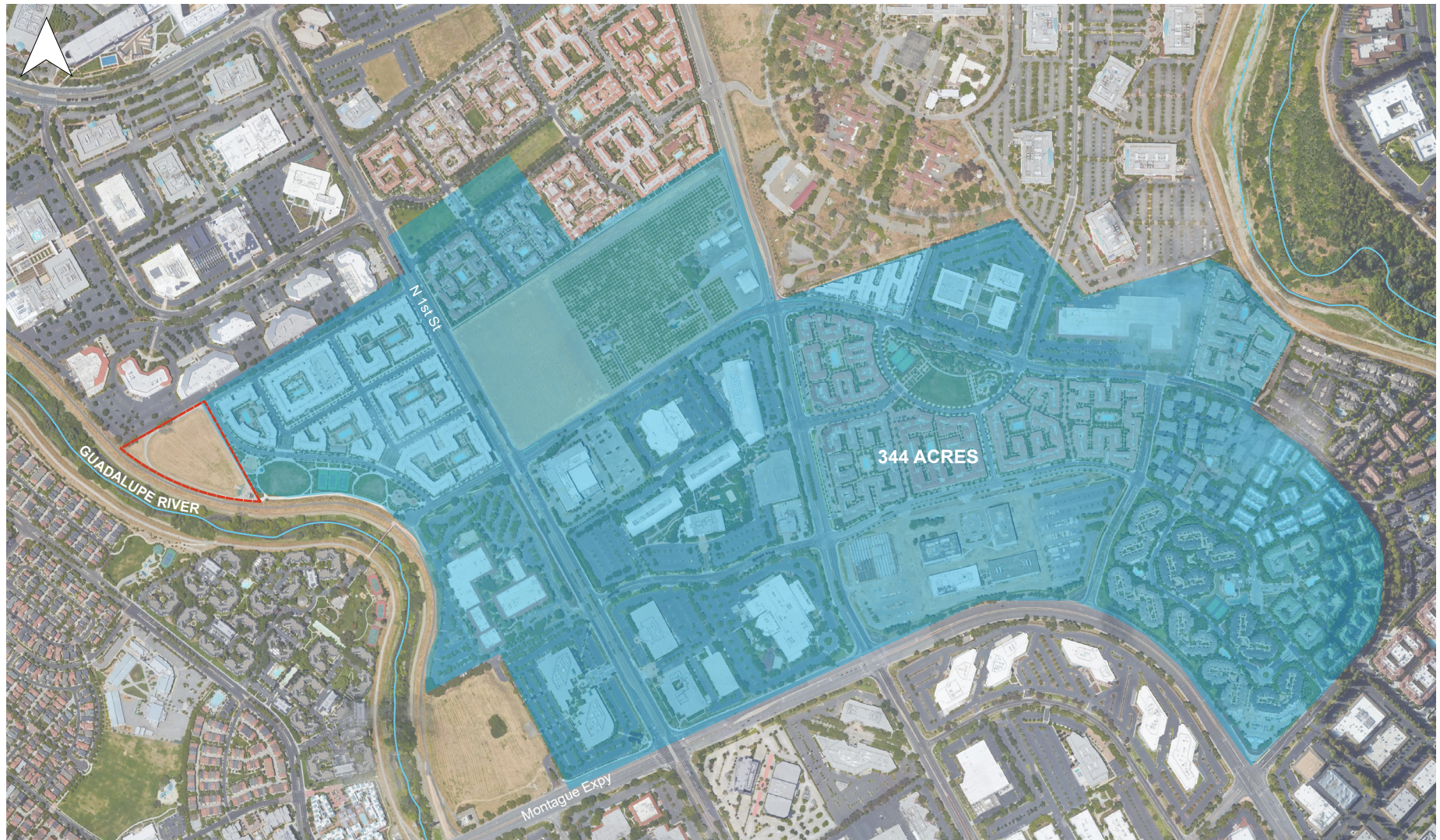
BIORETENTION

Total Facility Area	
	135,000 SF
Maximum Surface Ponding	
	3.0 FT

DESIGN CRITERIA

Total Storage Volume	
	10 AC-FT
Infiltration Rate	
	2.0 IN/HR
Total Runoff Captured	
	120 AC-FT/YR (90%)

CONCEPT SITE DRAINAGE AREA



LEGEND

- Project Footprint
- Creek / Channel
- Potential Drainage Area

0 500 1,000ft

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RIVER OAKS PUMP STATION REGIONAL STORMWATER CAPTURE CONCEPT

CONCEPT BASEMAP



Preliminary concept for discussion purposes only



Example of Regional Stormwater Treatment Integrated into Park Setting at Helms Park in Champaign, Illinois



Example of Regional Treatment Facility when Dry at Pacific Shores Center in Redwood City, California



*Before
Conceptual Rendering - River Oaks Pump Station Facing West*



After

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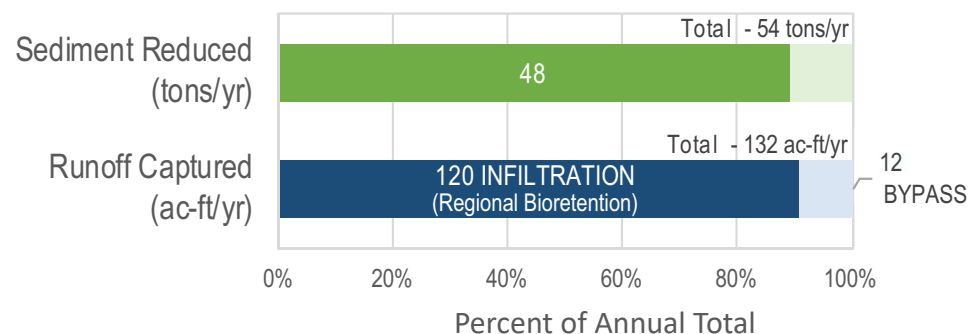
RIVER OAKS PUMP STATION REGIONAL STORMWATER CAPTURE CONCEPT

BUDGET-LEVEL COST ESTIMATES

DESCRIPTION	UNIT COST	UNIT	QUANTITY	SUBTOTAL
Utilities Protection/Relocation	\$20,000	LS	1	\$20,000
Pump Station Modifications	\$750,000	LS	1	\$750,000
Excavation & Offhaul	\$70	CY	13,800	\$966,000
Bio-soil Media	\$200	CY	3,800	\$760,000
Surface Restoration & Planting	\$8	SF	135,000	\$1,080,000
Overflow Structure with Return Pipe	\$150,000	EA	1	\$150,000
Boardwalk (for Maintenance Access)	\$1,200	LF	800	\$960,000
CONSTRUCTION SUBTOTAL				\$4,686,000
Mobilization (10% construction)				\$469,000
Contingency (30% Construction)				\$1,406,000
Design (12% Total)				\$787,000
TOTAL PROJECT COST (DESIGN + CONSTRUCTION)				\$7,348,000

- These are planning-level cost estimates (\$2018) for design and construction. Soft costs for City administration and project management and post-construction operations and maintenance are not included. Other factors that may affect the cost of future construction include escalation and market conditions.
- The cost estimate for pump modifications in the 2014 Brown and Caldwell feasibility study was increased to account for inflation and additional considerations not identified in that report.

CONCEPT EFFECTIVENESS (ANNUAL AVERAGE)



- Effectiveness is defined as the modeled ability of the proposed project to capture stormwater runoff from the management area, remove the identified constituents from that stormwater, and infiltrate or reuse the captured water.
- Modeling and performance estimates are based on an historical rainfall time series from water year 2007 through water year 2015.

ADDITIONAL POTENTIAL BENEFITS



FLOOD MANAGEMENT



WITHIN PRIORITY
DEVELOPMENT AREA



REESTABLISHES NATURAL
HYDROLOGY



COMMUNITY ENHANCEMENT

ADDITIONAL CONSIDERATIONS

This project concept is planning-level and subject to revision as additional information becomes available. Factors to be considered include but are not limited to the following:

- » Community Enhancement. San José identified “place-making” as an important aspect of these regional stormwater projects, and this project has the opportunity to transform an inaccessible, fenced-off detention basin into a recreational amenity linked to the Guadalupe River trail.
- » Infiltration Potential. The Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO) database lists soils within the detention basin as having an infiltration capacity of 1.98 to 5.95 inches-per-hour. A previous site investigation estimated the high seasonal groundwater level in the basin to be approximately 5 feet below ground level (Brown and Caldwell, 2014). Water may pond in the facility following a storm event, but will draw down after groundwater recedes and saturated soils drain to the river. A geotechnical investigation will be conducted to verify infiltration rates prior to design. Site-specific borings and infiltration tests will be performed during design development to ensure facilities are designed appropriately.
- » Stormwater Diversion. The flood control function of the pump station and detention basin will be further analyzed to ensure that the integrated water quality function proposed by this project does not compromise flood control operations in any way.
- » Stakeholder Coordination. In addition to community outreach to get input about public priorities and preferred improvements, the City and design team will stay closely coordinated with the Santa Clara Valley Water District on all matters related to flood control function, with the intent of enhancing capacity in the project area.

ROY M BUTCHER PARK REGIONAL STORMWATER CAPTURE PROJECT

San José

PROJECT DESCRIPTION

Butcher Park is a 9.3-acre park in the City of San José featuring a large softball field, volleyball and basketball courts, children's play area, and a dog park. The project concept involves intercepting flows from a 48-inch storm sewer main servicing a 343-acre area of predominately residential neighborhoods, and rerouting those flows through a new diversion pipe to an underground storage and infiltration facility in the softball outfield area for treatment and use for irrigation or infiltration. The diversion structure intercepts flows up to 25 cubic-feet-per-second (cfs) located six feet below existing grade at a manhole on Oakwood Avenue between Ross and Camden Avenues. Diverted water will flow northerly via gravity 80 feet into the park where the pretreatment and storage tanks are located. To facilitate gravity flow through the system, the storage tanks will be buried approximately 7-feet below the ballfield surface with adequate cover to allow healthy grass growth. The project will include full restoration of the ballfields and existing park athletic facilities.

At the edge of the park, diverted flows are routed through a pretreatment device (e.g., hydrodynamic separator) to remove trash & debris, floatables, and coarse solids prior to entering a subsurface storage chamber under the softball field. This provides a concentrated maintenance point and protects the downstream treatment units. To take advantage of the large amount of available space and to account for the expected moderate infiltration rate of the native soils, the storage chamber is relatively shallow with a broad footprint. A portion of the storage will be sized as a cistern for

an efficient water reuse system, and the remainder will be used as an infiltration chamber.

Soils data obtained from the Natural Resources Conservation Service (NRCS) indicates that the site is underlain by gravelly sandy loam, which has a much higher saturated hydraulic conductivity rate than the more clayey loam near the surface, and is therefore more conducive to infiltration. Groundwater depth is approximately 50 feet below ground surface which provides a sufficient buffer between the base of a deep infiltration chamber and groundwater. However, the NRCS soils data only goes down to a depth of 68 inches in the project area; therefore, a geotechnical investigation will be conducted during design development including site-specific borings and infiltration tests to ensure facilities are designed appropriately.

Overflow from the system will be directed through cartridge filters to remove all particles down to 10 microns before discharging back to the same 48-inch storm sewer main at the intersection of Ross Avenue and Hallmark Lane. Water will be drawn on an as-needed basis from the cistern, filtered, and disinfected before being used to meet non-potable irrigation demands in the park.

The proposed conceptual design will allow for treatment of 87.0% of the annual runoff volume (100 of 115 acre-feet) from the area draining to this project. All diverted flows will have full trash capture. Water that is infiltrated or used for irrigation is considered to provide 100% water quality treatment, while filtered flows metered back to the sewer provide equivalent 90% reduction of sediment and sediment-associated pollutants.

PROJECT METRICS

WATERSHED CHARACTERISTICS

Watershed	
	GUADALUPE RIVER
Drainage Management Area	
	343 AC
% Impervious of DMA	
	55
Total Runoff Volume	
	115 AC-FT/YR

FACILITY INFORMATION

CISTERN AND INFILTRATION CHAMBER

Total Facility Area	
	2.0 AC
Storage Depth	
	3.5 FT

DESIGN CRITERIA

Diversion Rate	
	25 CFS
Total Storage Volume	
	7 AC-FT
Infiltration Rate	
	1.0 IN/HR
Total Runoff Captured	
	100 AC-FT/YR (87.0%)

PROJECT SITE DRAINAGE AREA



LEGEND

- Site Parcel
- Creek / Channel
- Potential Drainage Area

0 250 500 ft

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ROY M BUTCHER PARK REGIONAL STORMWATER CAPTURE PROJECT

PROJECT BASEMAP



Preliminary concept for discussion purposes only



Existing Field Where Subsurface Storage Would Be Installed



Example of Subsurface Infiltration Chambers at University of St Thomas in St Paul, MN



Example of Subsurface Cistern at Patient Towers in Gainesville, FL

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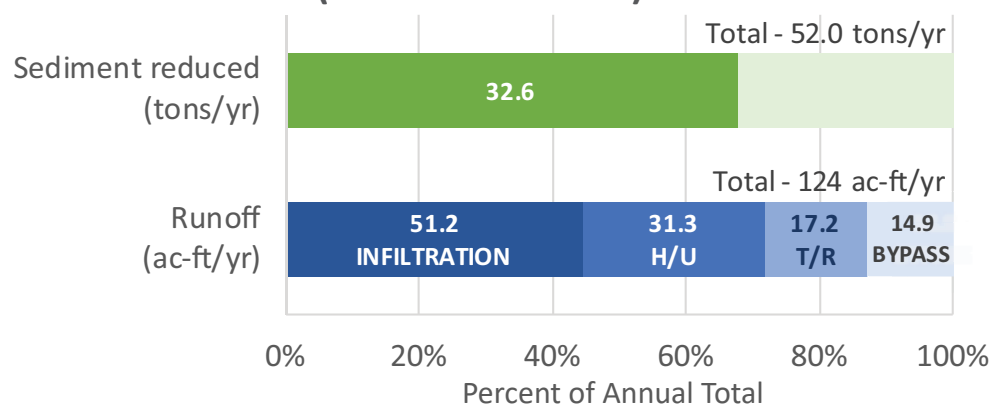
ROY M BUTCHER PARK REGIONAL STORMWATER CAPTURE PROJECT

BUDGET-LEVEL COST ESTIMATES

DESCRIPTION	UNIT COST	UNIT	QUANTITY	SUBTOTAL
Utilities Protection/Relocation	\$40,000	LS	1	\$40,000
Diversion Manhole Structure	\$25,000	LS	1	\$25,000
Diversion Pipe (30" RCP)	\$350	LF	80	\$28,000
Hydrodynamic Separator	\$150,000	EA	1	\$150,000
Excavation	\$40	CY	40,700	\$1,628,000
Offhaul	\$25	CY	15,900	\$397,500
Onsite Stockpile	\$5	CY	24,800	\$124,000
Subsurface Storage System	\$1.50	GAL	2,264,500	\$3,396,800
Backfill over Tanks	\$10	CY	24,800	\$248,000
Surface Restoration and Planting	\$5	SF	104,544	\$522,700
Reinstall Irrigation	\$3	EA	104,544	\$313,600
Water Reuse System and Housing	\$600,000	LS	1	\$600,000
Cartridge Filtration Units	\$200,000	EA	3	\$600,000
Overflow back to Sewer System	\$50,000	EA	1	\$50,000
CONSTRUCTION SUBTOTAL				\$8,124,000
Mobilization (10% construction)				\$812,000
Contingency (30% Construction)				\$2,437,000
Design (12% Total)				\$1,365,000
TOTAL PROJECT COST (DESIGN + CONSTRUCTION)				\$12,738,000

* These are planning-level cost estimates (\$2018) for design and construction. Soft costs for City administration and project management and post-construction operations and maintenance are not included. Other factors that may affect the cost of future construction include escalation and market conditions.

BMP EFFECTIVENESS (ANNUAL AVERAGE)



H/U - Harvest & Use T/R - Treat & Release

* Effectiveness is defined as the modeled ability of the proposed project to capture stormwater runoff from the management area, remove the identified constituents from that stormwater, and infiltrate or reuse the captured water.

* Modeling and performance estimates are based on an historical rainfall time series from water year 2007 through water year 2015.

ADDITIONAL POTENTIAL BENEFITS



ADDITIONAL CONSIDERATIONS

This project concept is planning-level and subject to revision as additional information becomes available. Factors to be considered include but are not limited to the following:

- » Community Enhancement. An enhanced water supply resulting from this project could provide the community with greater irrigation water security by reducing the use of potable water for irrigation.
- » Infiltration Potential. This project site is in a designated recharge area. The map for the Santa Clara Basin in Appendix A of the SCVURPPP C.3 Stormwater Handbook shows Depth to First Groundwater is approximately 50 feet; therefore, no conflicts with groundwater are anticipated. The Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO) database lists the controlling soil layer in the project area has an infiltration capacity of 0.20 to 0.57 in/hr. However, the site is underlain by gravelly sandy loam, which is much more conducive to infiltration than the clayey loam near the surface. This hydrogeologic condition has been observed in other areas of Santa Clara Valley with similar deeper infiltration strategies successfully employed. A geotechnical investigation will be conducted to verify infiltration rates prior to design. Site-specific borings and infiltration tests will be performed during design development to ensure facilities are designed appropriately.
- » Upstream Diversion. There is a flow split several blocks upstream within the tributary storm drain sewershed at the intersection of Nelson Way and Camden Ave. The opportunity to preferentially direct more or all flows at this flow split toward the project area with a new manhole structure could be explored as part of this project.
- » Utility Coordination. Utilities at the diversion on Oakwood Avenue and the overflow return on Ross Avenue should be evaluated for conflicts. No conflicts are expected within the park.
- » Stakeholder Coordination. Outreach should be conducted with neighborhood residents and park users. Installation of the storage tanks could be phased to preserve at least one recreational field area throughout construction.

TULLY BALLFIELDS REGIONAL STORMWATER CAPTURE PROJECT

San José

PROJECT DESCRIPTION

The Tully Ballfields are part of a 20-acre parcel that includes the Tully Community Branch Library located east of Tully Road and north of Coyote Creek. The park includes multiple play fields including two smaller ballfields typically used for softball. There are existing rain gardens adjacent to parking areas for the library and a solar panel array covers a portion of the parking area. The Coyote Creek Trail traverses the project parcel along the southwest edge making this site a good opportunity for education and community engagement.

The proposed project will divert flows from a 54-inch storm main located in Tully Road to two infiltrating bioretention cells and a subsurface infiltration storage system underneath the park's softball fields. This project will provide treatment and infiltration of runoff from 538-acres of mostly residential development. The existing two ballfields will be restored as part of this project.

This project will replace an existing manhole along the storm main with a diversion structure. The diverted flows will be sent to a pretreatment device such as a hydrodynamic separator to remove trash, floatables, and coarse sediment, which will serve as a concentrated point for maintenance and protect the infiltrating systems from being overloaded with sediment and trash. Flow from the pretreatment system will then be pumped to the two bioretention cells. The bioretention provide surface storage, infiltration, and pretreatment for the subsurface infiltration system. Flows that exceed the infiltration capacity of the bioretention will overflow to a subsurface infiltration storage system located under the two ballfields.

The infiltration storage system will be designed to maximize storage within the confined footprint of the two ballfields by utilizing modular pre-fabricated storage units with an internal depth of at least 6 feet. A geotechnical investigation will be conducted to verify infiltration rates prior to design. Site-specific borings and infiltration tests will be performed during design development to ensure facilities are designed appropriately.

This project is expected to infiltrate approximately 92.7 acre-feet of runoff per year and filter an additional 43.4 acre-feet per year. Overflow from the infiltration system will be directed back into the storm main along Tully Road prior to discharging into Coyote Creek through the existing outfall. These return flows will receive treatment through a cartridge filter system to remove all particles down to 10 microns.

In addition to the large infiltration system, this project will retrofit the existing rain garden adjacent to the ballfields parking area with a bioretention system. This system will serve as an education feature and park amenity for the ballfields and along the Coyote Creek Trail through inclusion of educational signage and beautification.

The location of the infiltration chamber in this concept is dependent upon adequate separation between the base of the infiltration chamber and the seasonal high water table. A site geotechnical investigation will be conducted to determine the elevation of the water table. If there is less than 10 feet of separation from that elevation, then the infiltration chambers will be located underneath one of the upgradient ballfields.

PROJECT METRICS

WATERSHED CHARACTERISTICS

Watershed	COYOTE CREEK
Drainage Management Area	538 AC
% Impervious of DMA	52
Total Runoff Volume	166 AC-FT/YR

FACILITY INFORMATION

BIORETENTION

Facility Area	18,000 SF
Ponding Depth	6 INCH
Storage Volume	0.4 AC-FT

INFILTRATION SYSTEM

Facility Area	1.0 AC
Storage Depth	6 FT
Storage Volume	6 AC-FT

DESIGN CRITERIA

Diversion Rate	30 CFS
Infiltration Rate	1.0 IN/HR
Total Storage Volume	7.6 AC-FT
Total Runoff Captured	136 AC-FT/YR (82%)

PROJECT SITE DRAINAGE AREA



LEGEND

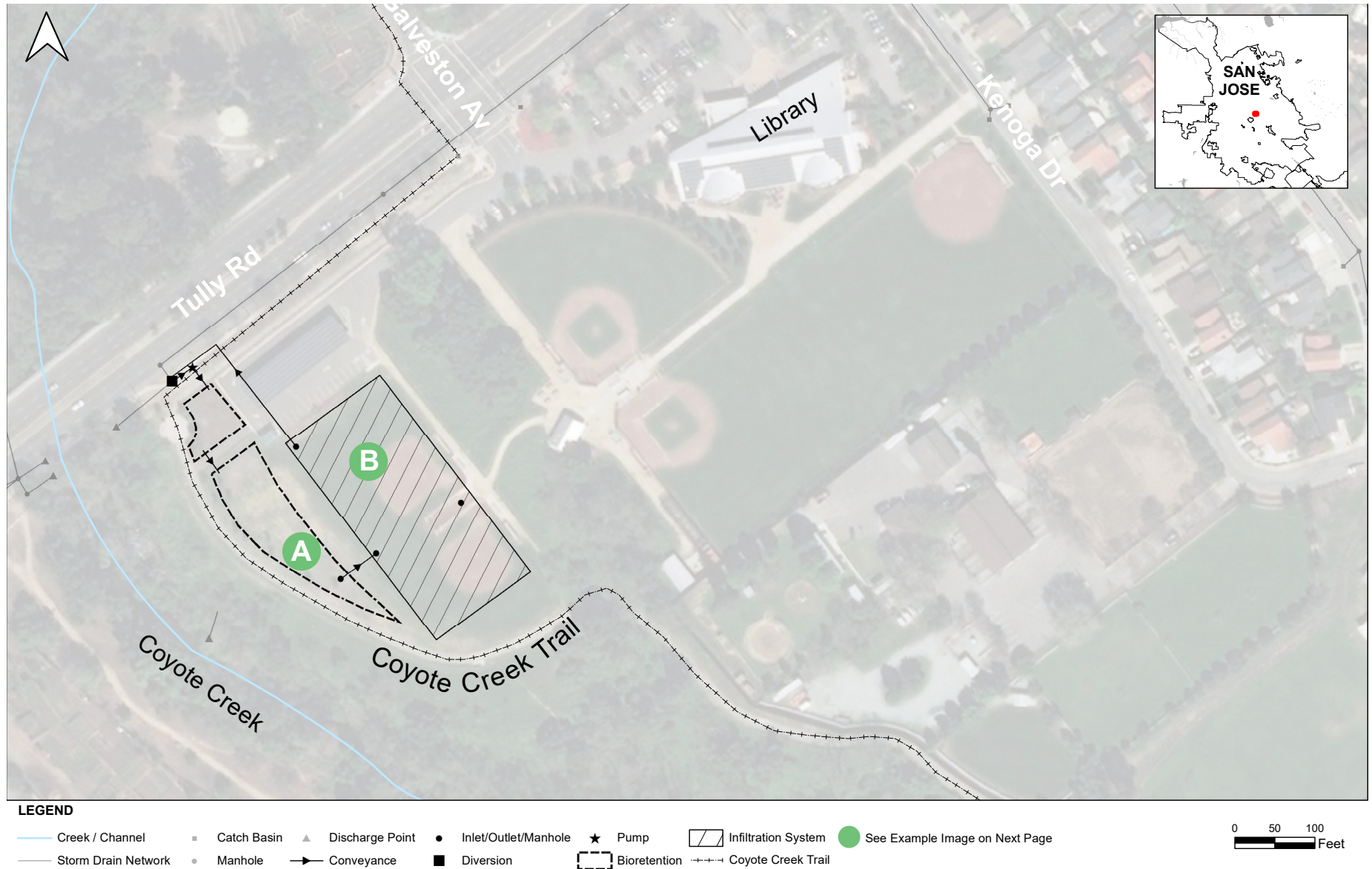
- Site Parcel
- Coyote Creek
- Potential Drainage Area

0 400 800 Ft

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TULLY BALLFIELDS REGIONAL STORMWATER CAPTURE PROJECT

PROJECT BASEMAP



Preliminary concept for discussion purposes only



Example of Bioretention System Integrated into Park Setting at High Point High School in Beltsville, Maryland



Example of Subsurface Infiltration System at Bolivar Park in Lakewood, California



Conceptual Rendering - Tully Ballfields Facing North from the Coyote Creek Trail



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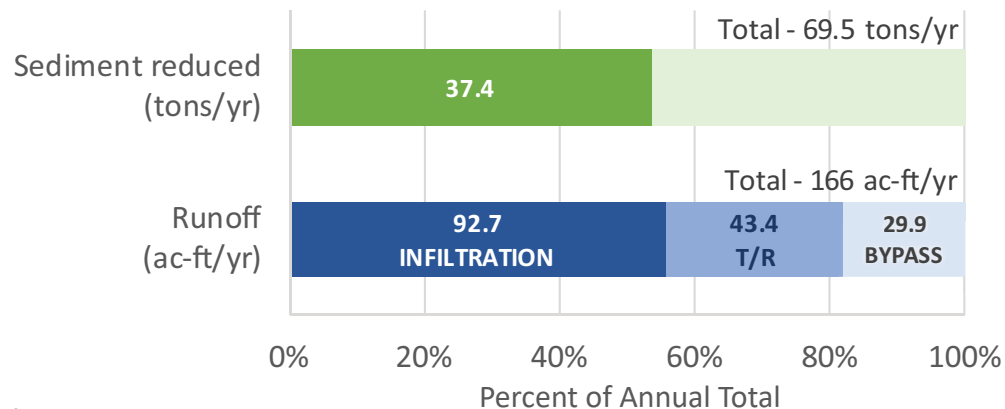
TULLY BALLFIELDS REGIONAL STORMWATER CAPTURE PROJECT

BUDGET-LEVEL COST ESTIMATES

DESCRIPTION	UNIT COST	UNIT	QUANTITY	SUBTOTAL
Utilities Protection and Relocation	\$30,000	LS	1	\$30,000
Hydrodynamic Separator	\$150,000	EA	1	\$150,000
Pump Station (30 CFS) & Diversion	\$5M	LS	1	\$5,020,000
Culvert	\$300	LF	30	\$9,000
Storm Sewer Pipe	\$200	LF	460	\$92,000
Excavation	\$40	CY	16,000	\$640,000
Haul	\$25	CY	13,000	\$325,000
Bioretention Soil	\$200	CY	1,000	\$200,000
Bioretention Planting and Mulch	\$22	SF	18,000	\$396,000
Stockpile & Backfill	\$15	CY	3,000	\$45,000
Subsurface Storage	\$1.50	GAL	2,000,000	\$3,000,000
Surface Restoration	\$5	SF	45,000	\$225,000
Irrigation System	\$3	SF	45,000	\$135,000
Fence	\$45	LF	650	\$29,250
Connection to Storm Sewer Main	\$75,000	EA	1	\$75,000
Cartridge Filtration Units	\$200,000	EA	3	\$600,000
CONSTRUCTION SUBTOTAL				\$10,971,250
Mobilization (10% construction)				\$1,097,000
Contingency (30% Construction)				\$3,291,000
Design (12% Total)				\$1,843,000
TOTAL PROJECT COST (DESIGN + CONSTRUCTION)				\$17,202,250

* These are planning-level cost estimates (\$2018) for design and construction. Soft costs for City administration and project management and post-construction operations and maintenance are not included. Other factors that may affect the cost of future construction include escalation and market conditions.

BMP EFFECTIVENESS (ANNUAL AVERAGE)



T/R - Treat & Release

- Effectiveness is defined as the modeled ability of the proposed project to capture stormwater runoff from the management area, remove the identified constituents from that stormwater, and infiltrate or reuse the captured water.
- Modeling and performance estimates are based on an historical rainfall time series from water year 2007 through water year 2015.

ADDITIONAL POTENTIAL BENEFITS



FLOOD MANAGEMENT



COMMUNITY ENHANCEMENT



REESTABLISHES NATURAL
HYDROLOGY

ADDITIONAL CONSIDERATIONS

This project concept is planning-level and subject to revision as additional information becomes available. Factors to be considered include but are not limited to the following:

- » Pumping. The storm main is currently located 15 feet deep and is too deep to gravity drain to the system, therefore diverted flow will need to be pumped between the diversion point and the infiltration system.
- » Infiltration Potential. The depth to groundwater is estimated to be between 10 and 30 feet in the project area based on mapping for the Santa Clara Basin in Appendix A of the SCVURPPP C.3 Stormwater Handbook. A geotechnical investigation will be conducted to verify infiltration rates and groundwater depths prior to design. Site-specific borings and infiltration tests will be performed during design development to ensure facilities are designed appropriately.
- » Community Enhancement. Enhancing the trail network through incorporation of attractive bioretention facilities in the project area could provide additional educational opportunities for local neighborhoods.
- » Stakeholder Coordination. Outreach should be conducted with neighborhood residents and park users as construction would impact sports field usage.

VINCI PARK REGIONAL STORMWATER CAPTURE CONCEPT

San José

CONCEPT DESCRIPTION

Vinci Park is a 2.3-acre neighborhood park in the City of San José. Stormwater runoff from the 35-acre residential area to the east of the park between Flickinger Avenue and Berryessa Road drains into a 21-inch storm sewer running along the side of the park under Vinci Park Way. To increase the tributary area to this project, an 18-inch cross connection pipe will be installed along 715 feet of Hikido Drive between Flickinger Avenue and Vinci Park Way to capture an additional 43 acres.

The project concept involves constructing a pump station to lift flows from the storm sewer on Vinci Park Way, which is approximately 15 feet below grade, up and into a subsurface pretreatment (e.g., hydrodynamic separator) unit. Flows would then drain into an infiltration chamber under the park. Loamy soils in the park are conducive to infiltration. The pretreatment device will remove trash & debris, floatables, and coarse solids prior to entering the chamber. This will provide a concentrated maintenance point and help prevent

clogging at the interface of the infiltration gallery and native soil over the long-term.

To maximize storage capacity within the limited footprint of the park, the infiltration chamber will be comprised of modular pre-fabricated units with 8-feet of interior storage depth. The chamber will have a footprint of 0.48 acres and provide a total of 3.8 acre-feet of storage. The proposed design would allow for the capture and treatment of 96% of the annual runoff volume (22 of 23 acre-feet) from the 78-acre area draining to this project.

Installation of the subsurface infiltration chamber will not affect the presence or health of existing trees. Following installation, affected park play areas and pathways will be restored. This project will enjoy positive synergies with planned park upgrades. In addition, signage could be added to educate park users on the treatment system beneath the field and its benefits.

CONCEPT METRICS

WATERSHED CHARACTERISTICS	
Watershed	COYOTE CREEK
Drainage Management Area	78 AC
% Impervious of DMA	48
Total Runoff Volume	23 AC-FT/YR
FACILITY INFORMATION	
INFILTRATION GALLERY	
Total Facility Area	0.48 AC
Storage Depth	8 FT
DESIGN CRITERIA	
Diversion Rate	7.8 CFS
Total Storage Volume	3.8 AC-FT
Infiltration Rate	1.6 IN/HR
Total Runoff Captured	22 AC-FT/YR (96%)

CONCEPT SITE DRAINAGE AREA



LEGEND

- Site Parcel
- Storm Drain Network
- Diversion Pipe
- Potential Drainage Area
- Catch Basins

0 200 400ft

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VINCI PARK REGIONAL STORMWATER CAPTURE CONCEPT

CONCEPT BASEMAP



Preliminary concept for discussion purposes only



City of Lakewood
Example of Subsurface Infiltration Chamber under Large Green Space at Bolivar Park in Lakewood, California



Open Space in Park where Infiltration Gallery will be Located

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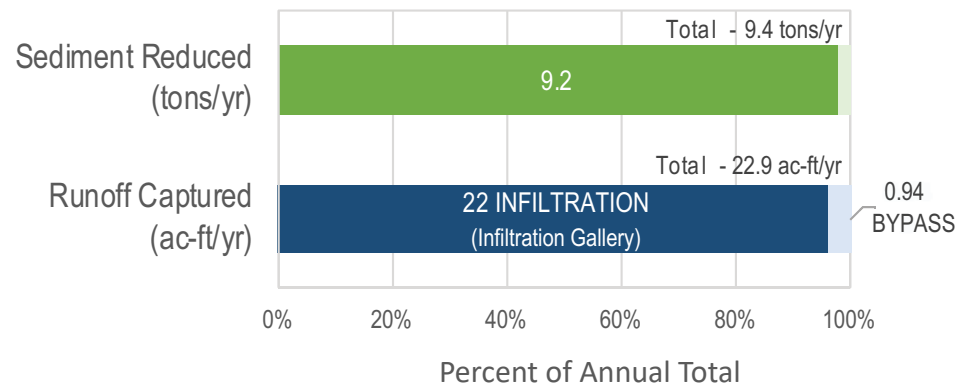
VINCI PARK REGIONAL STORMWATER CAPTURE CONCEPT

BUDGET-LEVEL COST ESTIMATES (PHASE 1)

DESCRIPTION	UNIT COST	UNIT	QUANTITY	SUBTOTAL
Utilities Protection/Relocation	\$30,000	LS	1	\$30,000
Cross Connection Pipe (18" RCP)	\$275	LF	715	\$196,625
Pump Station (7.8 CFS)	\$2.23M	LS	1	\$2,223,400
Diversion Pipe (24" RCP)	\$300	LF	50	\$15,000
Hydrodynamic Separator	\$125,000	EA	1	\$125,000
Excavation & Offhaul	\$70	CY	7,400	\$518,000
Modular Infiltration Structures	\$14,000	EA	172	\$2,408,000
Surface Restoration & Planting	\$3	SF	26,136	\$78,000
CONSTRUCTION SUBTOTAL				\$5,594,000
Mobilization (10% Construction)				\$559,000
Contingency (30% Construction)				\$1,678,000
Design Fees (12% total)				\$940,000
TOTAL PROJECT COST (DESIGN + CONSTRUCTION)				\$8,771,000

• These are planning-level cost estimates (\$2018) for design and construction. Soft costs for City administration and project management and post-construction operations and maintenance are not included. Other factors that may affect the cost of future construction include escalation and market conditions.

CONCEPT EFFECTIVENESS (ANNUAL AVERAGE)



• Effectiveness is defined as the modeled ability of the proposed project to capture stormwater runoff from the management area, remove the identified constituents from that stormwater, and infiltrate or reuse the captured water.
 • Modeling and performance estimates are based on an historical rainfall time series from water year 2007 through water year 2015.

ADDITIONAL POTENTIAL BENEFITS



FLOOD MANAGEMENT



COMMUNITY ENHANCEMENT



REESTABLISHES NATURAL
HYDROLOGY

ADDITIONAL CONSIDERATIONS

This project concept is planning-level and subject to revision as additional information becomes available. Factors to be considered include but are not limited to the following:

- » **Infiltration Potential.** The map of Depth to First Groundwater for the Santa Clara Basin in Appendix A of the SCVURPPP C.3 Stormwater Handbook shows depth to groundwater in the range of 20 to 30 feet. Site-specific borings should be drilled to confirm depth to groundwater. The Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO) database notes that soils within the park have a limiting layer of silt loam with an infiltration capacity of 0.57 to 5.95 inches-per-hour, and deeper soils coincident with the base of the facility are loam and are thus likely to be on the higher end of that range. A geotechnical investigation will be conducted to verify infiltration rates prior to design. Site-specific borings and infiltration tests will be performed during design development to ensure facilities are designed appropriately.
- » **Flood Reduction.** The park is located in a flood-prone catchment so there could be an opportunity to provide flood protection to the surrounding neighborhood as part of the project. Flood control design considerations and potential flood reduction benefits will be coordinated with Santa Clara Valley Water District (SCVWD).
- » **Utility Coordination.** Vinci Park Way appears to contain typical right-of-way utility service for a residential neighborhood. Additional spatial data showing all utility mains along the roadway corridors within the project area (Vinci Park Way and Hikido Drive) should be collected and evaluated for potential conflicts; proposed facility locations should be adjusted as necessary to avoid any major conflicts.
- » **Stakeholder Coordination.** Outreach should be conducted to the neighboring residents and Vinci Park Elementary school throughout the design development process to ensure that all improvements are compatible with the neighborhood and school priorities.

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D

MAINTENANCE & MONITORING PLAN

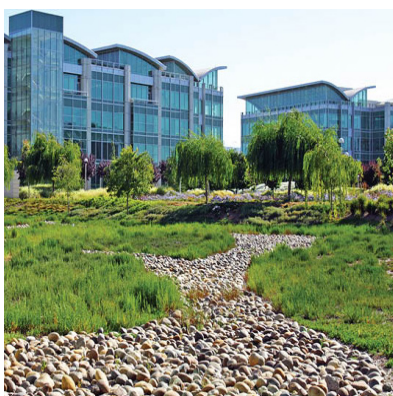
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CITY OF SAN JOSE

**GREEN STORMWATER INFRASTRUCTURE
MAINTENANCE &
MONITORING
PLAN**

January 2019

Draft



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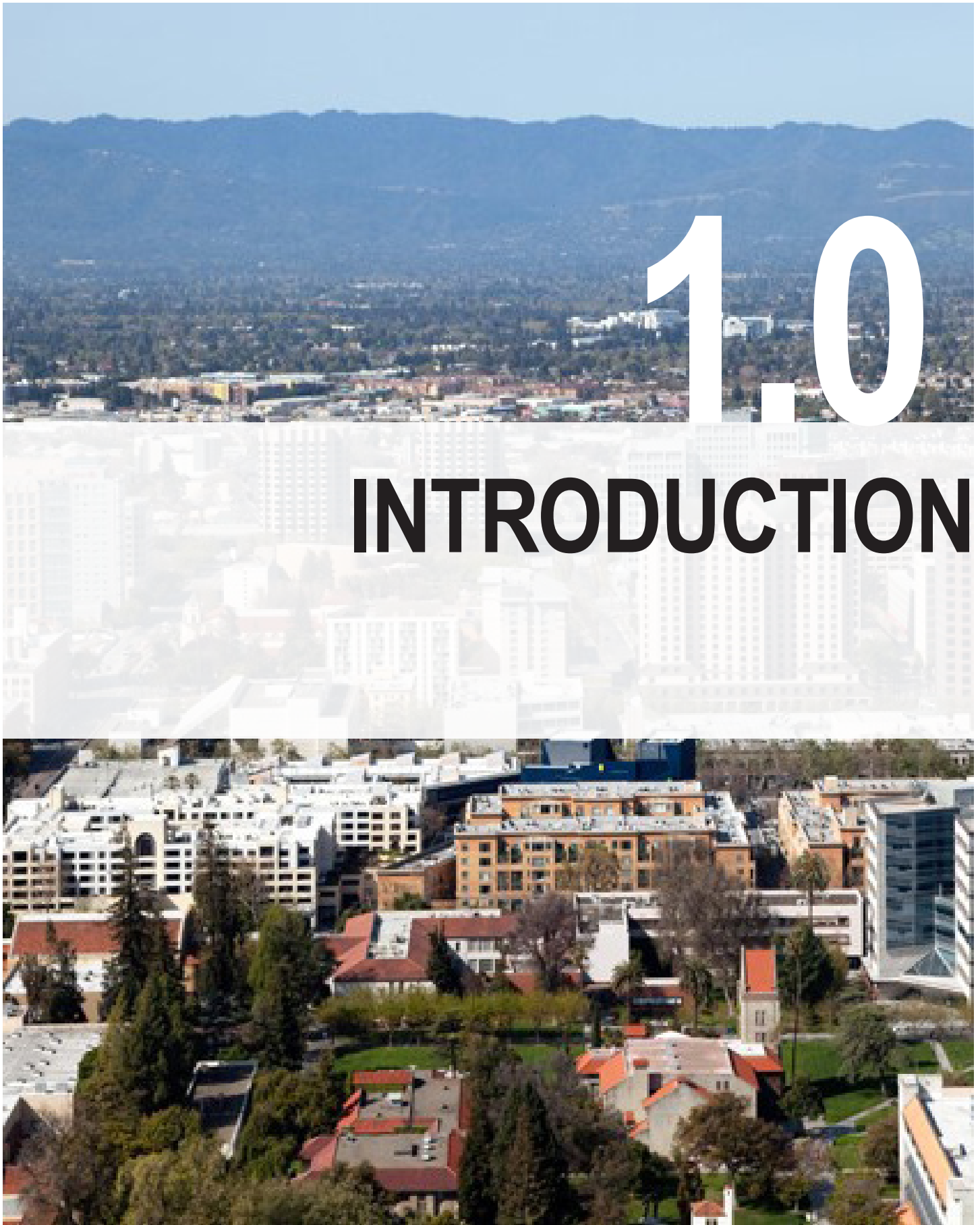
Acronym / Abbreviation	Definition
ADA	American with Disabilities Act
BASMA	Bay Area Stormwater Management Agencies Association
BSM	Biotreatment Soil Media
BMP	Best Management Practice
CCR	California Code of Regulations
CIP	Capital Improvement Project or Program
City	City of San José
CLRP	Comprehensive Load Reduction Plan
DDOT	District Department of Transportation (Washington DC)
EEDMS	Environmental Enforcement Data Management System
EPA	Environmental Protection Agency
ERP	Enforcement Response Plan
ESD	Environmental Services Department
FDR	Full Depth Reclamation
FHWA	Federal Highway Administration
GIPF	Green Infrastructure Plan Framework
FY	Fiscal Year
GSI	Green Stormwater Infrastructure
GIS	Geographic Information System
HDM	Highway Design Manual
H&H	Hydrologic and Hydraulic (Model)
IPM	Integrated Pest Management
LID	Low Impact Development
MG	million gallon(s)
MGD	million gallons per day
MRP	Bay Area Municipal Regional Stormwater Permit
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
PBCE	Plan, Building and Code Enforcement
PCBs	Polychlorinated Biphenyls
PICP	Permeable Interlocking Concrete Pavement
POC	Pollutants of Concern
PP	Pervious Pavement
PRNS	Parks, Recreation and Neighborhood Services
PW	Public Works
RAA	Reasonable Assurance Analysis
ROW	Right-of-Way
RWQCB	San Francisco Bay Regional Water Quality Control Board ("Water Board")
SCVWD	Santa Clara Valley Water District
SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program
SMCWPPP	San Mateo Countywide Water Pollution Prevention Program
SOP	Standard Operating Procedure
SWRP	Santa Clara Basin Stormwater Resource Plan
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency

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1.0

INTRODUCTION

1.1 PURPOSE

Water enters the City's storm sewer system through approximately 32,000 storm drain inlets. Stormwater flows are conveyed without treatment to local creeks and streams and ultimately to the San Francisco Bay. These flows are comprised of rainfall runoff, excess irrigation water, and other outdoor water that collect pollutants as they run across rooftops, sidewalks, driveways, streets, and landscaping. Green Stormwater Infrastructure (GSI) is an approach that uses vegetation, soils, and natural processes to filter the runoff and reduce pollutants in local waterways and the Bay. Generally, GSI has several different layers that each serve a separate function. These layers may include: vegetation, mulch, a special soil mix, and rock. Regular maintenance is needed to ensure each part continues to function. If GSI is not maintained, the systems may fall into disrepair. The City must ensure that they are functioning and meeting their intent. The City is establishing this monitoring program to ensure proper maintenance.

Post-construction asset management is different for GSI facilities than traditional gray infrastructure. GSI facilities are most often living surface features that become a visible part of the landscape. Proper maintenance is essential in order to sustain the health, appearance, and function of these engineered systems. Regular monitoring and maintenance of GSI provides assurance that facilities will perform as intended over their full lifespan. Providing proper maintenance requires an organizational structure that defines roles and responsibilities, a comprehensive tracking system, and training on proper maintenance methods and techniques.



Figure 1-1 Existing Green Stormwater Infrastructure

1.2 BACKGROUND

The Federal Clean Water Act requires the City to operate under a National Pollutant Discharge Elimination System (NPDES) Municipal Regional Stormwater Permit (MRP) for the discharge of stormwater to surface waters via the City's storm sewer collection system. The MRP specifies actions necessary to reduce the discharge of pollutants in stormwater to the maximum extent practicable and effectively prohibits discharges of non-stormwater into the municipal storm sewer system to protect local creeks and the Bay.

Over the last 13 years, under current and previous stormwater permits, new development and redevelopment projects on private and public property that exceed certain size thresholds ("Regulated Projects") have been required to mitigate impacts on water quality by incorporating site design, pollutant source control, stormwater treatment and flow control measures, as appropriate. Low Impact Development (LID) such as rainwater harvesting and use, infiltration, and biotreatment, have been required on most Regulated Projects since December 2011.

In December 2010, the MRP began requiring permittees to implement an Operation and Maintenance Verification Program to ensure that onsite, joint, and offsite stormwater treatment systems and hydromodification controls installed by Regulated Projects are properly operated and maintained in perpetuity. This Provision also required the development of a database or equivalent tabular format to track the operation and maintenance inspections and any necessary enforcement actions against Regulated Projects.

While both public and private Regulated Projects have been addressed on a project-by-project basis, the City as a whole, with a particular focus on public right-of-ways and properties that encompass large areas of impervious land with associated runoff, have not been addressed in a comprehensive way. Recognizing this gap, the 2015 MRP added a requirement for municipalities to develop a Green Stormwater Infrastructure Plan (GSI Plan) to address the issue. Moving forward, the City will maintain City-owned GSI on public property. GSI will also be incorporated on Regulated Project sites and additional installations built beyond MRP requirements to meet flow reduction goals described in the GSI Plan. All of these GSI projects will be incorporated into the City's existing Operations and Maintenance Verification Program.

The City's GSI Plan includes a Reasonable Assurance Analysis (RAA) that is focused on flow reduction of a critical bacteria storm. All public and private GSI will contribute to the City's goal of reducing flow to meet the critical bacteria storm and MRP total maximum daily loads. Therefore, this Maintenance and Monitoring Plan has been developed to address both public and private GSI.

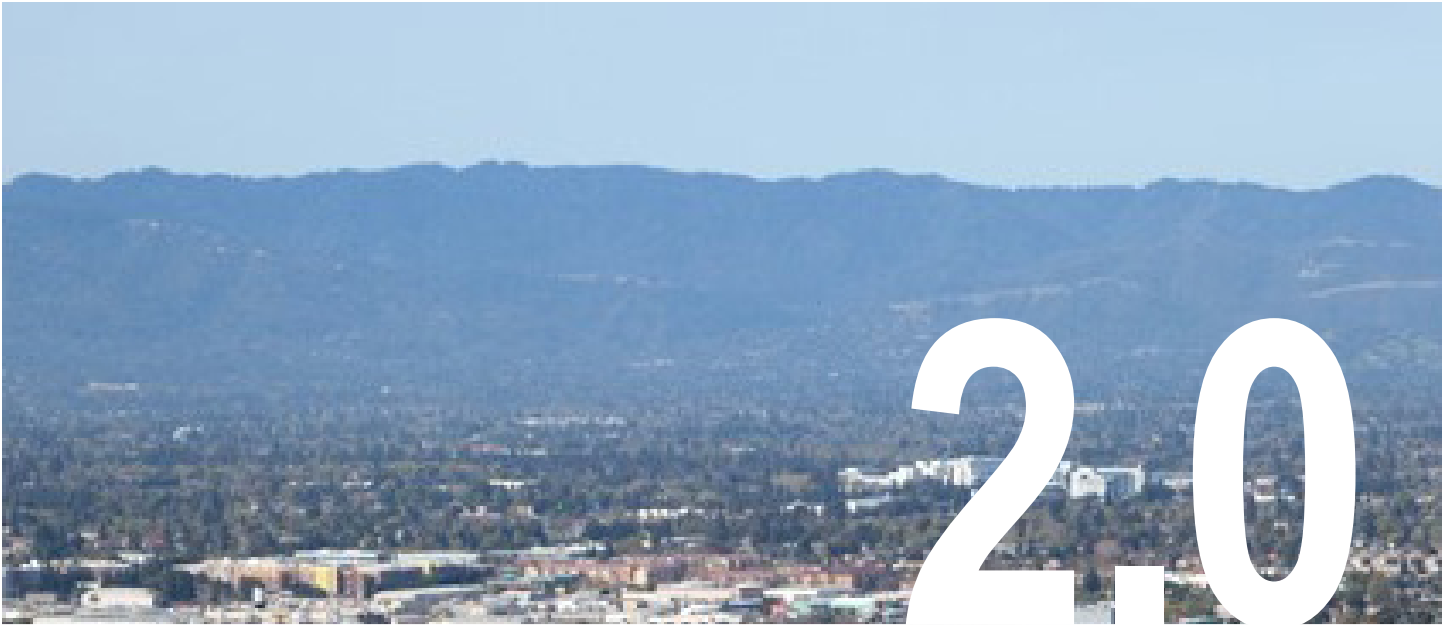
1.3 PROGRAM OBJECTIVE AND GOALS

This document describes the program structure of the Citywide maintenance and monitoring activities in place to ensure that GSI in the City is being maintained sufficiently to meet the goal set forth in the GSI Plan of reducing flow consistent with the critical bacteria storm. The City utilizes resources such as Standard Operating Procedures (SOPs), Enforcement Response Plans (ERP), and Best Management Practice (BMP) guides to implement the maintenance and monitoring activities.

Primary Maintenance and Monitoring Plan goals:

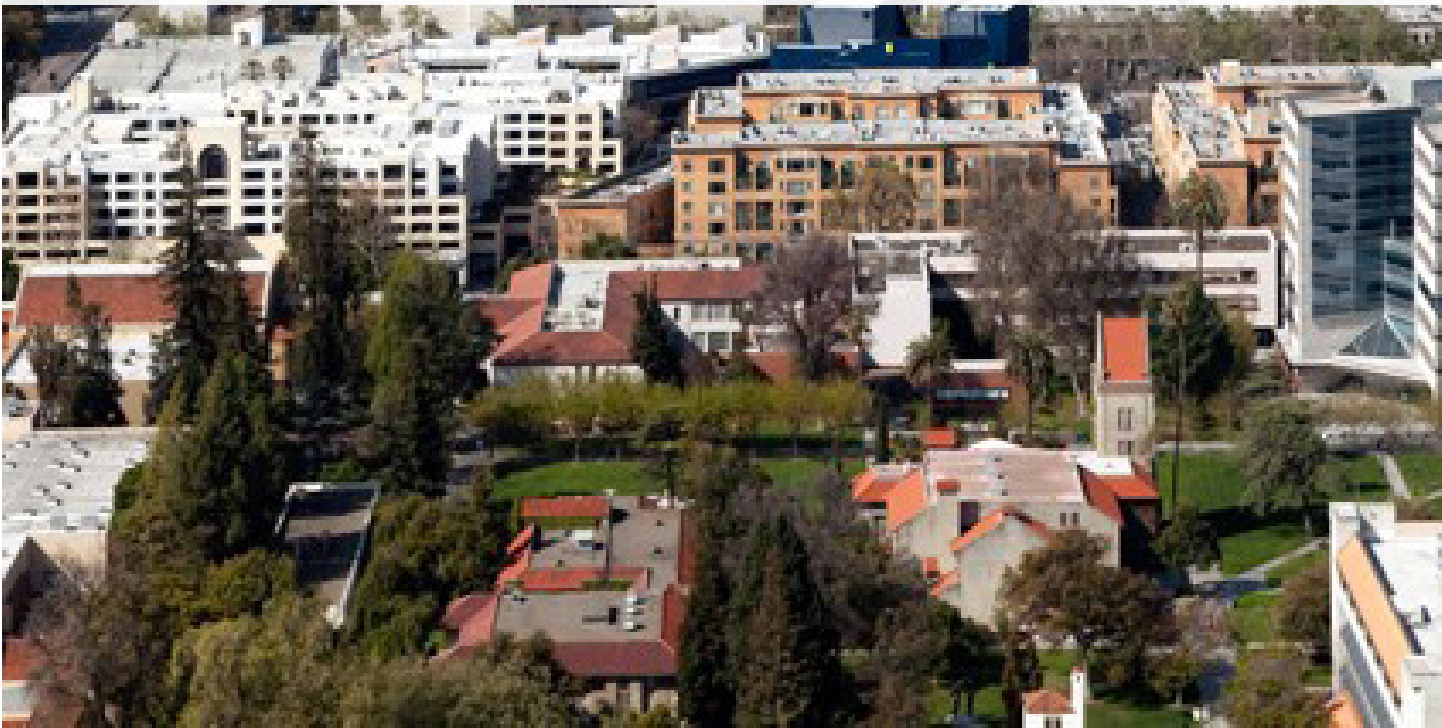
- » Summarize the existing program, including SOPs, ERPs, and other guidance documents.
- » Provide reasonable assurance that GSI installed in San José is maintained and operated such that the installations continue to treat the target flows identified in the GSI Plan.
- » Draw conclusions, identify lessons learned, and establish a feedback loop to incorporate this information into future project planning, design, and SOPs.

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2.0

**PROJECT TYPES AND
TECHNOLOGIES**



2.1 PROJECT TYPE

GSI projects can be separated into three major categories:

LOW IMPACT DEVELOPMENT

LID projects capture and manage runoff onsite. These projects are designed to reduce runoff and mimic a site's predevelopment hydrology by reducing impervious coverage with site design measures, limiting polluted runoff with source control measures, and by treating runoff close to its source. LID projects include bioretention facilities, infiltration trenches, detention and retention areas in landscaping, pervious pavement, green roofs, and systems for stormwater capture and use. These projects may or may not be Regulated Projects.



GREEN STREET PROJECTS

Green streets projects are located in the public right-of-way and capture runoff from the street and adjacent drainage areas. Projects typically include bioretention (e.g., stormwater planters, stormwater curb extensions, or stormwater tree filters), pervious pavement, and/or infiltration trenches. These projects are designed to reduce runoff volume and pollutants while providing benefits such as greening and habitat.



REGIONAL PROJECTS

Regional projects capture and manage runoff from large areas of off-site sources through storm drains, channels, culverts, and streams. These projects could include large above-ground or below-ground runoff capture facilities located in large open space areas or under existing uses to which runoff from large acreages of impervious surface can be directed. These projects can take a variety of forms such as detention and retention basins, infiltration galleries, and constructed wetlands.



2.2 GSI FACILITY TYPES

GSI projects utilize different technologies to meet runoff reduction targets depending on scale, location, and performance targets. This section describes the typical GSI facility types constructed in the City. These facility types have specific maintenance and monitoring needs in order to preserve their function and appearance. For additional information on operations and maintenance guidance, refer to the City's GSI Maintenance Field Guide described in Chapter 3.

BIORETENTION

Bioretention planters are living systems that utilize a specially engineered soil mixture and selective plant palette which allows the soil matrix and root zone to provide storage and treatment of rainwater runoff. Maintenance of bioretention systems is focused on weed prevention, plant health, sediment/trash/debris removal, and other stressors that affect the overall facility appearance and function.



PERVIOUS PAVEMENT

Pervious pavement is made up of a porous top surface and an underlying clean aggregate (drain rock) layer. The aggregate layer provides temporary storage before stormwater infiltrates into the soil below. Proper maintenance to remove accumulated sediment or other solid particles is critical to ensure long-term function and appearance.



TREE WELL FILTER

A tree well filter uses bioretention soil media to filter stormwater flows and support the growth of a tree within a designed structure. Tree well filters can provide peak flow reduction, filtration, and in some cases infiltration. Maintenance activities typically include mulch replacement and removal of sediment and debris that may clog the soil.



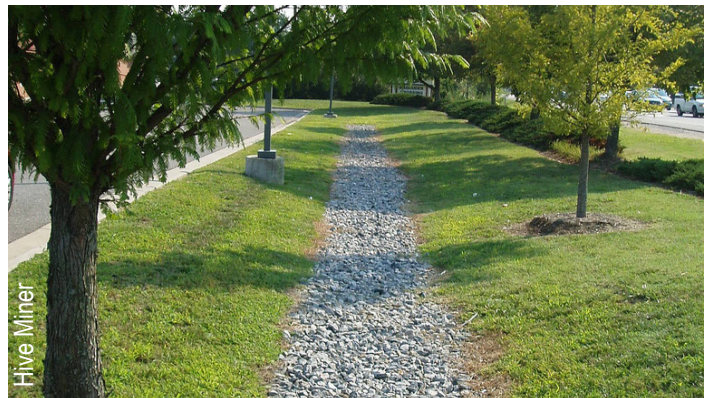
DETENTION BASIN

Detention basins reduce flooding and peak flows by providing temporary storage of stormwater and slowly releasing flows using an outlet control structure. Detention basins drain over an average of 48 hours and do not maintain a permanent pool of water. Typical maintenance activities include clearing sediment and materials preventing infiltration or flow through the system.



INFILTRATION TRENCH

An infiltration trench is an excavated trench lined with a filter fabric and backfilled with a stone aggregate. Infiltration trenches detain stormwater runoff by providing storage within the void space of the aggregate and allowing runoff to infiltrate into the underlying soil. The main threat to infiltration trenches is the accumulation of debris and sediment that prevents flow through the system. Maintenance activities focus on removing accumulated sediment and debris.



GREEN ROOF

Green roofs are vegetated roof systems that filter, absorb, and detain the rain that falls on them. Green roof systems are comprised of a layer of planting media and vegetation, underlain by structural components such as waterproof membranes, synthetic insulation and geofabrics. Maintenance activities focus on establishing healthy vegetation within the first year, and maintaining vegetation quality in subsequent years.



RAINWATER HARVESTING

Rainwater harvesting is the process of collecting rainwater from impervious surfaces and storing it for later use. Rainwater harvesting systems are designed to store a specific volume of water with no discharge until this volume is exceeded. Rainwater harvesting systems can include complex components such as pumps, treatment devices, first flush systems, etc., which can require specific inspection and maintenance frequencies and actions.



2.3 PROJECT OWNERSHIP

Private

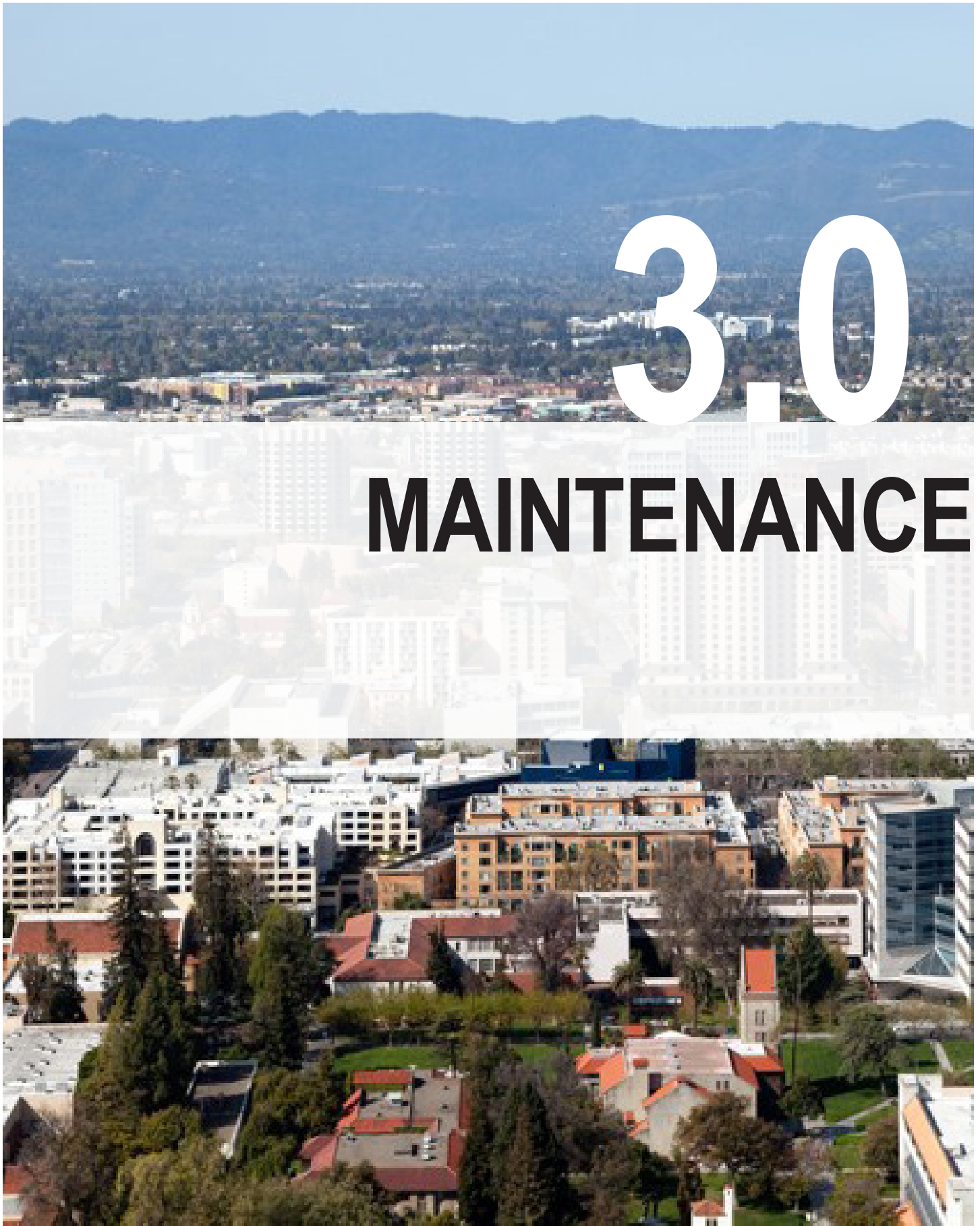
Private projects are development projects constructed by private developers and typically fall into the category of LID. In some cases they can include green street projects or large-scale regional type facilities. These projects are designed and submitted to the City for review. The City follows an interdepartmental SOP for stormwater review of development projects. The SOP was developed to ensure projects are designed to properly function and minimize maintenance requirements.

Public

Public projects can fall into all three GSI project types. The City develops parcel-based projects like libraries and community centers that must be designed in accordance with LID concepts. The City also has constructed and continues to construct green streets for which project design is either managed or completed by the City. The City is also exploring regional projects.

The following two chapters describe the City's approach for Maintenance and Monitoring of GSI.

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3.0

MAINTENANCE

3.1 GSI Maintenance Field Guide

In coordination with the Maintenance and Monitoring Plan the City developed a GSI Maintenance Field Guide (Field Guide) to be used by both private and public parties responsible maintaining GSI. The two main purposes are to provide:

- 1) maintenance standards, and
- 2) maintenance guidelines.

Maintenance Standards

The City established visual standards for the most common GSI types (Bioretention and Pervious Pavement Systems) and corresponding metrics. The standards are organized by a scoring system of 1 (Poor Condition) through 4 (Excellent Condition) which helps assess the overall health and function of GSI facilities. Each metric provides guidance language for what constitutes a “poor” or “excellent” condition. Below is an example of a visual aid and metrics for “Plant Health” in a bioretention area. For less common types of GSI (Tree Well Filters, Detention Basins, Infiltration Trenches, Green Roofs, and Rainwater Harvesting Systems) one-page factsheets were developed to visually demonstrate

Maintenance conditions are based on staff inspection and maintenance experience to-date and direction in similar GSI maintenance programs in the cities of Philadelphia, Seattle, San Francisco, and Austin.

and describe metrics to determine if the GSI is in good or poor condition.

The standards are intended to help guide responsible parties on how to adaptively manage their GSI systems by adjusting the amount of maintenance based on the condition of the facility. The standards also correspond to the City's GSI monitoring program described in Chapter 4. GSI systems that fall into conditions rated as a 2 (Moderate Condition) or 1 (Poor Condition) could be subject to enforcement if the issues causing those condition ratings are not addressed by the responsible party.

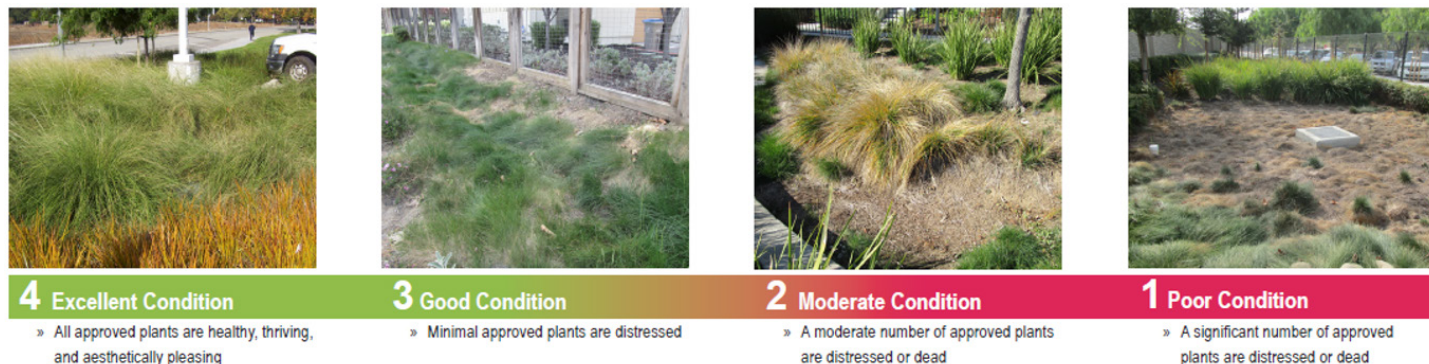


Figure 3-1 Exemplary GSI Maintenance Standard for Plant Health in a Bioretention Area

Maintenance Guidelines

The Field Guide provides clear guidance that will allow maintenance staff to meet the Maintenance Standards set by the City of San José. This section includes general BMPs that correspond directly with the Maintenance Standards categories for each type of GSI. The Maintenance Guidelines are organized by GSI type and each section has a general introductory educational page followed by factsheet pages that illustrate “What to Do” and “What Not to Do” for maintenance activities. Each maintenance factsheet page is intended to function either as a standalone tear-sheet or as a part of the whole Field Guide to help guide staff maintenance activities. The goal of this design was to allow fact sheets to be combined or distributed individually to address specific maintenance challenges.

Visual aids are formatted in the universal red (“stop”) and green (“go – keep doing”). A generic photo of the GSI device is included to provide an “ideal” overview of a properly maintained GSI device in the “What to Do” sections. A generic photo of the GSI device in poor condition is also included in the “What Not to Do” sections. The photos for each section are taken from the standards section to further reinforce how to achieve excellent conditions and how to avoid poor conditions as defined in the Maintenance Standards section.

3.2 FIELD GUIDE DESIGN AND USE

The Field Guide was specifically designed for maintenance staff and functions as a quick reference guide for maintenance assessments and activities. Understanding of GSI maintenance is evolving and as such the layout of the Field Guide was designed to facilitate adding on new information. An emphasis was placed on including photos to help clearly demonstrate actions and expectations beyond the written metrics and guidance. The Field Guide was also specially designed to function as a whole or as individual outreach factsheets. Although it can be referred to in individual pieces, all the sections of the Field Guide are interconnected.

The Field Guide is organized in the following order:

- c) Overview
- d) Site Visit Preparation
- e) Maintenance Inspection Checklist(s)
- f) Maintenance Standards
- g) Maintenance Guidelines, and
- h) Additional Resources.

The City customized maintenance inspection checklists for the following GSI devices: bioretention areas, flow-through planters, and swales (combined), pervious pavement systems, tree wells, detention basins, infiltration trenches, green roofs, and rainwater harvesting systems. These can be used to help facility maintenance staff carefully assess each GSI maintenance category while utilizing the maintenance standards which prompt maintenance activities that are outlined in the Maintenance Guidelines section. The checklist allows maintenance staff to prioritize tasks, document hours spent on a particular task, and identify material needs for any particular task(s).

Maintenance staff can follow the maintenance process by:

- 1) Obtaining the correct GSI Maintenance Inspection Checklist;
- 2) Performing a condition assessment which corresponds to the Maintenance Standards;
- 3) Determining the maintenance needs based on the results of the inspection. Maintenance staff should address any categories that fall into the “moderate and poor” conditions based on the Maintenance Standards;
- 4) Referring to the Maintenance Guidelines (factsheets) that correspond to the maintenance needs identified in the checklist;
- 5) Completing the maintenance activities per the factsheets; and
- 6) Checking the final condition against the Maintenance Standards

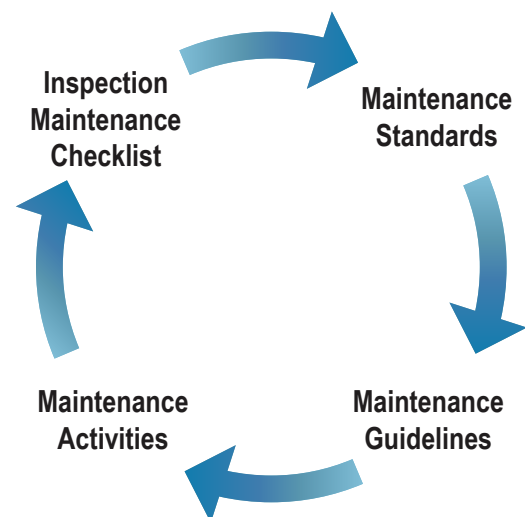


Figure 3-2 Maintenance Process

BIORETENTION

Refer to Field Guide for comprehensive maintenance checklist and guidance.

EVERY SITE VISIT

- » Initial site inspection
- » Trash and debris removal
- » Weeding

AS NEEDED

- » Inlets, outlets, and overflow structures cleared of obstructions
- » Erosion control and repair
- » Sediment removal
- » Mulching
- » Pruning or trimming vegetation
- » Plant replacement

DOCUMENT AND REPORT

- » Standing water (>48 hours after most recent rainfall)
- » Structural damage to concrete/wood/metal elements
- » Severe erosion or sedimentation in the planter or drainage system
- » Oversized trash or debris that cannot be removed by hand
- » Irrigation leaks or evidence of other malfunction
- » Vandalism
- » Contamination



PERVIOUS PAVEMENT

Refer to Field Guide for comprehensive maintenance checklist and guidance.

EVERY SITE VISIT

- » Initial site inspection
- » Trash and debris removal
- » Weeding

AS NEEDED

- » Clear inlets, outlets, and overflow structures of obstructions
- » Sediment removal

DOCUMENT AND REPORT

- » Standing water (>48 hours after most recent rainfall)
- » Structural damage to concrete/wood/metal elements
- » Oversized trash or debris that cannot be removed by hand
- » Vandalism
- » Contamination
- » Settling and shifting
- » Spills



DETENTION BASIN

Refer to Field Guide for comprehensive maintenance checklist and guidance.

EVERY SITE VISIT

- » Initial site inspection
- » Trash and debris removal
- » Weeding

AS NEEDED

- » Inlets, outlets, and overflow structures cleared of obstructions
- » Erosion control and repair
- » Sediment removal
- » Pruning vegetation

DOCUMENT AND REPORT

- » Standing water (>48 hours after most recent rainfall)
- » Structural damage to concrete/wood/metal elements
- » Severe erosion or sedimentation in the basin
- » Irrigation leaks or evidence of other malfunction
- » Vandalism
- » Contamination



INFILTRATION TRENCH, GREEN ROOF, RAINWATER HARVESTING SYSTEM

Refer to Field Guide for comprehensive maintenance checklist and guidance.

EVERY SITE VISIT

- » Initial site inspection
- » Trash and debris removal
- » Weeding

AS NEEDED

- » Inlets, outlets, and overflow structures cleared of obstructions
- » Erosion control and repair
- » Sediment removal
- » Pruning vegetation

DOCUMENT AND REPORT

- » Standing water (>48 hours after most recent rainfall)
- » Structural damage to concrete/wood/metal elements
- » Severe erosion or sedimentation
- » Irrigation leaks or evidence of other malfunction
- » Vandalism
- » Contamination



3.3 MAINTENANCE PER PROJECT TYPE

Private

As mentioned in the background, there are many existing GSI installations at private development sites in San José. Currently, the inventory is approximately 2,100 GSI installations at close to 400 project sites and it continues to grow. These sites are distributed throughout the City. Each property owner is responsible for proper operation and maintenance of GSI on their site. Maintenance practices must be sufficient to meet the standards set forth in the Field Guide and the requirements in the San José Municipal Code.

Public

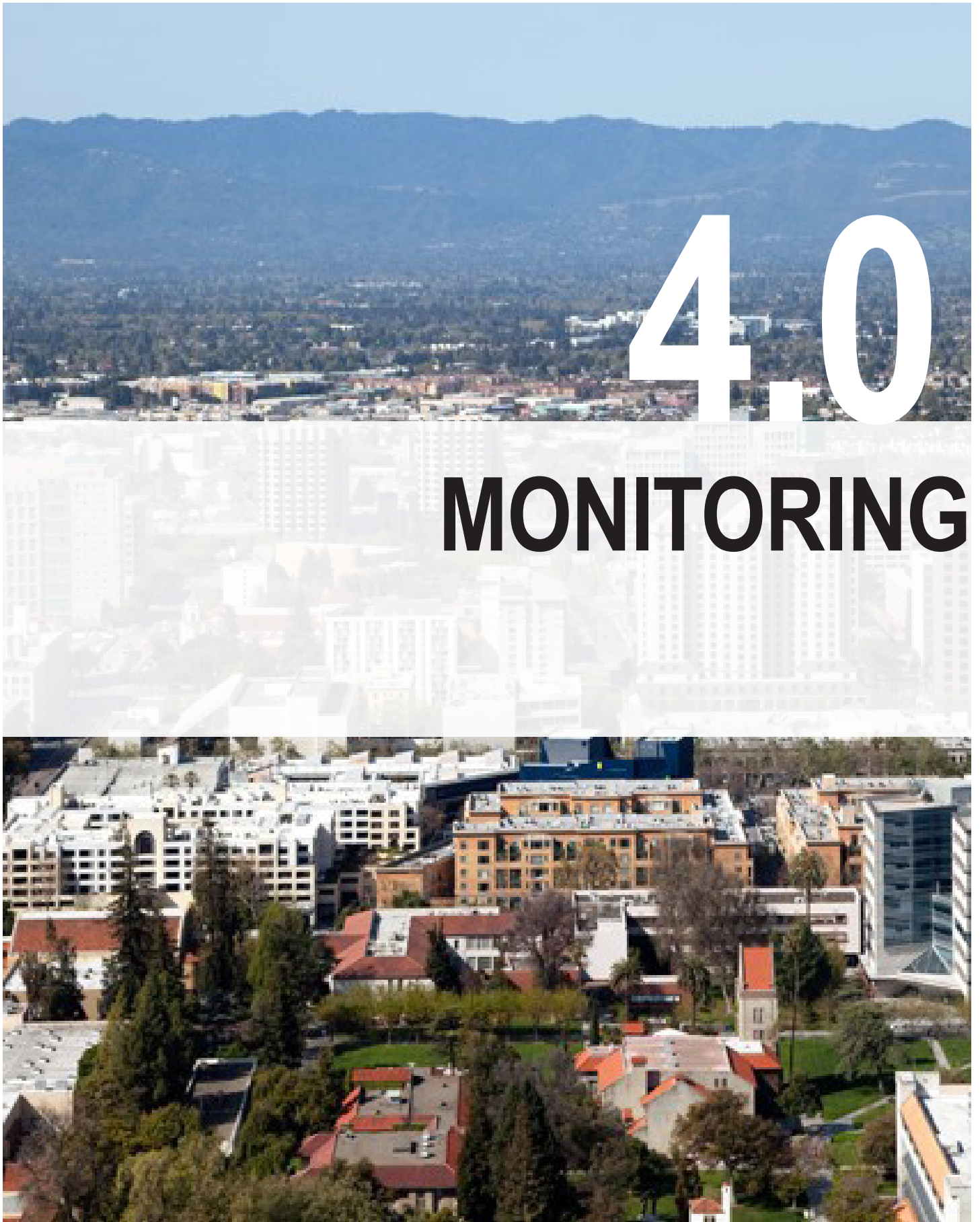
GSI is installed as part of regulated new and redevelopment projects on City-owned properties, grant funded City-initiated projects, or other efforts to improve water quality. The City is the responsible party for maintaining all GSI on property owned and operated by the City and the public right-of-way, unless otherwise specified by a maintenance agreement.

San José Green Stormwater Infrastructure Asset Management

The City manages many municipal assets including roads, storm and sanitary sewer systems, parks, and buildings. In order to do so effectively, the City manages these facilities with the assistance of asset management programs. City-owned and maintained GSI assets will be incorporated into asset management systems.

Generally, there are many factors that can impact the level of maintenance required for GSI including the facility type, project design, drainage area size, land-use, and location (e.g., high pedestrian/vehicle traffic versus low pedestrian/vehicle traffic areas). Maintenance frequencies can vary based on the type of impacts. For example, GSI installations more susceptible to trash or weeds may require more frequent maintenance than those that are less susceptible to these impacts.

The City's asset management programs allow departments to track GSI conditions and required maintenance activities. Departments can utilize this information to adaptively manage the frequencies with which maintenance is scheduled. They can assign different maintenance frequencies for specific tasks (e.g. weeding or trash removal) on a per-site or per-GSI device basis. By using an adaptive approach to asset management the City can distribute resources more strategically to areas of higher maintenance needs over areas of lower maintenance needs based on a site's ability to maintain an acceptable standard as defined in the GSI Field Guide.



4.1 MONITORING PROGRAM OVERVIEW

Monitoring of green stormwater infrastructure is accomplished through two MRP-required inspection programs: the Installation Verification Inspection Program and the Operation and Maintenance (O&M) Inspection Program.

Prior to entering the Operation and Maintenance Verification Program inventory both public and private projects go through a design and approval phase. Understanding the impact a site design can have on the operation and maintenance of GSI, the City developed an interdepartmental SOP for stormwater development plan review to ensure a successful design and minimize maintenance. The document is updated on an as-needed basis to accommodate new industry standards, regulations, and lessons learned from maintenance and monitoring.

Once a project is approved it may begin construction at which point monitoring begins with the Installation Verification Inspection Program. Once GSI is installed it is added to the O&M Inspection Program inventory. The monitoring programs are described below.

4.2 INSTALLATION VERIFICATION INSPECTION PROGRAM

The City is tasked with verifying the proper installation of all GSI per the MRP. The City acknowledges the importance of monitoring during this phase, understanding that improperly installed GSI may not function and may lead to maintenance issues. The City's Installation Verification Inspection Program operates under an Enforcement Response Plan (ERP) that defines how the City will ensure GSI is installed and the steps that will be taken in the event that a project fails to properly complete the installation.

The program begins with the approval of the project plans (e.g., grading and drainage permit plans), which are referenced by the inspector to ensure GSI is constructed correctly. Inspectors utilize pre-construction meetings to discuss inspection expectations, the project schedule, and site protection. The contractor is responsible for notifying the City Inspector when GSI installation occurs during a construction project. Inspections are conducted throughout each of the construction phases of GSI installation to ensure both above and below-ground features are installed correctly. At the completion of each GSI facility installation, the Inspector provides a final inspection to ensure the GSI was built per plan and will function as intended. Inspectors complete installation inspection forms using a GIS-based format (i.e., Survey 123 and ArcCollector) that stores inspection data, GPS coordinates, and photos for each GSI facility.

If the GSI is installed per plan, the inspector collects the GPS coordinates, takes photographs, and completes an inspection form. If the GSI is not installed per plan, the City Inspector notes deficiencies on the Installation Inspection Form and notifies the contractor for corrections. The City Inspector conducts follow-up inspections to ensure corrections are implemented in a timely manner. If corrections are outstanding, then the City Inspector will not complete the Installation Inspection Form and will not provide necessary documents to close the project.

Installation of GSI may be completed before a construction project is fully completed. For example, GSI may be installed during the early phases of a construction project. If this occurs, City Inspectors are tasked with ensuring GSI is maintained and protected with proper stormwater BMPs, as appropriate, throughout construction. In the event that changes or violations associated with GSI installations occur due to ongoing construction at a project site, the City Inspector will notify the contractor immediately who must then implement corrective actions that the City Inspector confirms with follow-up inspections. A project will not be closed out or completed if corrective actions are outstanding.

Ultimately, the City signs off on all GSI installations prior to closing out permits, finalizing contractor agreements, releasing construction retention, and releasing construction bonds. No project is approved by the City unless the GSI is shown to be properly installed and in operating order.

4.3 OPERATION AND MAINTENANCE INSPECTION PROGRAM

The City implements an Operations and Maintenance Inspection program to ensure GSI is maintained such that it continues to function per the MRP and in a manner that reduces flow as prescribed by the Green Stormwater Infrastructure Plan on both private and public sites. City Inspectors utilize SOPs that outline how to prepare and conduct visual inspections of GSI. The SOPs are further supported by the Maintenance Field Guide which describes the standards on which City Inspectors will base their inspection findings. While performing an inspection, inspectors look for clear indicators that the system is not operating efficiently. For example, for bioretention areas, inspectors look for standing water, stressed vegetation, signs of blockage, erosion, excessive sediment buildup, and other visual cues as indicated in the Field Guide. A bioretention area with any of these elements would require corrective action.

In instances where a site still fails to properly operate and maintain its GSI, the O&M Inspection Program operates under an ERP. The ERP guides the City on how to identify, document, and respond to violations of the San José Municipal Code (SJMC) relating to the ongoing maintenance and operation of installed GSI at both publicly and privately owned sites in a consistent and timely manner. Included in the ERP is a tiered approach for issuing enforcement actions for problems (violations of the SJMC) discovered during an inspection. There are multiple levels of enforcement actions which represent an increasing level/degree of severity of the associated violation and include:

- 1) *Correction Notice (CN)*: The CN enforcement action is commonly used when a regulated site fails to properly maintain installed GSI facilities, has no previous history of the same or similar violation, and the observed condition(s) is not severe enough to warrant a higher level of enforcement.
- 2) *Official Warning Notice (OWN)*: This enforcement action is commonly used when a regulated site has a history of the same or a similar violation, or the Responsible Party (RP) fails to adequately complete a required Remedial Action (RA) for an open violation(s), which was issued at the CN level, by the assigned due date, and/or the observed condition is not severe enough to warrant a higher level of enforcement.
- 3) *Administrative Citation Referral (ACR)*: This enforcement action is commonly used when a regulated site has a history of the same or similar violation at the OWN level, or the RP fails to adequately complete a required RA for an open violation(s), which was issued at the OWN level by the assigned due date, and/or the observed condition is severe enough to warrant this level of enforcement.

- 4) *Administrative Citation (AC)*: This enforcement action is a civil, monetary penalty imposed by the City for a violation of a municipal code; it carries no criminal charges. Fine amounts are set in the schedule of fines by council resolution.

A Compliance Meeting is an additional enforcement action, which may be issued in lieu of or in conjunction with an ACR and AC, if appropriate. A Compliance Meeting is a formal meeting with the RP to discuss the causes of the violation(s), the remedial actions required to achieve compliance, and to establish the compliance schedule for the implementation of remedial actions. Additionally, an enforcement case may be referred to the City Attorney if the above enforcement actions fail to achieve compliance.

Enforcement actions may be escalated (changed from one enforcement tier level to a higher, more serious level) based upon: significance of the problem, compliance history, RP's understanding of the requirements, and/or good faith efforts of the RP to implement adequate corrective measures in a timely manner. Factors used in determining the significance of the problem and requirements for a timely response to an enforcement action are dictated by the nature of the problem, the type and condition of the GSI facility, and the corrective measures needed.

When a GSI operation and/or a maintenance problem(s) (i.e., violation of the SJMC) exists, corrective action(s) must be implemented no more than 30 days after a problem is identified by an inspector. Corrective actions can be temporary and more time may be allowed for permanent corrective actions. If more than 30 days are required for compliance, a rationale is recorded in the Environmental Enforcement Data Management System (EEDMS). For inspections resulting in an enforcement action and associated required RAs, a follow up inspection is conducted to verify all RAs are adequately implemented and to ensure compliance is achieved.

The ERP is periodically reviewed and revised to comply with new MRP requirements, more effectively issue enforcement actions and administrative penalties, further compliance, minimize the discharge of contaminated stormwater runoff, and prevent increases in runoff flow from Regulated Projects.

4.4 LEGAL AUTHORITY

The City of San José has established adequate legal authority to ensure that all GSI Operation and Maintenance requirements of the MRP are properly implemented. This authority is contained in Title 20 of the San José Municipal Code (SJMC), Chapter 20.95 “Stormwater Management”, and specifically addressed

in two City Council Policies: Policy 6-29 “Post-Construction Urban Runoff Management” and Policy 8-14 “Post-Construction Hydromodification Management”. The SJMC and these two policies establish an implementation framework to ensure proper stormwater management consistent with the MRP.

4.5 OUTREACH

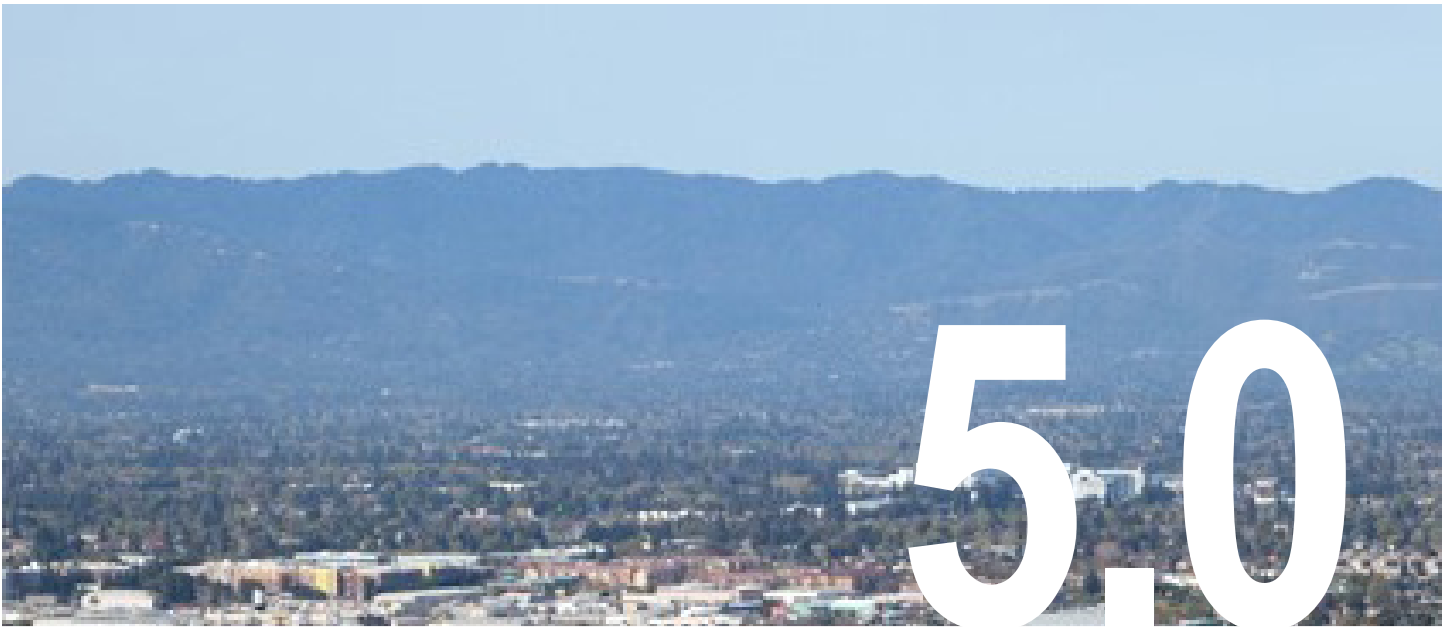
With an overall goal of reducing instances of non-compliance, the City coordinates directly with both private and public site representatives responsible for GSI by maintaining open communication and by providing background information highlighting the importance of properly functioning GSI. Inspectors inquire about routine inspection and maintenance activities conducted at the site and utilize the Maintenance Field Guide as an outreach tool to assist in guiding the RP to compliance. In addition to direct communication during O&M inspections, the City also utilizes other means of outreach and communication to remind site representatives of the City’s GSI requirements. The City regularly updates its website with current GSI-related information, maintains a presence on social media, and sends annual letters to property owners reminding them of their obligation to maintain GSI.

Additionally, the City regularly collaborates with regional partner stormwater management agencies (i.e., Santa Clara Valley Urban Runoff Pollution Prevention Program, SCVURPPP) to develop SOPs and BMPs for residential and commercial audiences. Coordination on a regional level helps provide consistency amongst enforcement programs related to GSI.

4.6 O&M INSPECTION PLAN

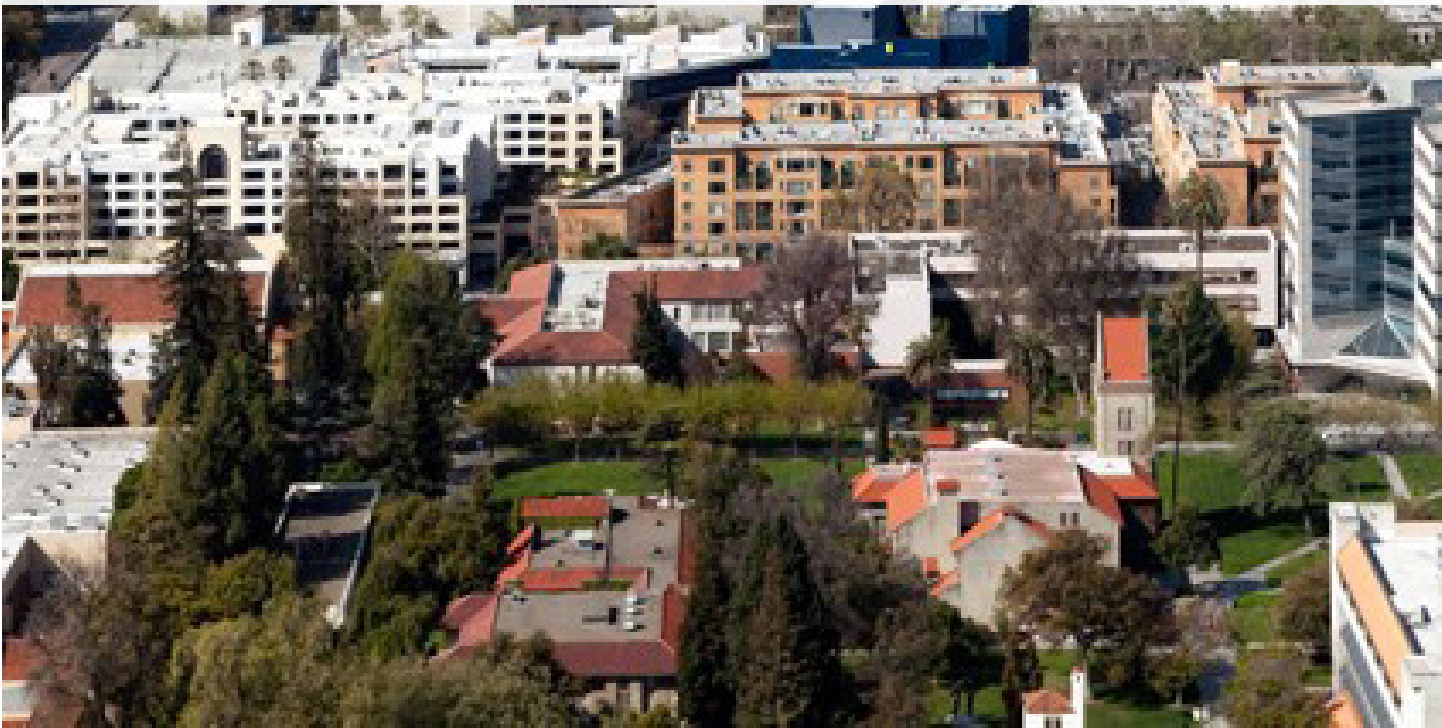
The site selection method for inspecting facilities for compliance with O&M requirements is detailed in the O&M Inspection Program Inspection Plan (Inspection Plan). The Inspection Plan prioritizes sites for inspection and is updated regularly as part of an adaptive management technique that allows the program flexibility to focus on higher risk sites that may need more frequent inspections. The Inspection Plan is designed to ensure the City is meeting or exceeding regulatory inspection requirements and helps select sites to be inspected using a prioritization schedule that allows the City to more effectively ensure GSI measures are being operated and maintained. Inspection priority and frequency are primarily based on the installation date and the date of the last inspection for each site.

Other categories that may be used to determine priority and inspection frequency include, but are not limited to: violation history, data collection needs, land use category, and type of GSI installed. Based on updates to the Inspection Plan, these general guidelines may be adapted to better address the needs of the program.



5.0

**DATA TRACKING
AND REPORTING**



5.1 DATA TRACKING AND REPORTING

In accordance with Provisions C.3.b.iii-iv of the MRP, the City maintains an electronic database of regulated projects, offsite projects, and regional projects. The database maintains information regarding project type, location, size, and design. GSI project information is tracked in four stages: project approval, construction, installation, and operations and maintenance. The City utilizes an Oracle-based data management system called Environmental Enforcement Data Management System (EEDMS) to collect and store all GSI data. This data management system allows for large amounts of data storage and tracks updates so that information is not lost.

All GSI projects go through a plan review process whether they are public or private. Public projects will go through an internal review and approval process while private projects are reviewed throughout the planning entitlement and grading and drainage permit phases. When a public or private project is approved by the City, following the review process, the project is entered into the EEDMS tracking database. When GSI projects are implemented for compliance with LID requirements under Provision C.3 of the Stormwater Permit they are reported as regulated projects in the MRP Annual Report. When they are implemented separately they are currently reported as Early Implementation Green Stormwater Infrastructure Projects. Although the projects are reported differently, they are tracked in the EEDMS database in the same manner.

The City tracks when GSI projects begin construction. Once a project enters this phase, the database is updated so that the existing file is re-classified as under construction. When a project is classified as under construction, the process for tracking installations of green stormwater infrastructure begins.

Each installation is captured electronically via a GIS-based format that records the inspection form, photos of the newly installed GSI, and the GPS coordinates. When an individual GSI facility is completed, the database file is updated to reflect that one or all GSI facilities are installed. Inventory updates and location coordinates are provided to responsible departments within the City so that the respective asset management programs can be updated and the task work orders can be associated with the GPS point. Newly installed GSI is reported to the Water Board and the Santa Clara County Vector Control District on an annual basis.

Upon installation, GSI facilities are tracked during the ongoing operations and maintenance of the facility. Once the database is updated to reflect that GSI has been installed, that particular installation enters the inspection cycle. Each inspection is tracked within the database including, but not limited to, the following information.

- » Date of inspection.
- » Type of inspection (e.g., installation, annual, follow-up, spot).
- » Type(s) of pervious pavement systems inspected (e.g., pervious concrete, pervious asphalt, pervious pavers).
- » Type(s) of stormwater treatment systems inspected (e.g., swale, bioretention unit, tree well) and an indication of whether the treatment system is an onsite, joint, or offsite system
- » Type of hydromodification controls inspected.
- » Inspection findings or results (e.g., proper installation, proper operation and maintenance, system not operating properly because of plugging, bypass of stormwater because of improper installation or maintenance, maintenance required immediately).
- » Enforcement action(s) taken, if any (e.g., verbal warning, notice of violation, compliance schedule, administrative citation, administrative order).

This is a very detailed process that involves City interdepartmental coordination to ensure all the information is accurately tracked and reported. This is a closed loop process (as shown in Figure 6-1) because the steps for each phase of the tracking process help inform the next. Lessons learned at each phase of the process are ultimately tracked and conveyed back to the plan review process through coordination meetings and updates to the SOPs.

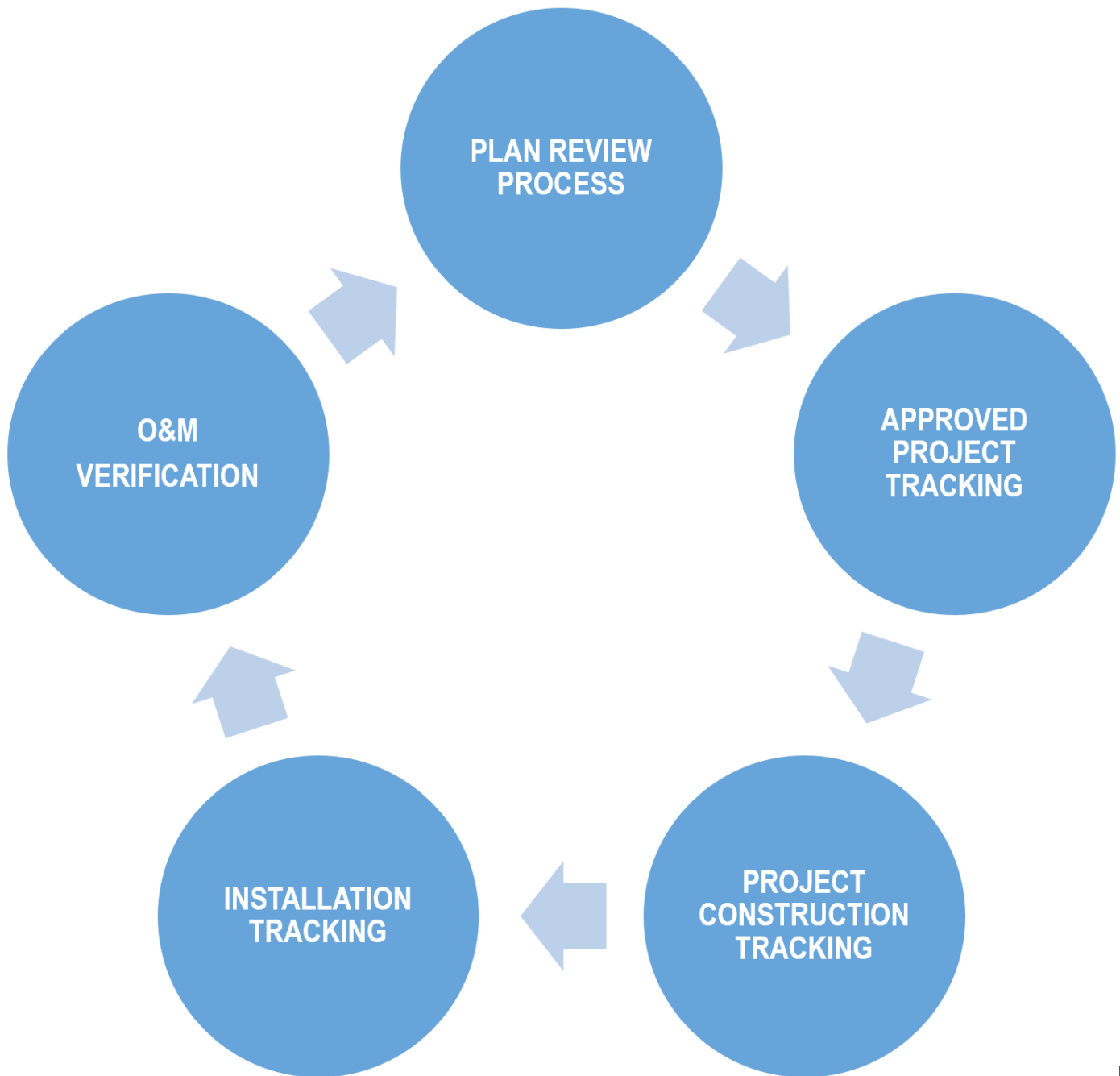


Figure 5-1 GSI Closed Loop Tracking Process

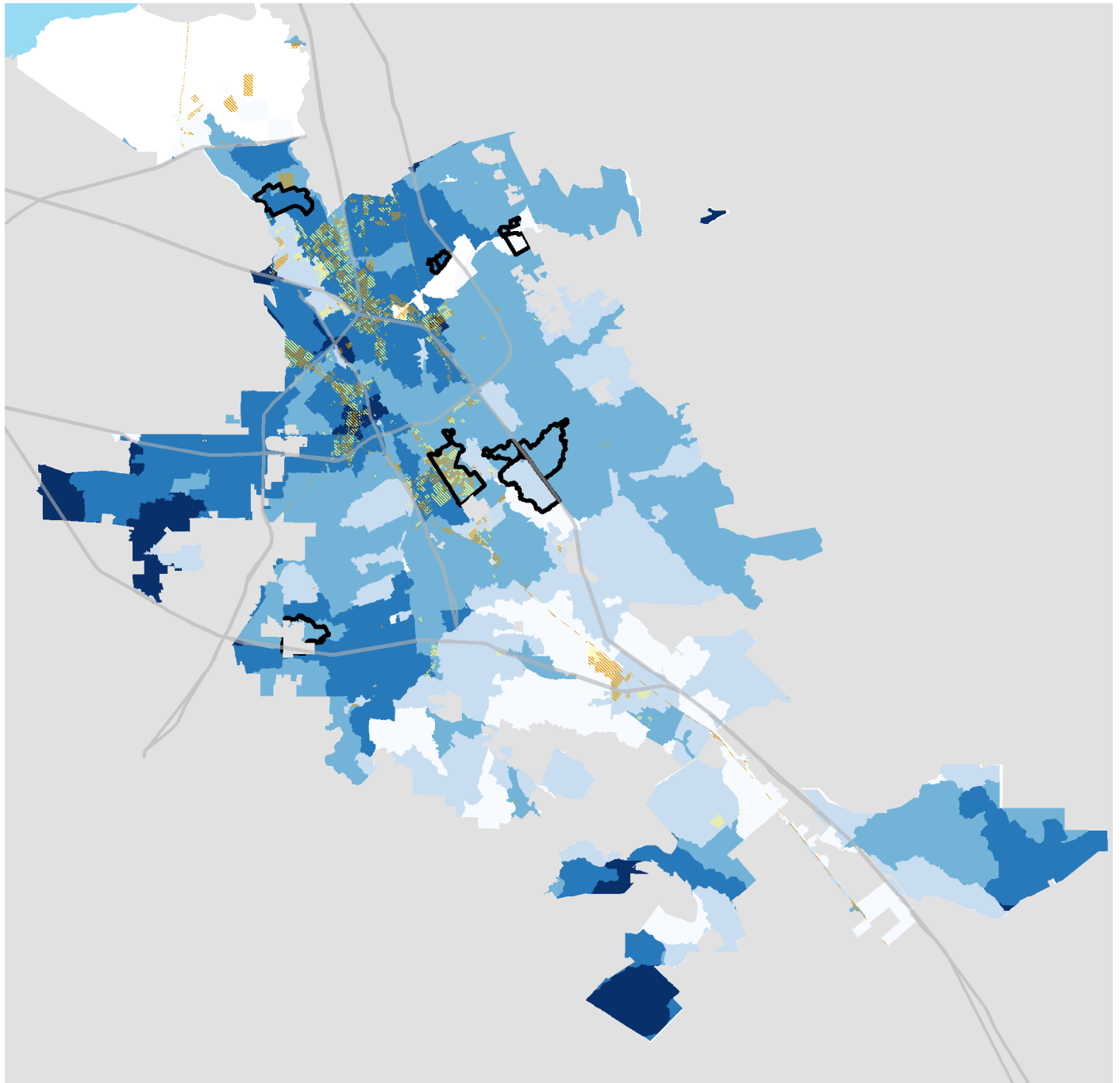
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E

**GREEN STREET
PRIORITIZATION
MAPS**

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Water Quality Effectiveness



LEGEND

DMA to Planned Regional Facilities

PCB Interest Area

High

Moderate

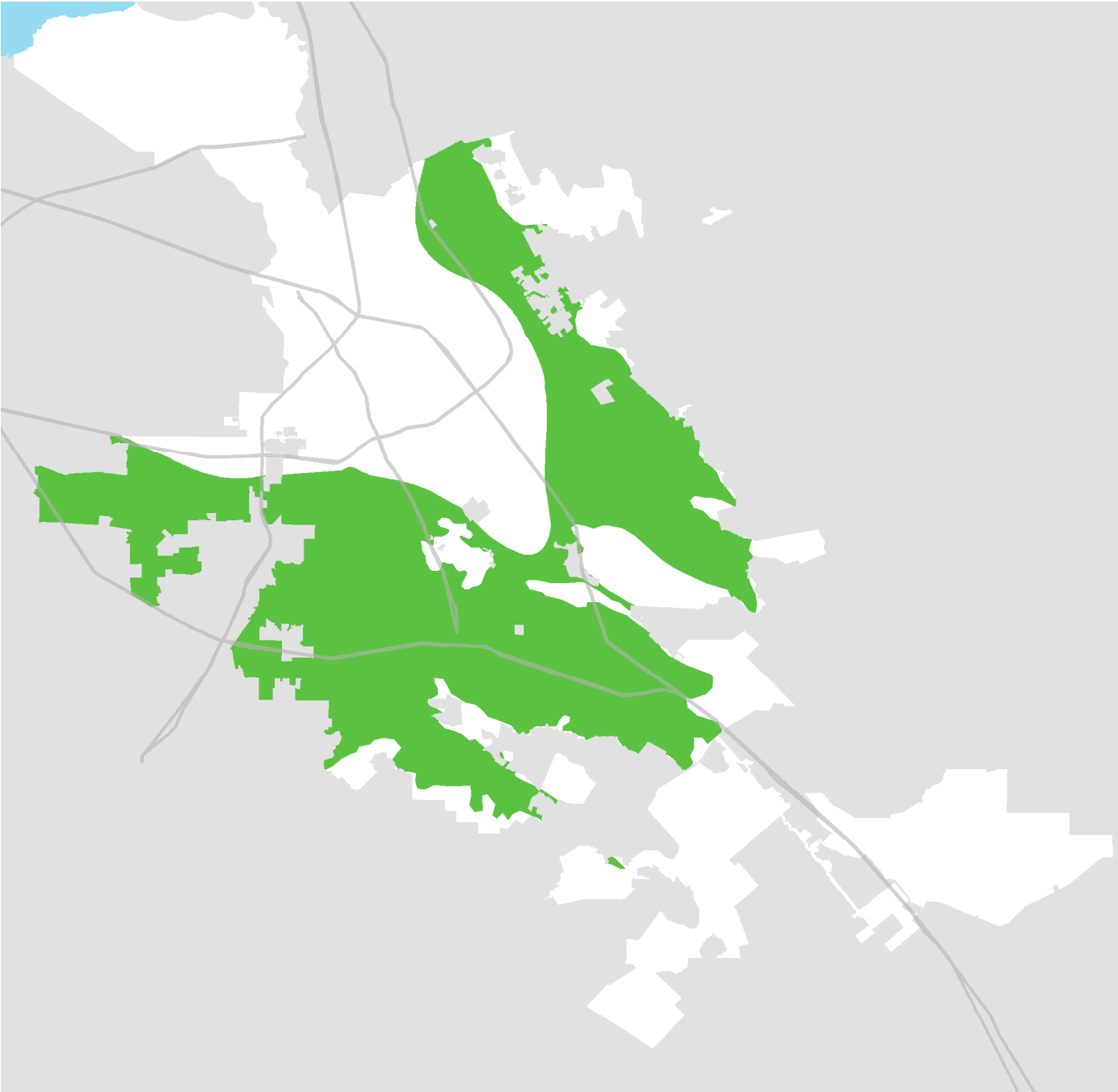
Runoff Depth during Critical Bacteria Storm (inch)

0-0.05
 0.05-0.1
 0.1-0.15
 0.15-0.2
 >0.2

Miles
0 3.5 7

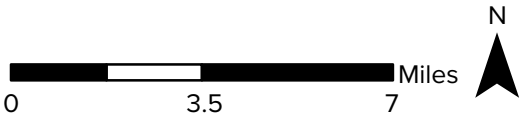


Groundwater Recharge Area

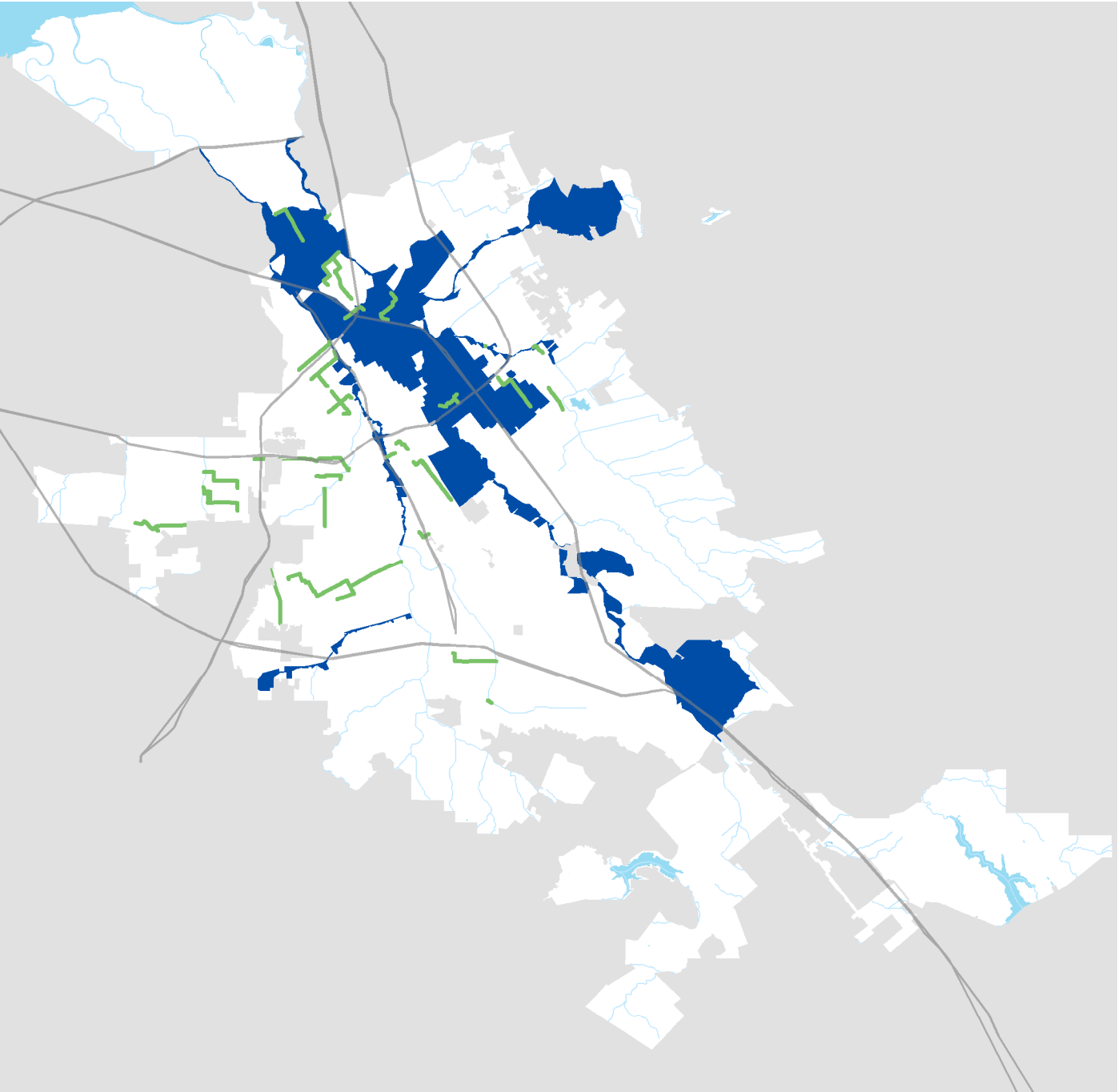


LEGEND

 Groundwater Recharge Area

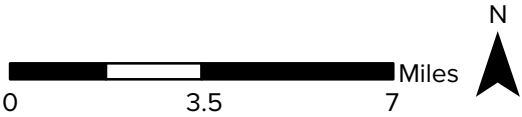


Flood Reduction Effectiveness

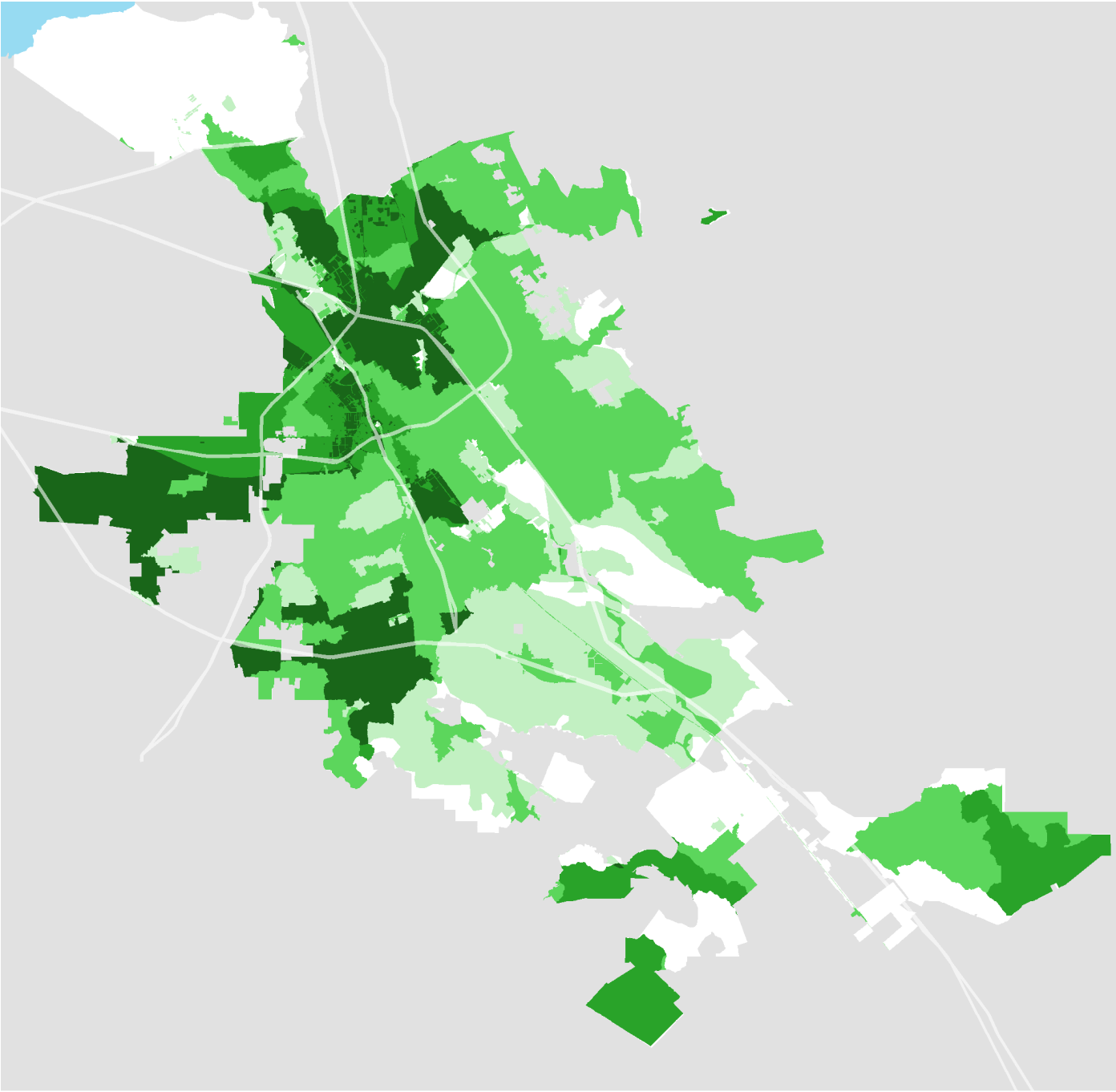


LEGEND

- 10-year High Priority Projects from Storm Sewer Master Plan (Preliminary Draft)
- Watershed of Flood Prone Streams & Areas



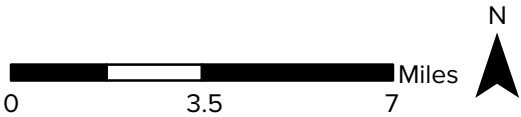
Stormwater Performance Spatial Effectiveness Rating



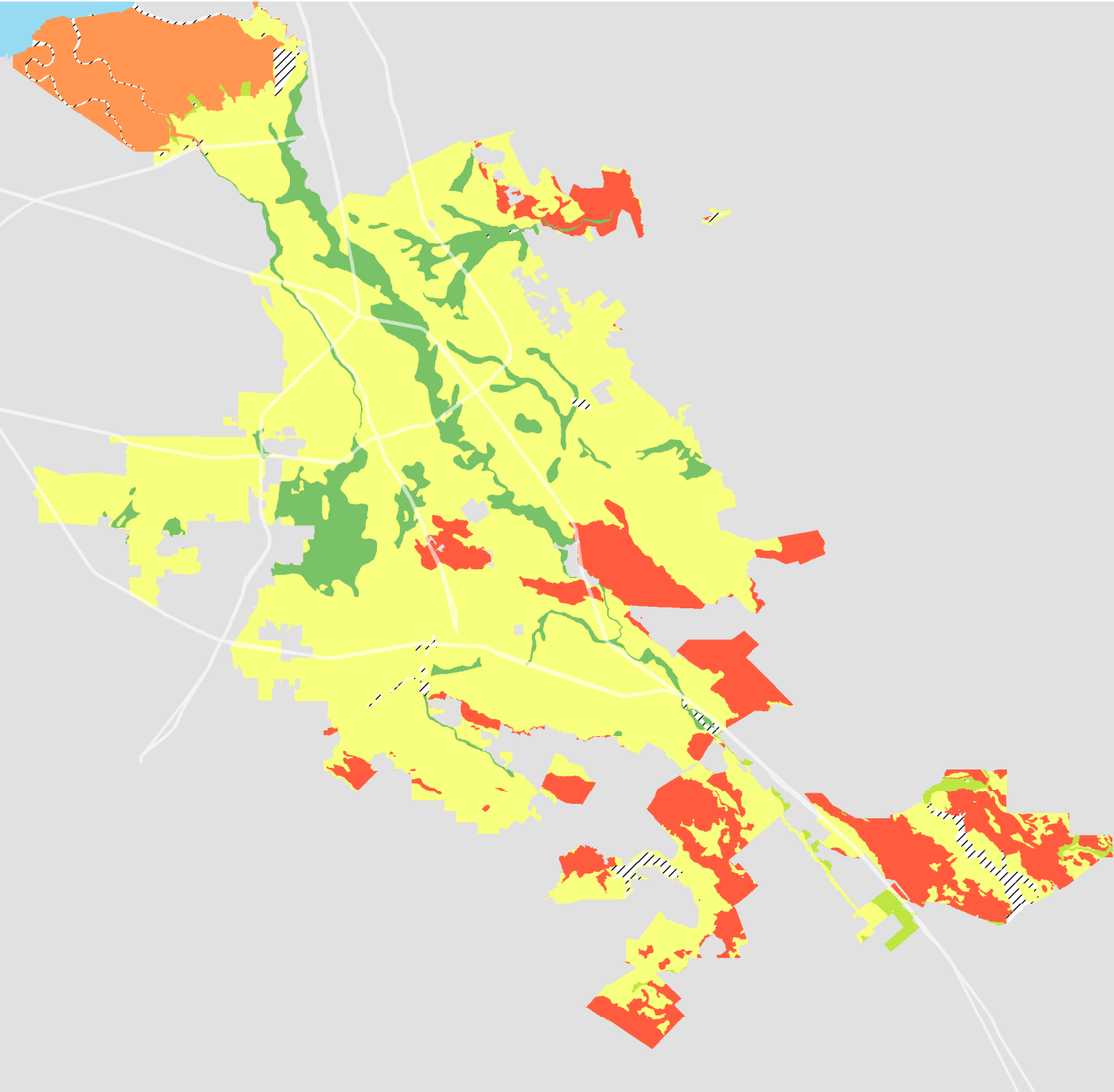
LEGEND

- > 0.15 inch Runoff Depth and in 1 or more Priority Areas
- > 0.15 inch Runoff Depth or in 3 Priority Areas
- 0.1 - 0.15 inch Runoff Depth or in 2 or more Priority Areas
- 0.05 - 0.1 inch Runoff Depth and in 1 Priority Area
- 0 - 0.5 inch Runoff Depth and in 0 Priority Areas

Note: Priority Areas: PCB Interest Area, Groundwater Recharge Area, Flood Prone Area



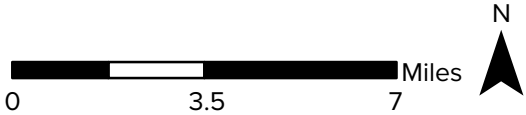
Hydrologic Soil Group



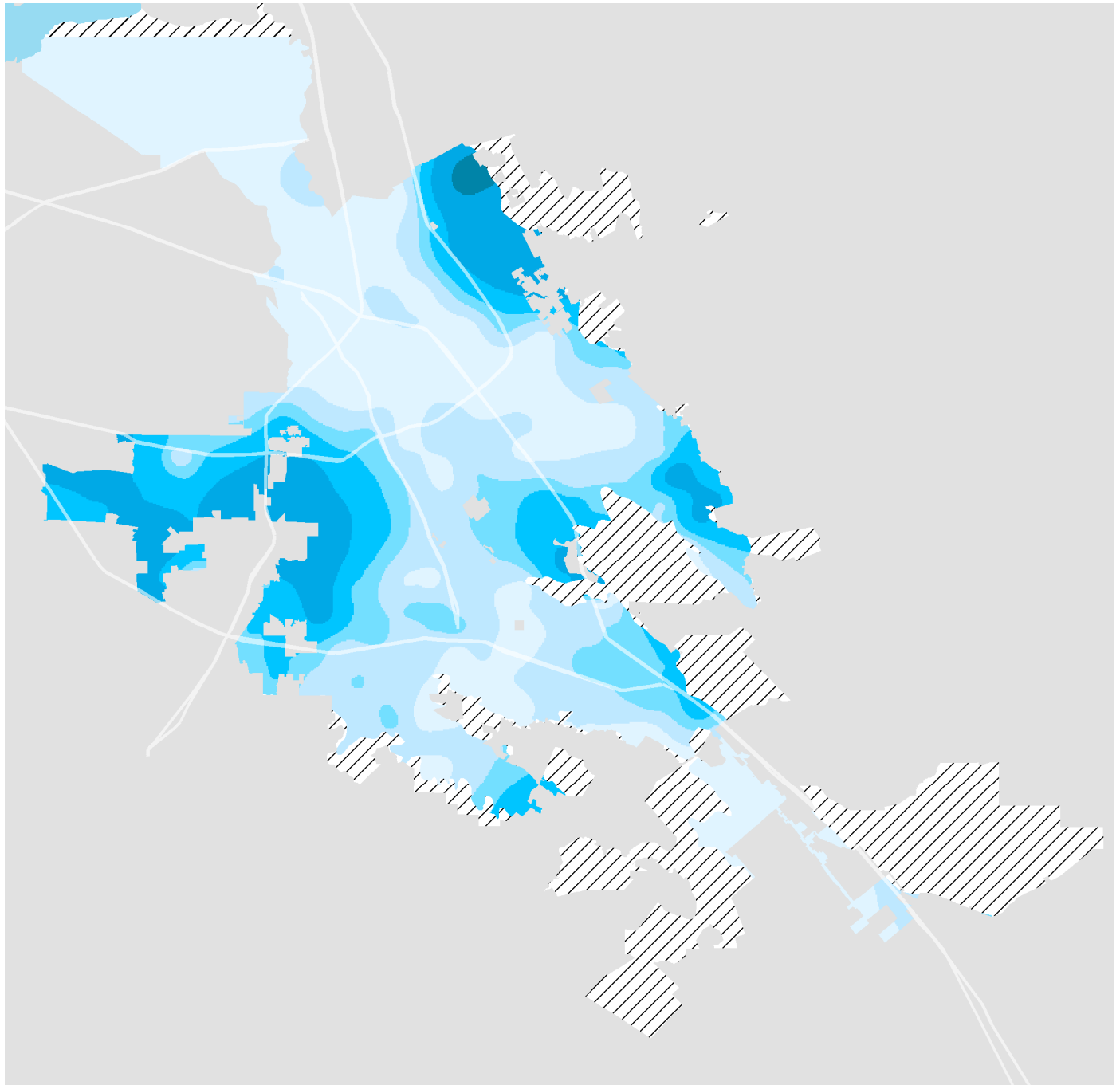
LEGEND

- | | |
|---|---------|
| A | C/D |
| B | D |
| C | Unknown |

Source: NRCS SSURGO Database (2016)

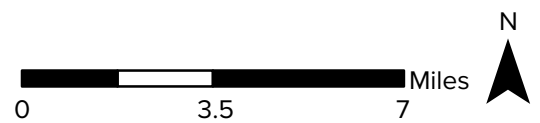


Depth to Groundwater

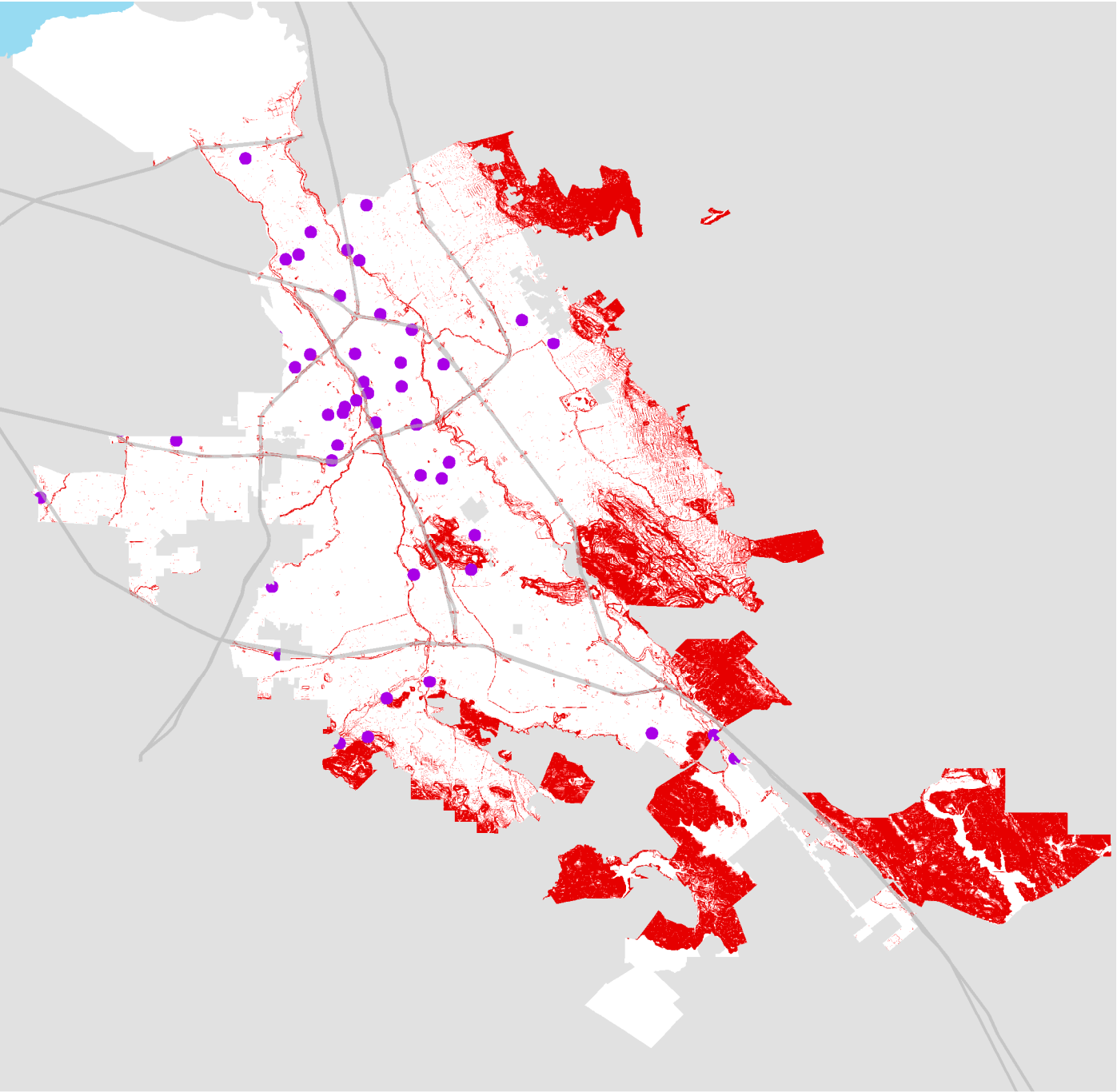


LEGEND

 0 to 10 ft.	 50 to 100 ft.
 10 to 20 ft.	 Greater than 100 ft.
 20 to 30 ft.	 No Data
 30 to 50 ft.	



Slope & Contamination



LEGEND

Slope

0% - 5%

5% - 10%

> 10%

GeoTracker Site

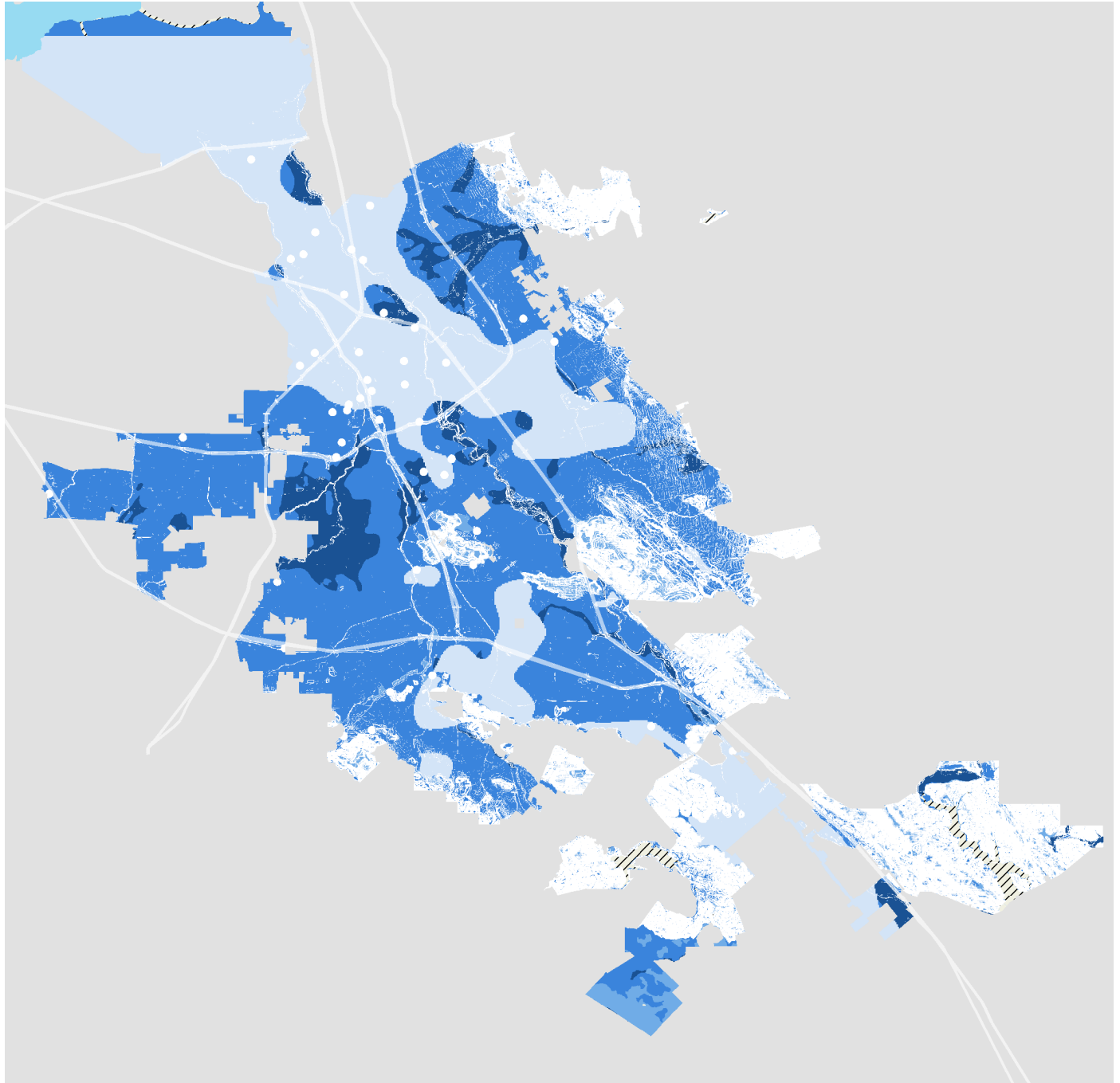
(Groundwater Contamination Area)



0 3.5 7 Miles



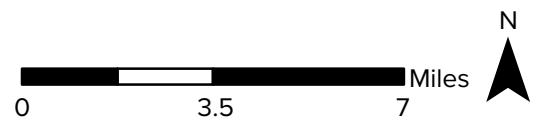
Hydrogeological Constraints - Desktop Suitability Rating



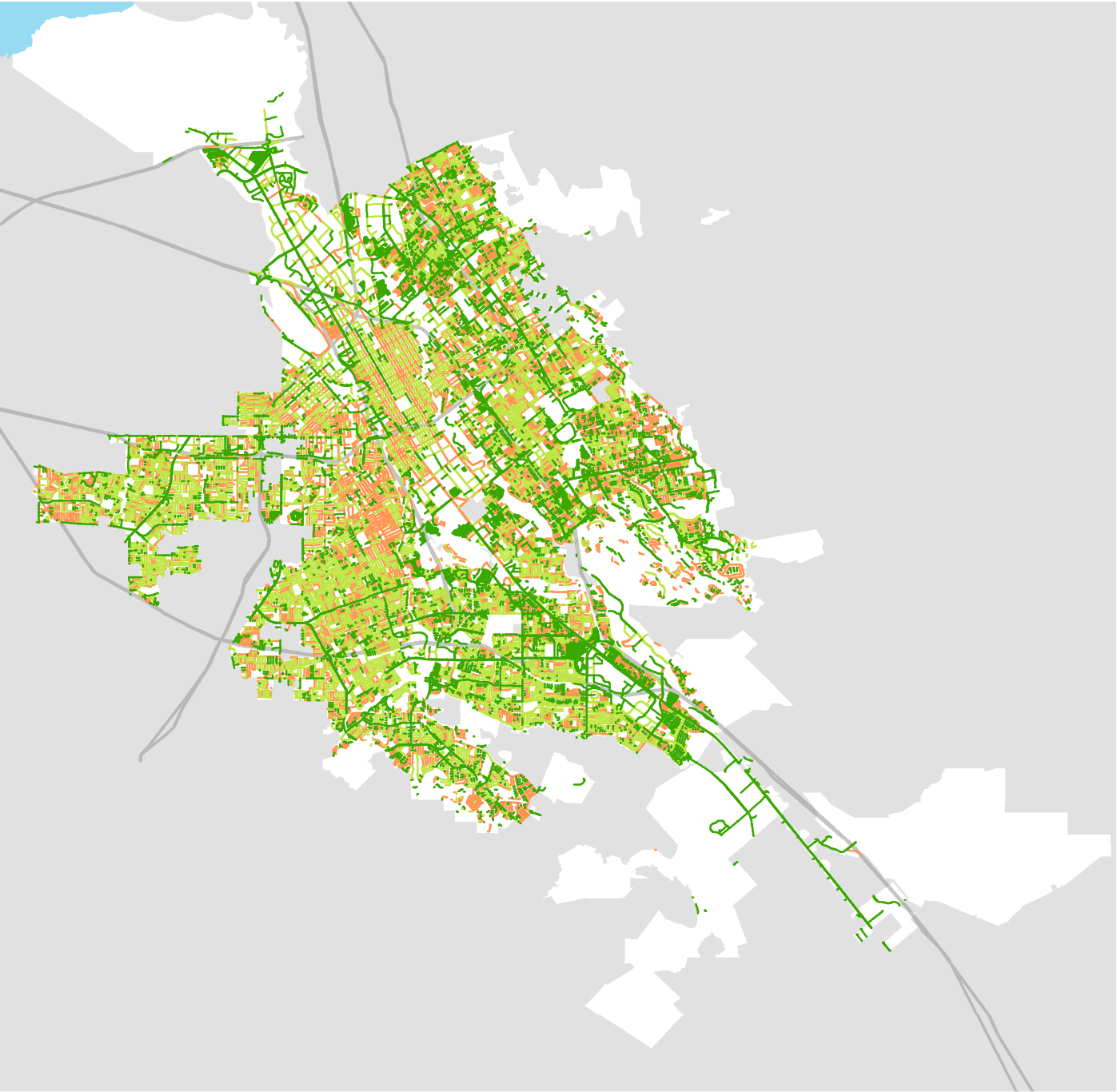
LEGEND

- HSG Soil Type: A, B; Depth to GW > 10ft; Slope < 5%
- HSG Soil Type: C; Depth to GW > 10 ft; Slope < 5%
- HSG Soil Type: D or Depth to GW > 10 ft; Slope < 5%
- Depth to GW ≤ 10 ft or Slope 5-10%
- Slope > 10% or Contaminated GW

Note: Hatched areas have no groundwater or soil data



Width Constraints



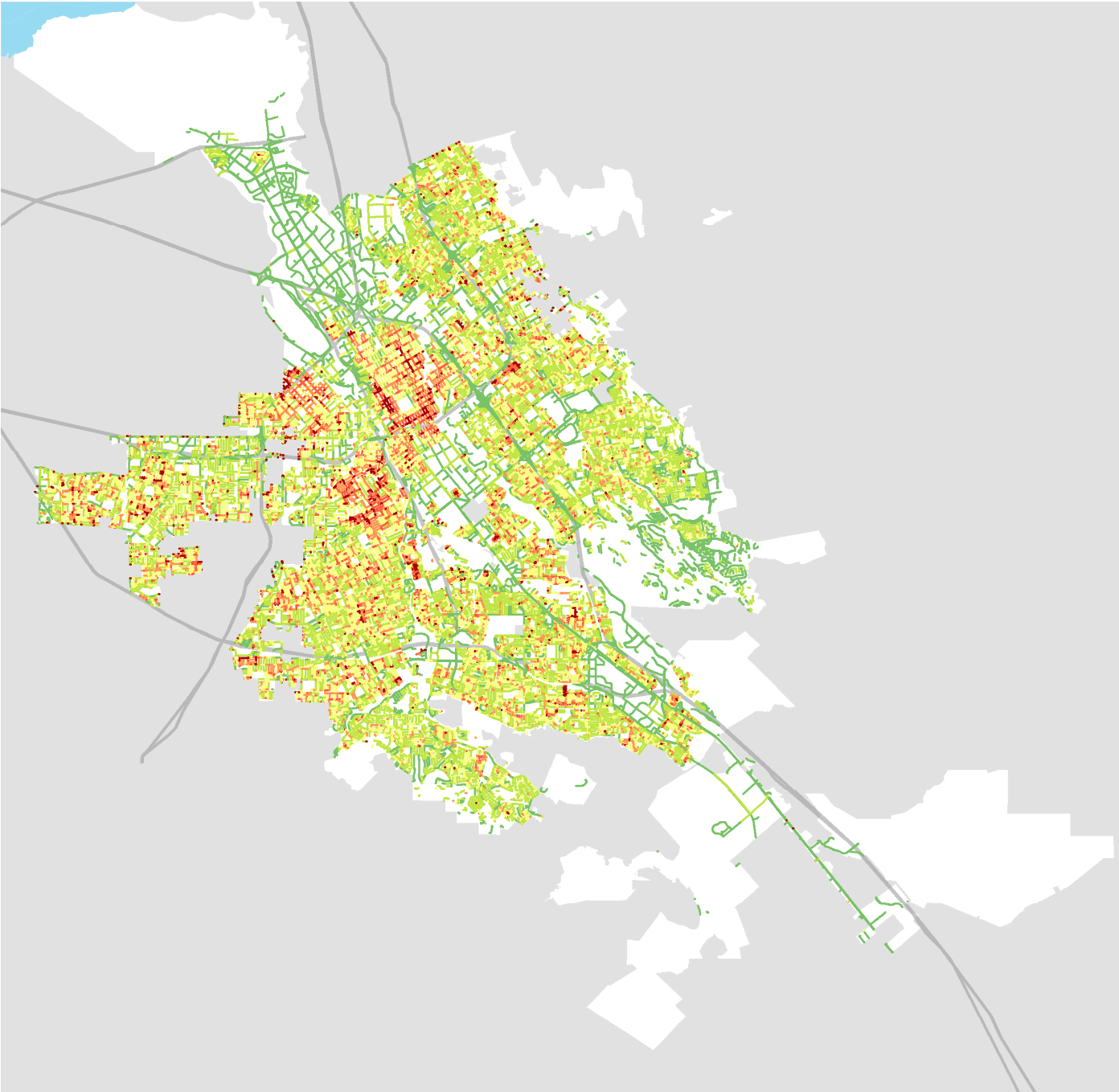
LEGEND

ROW Width

- Wide ROW by Road Class
- Average ROW by Road Class
- Skinny ROW by Road Class



Length Constraints

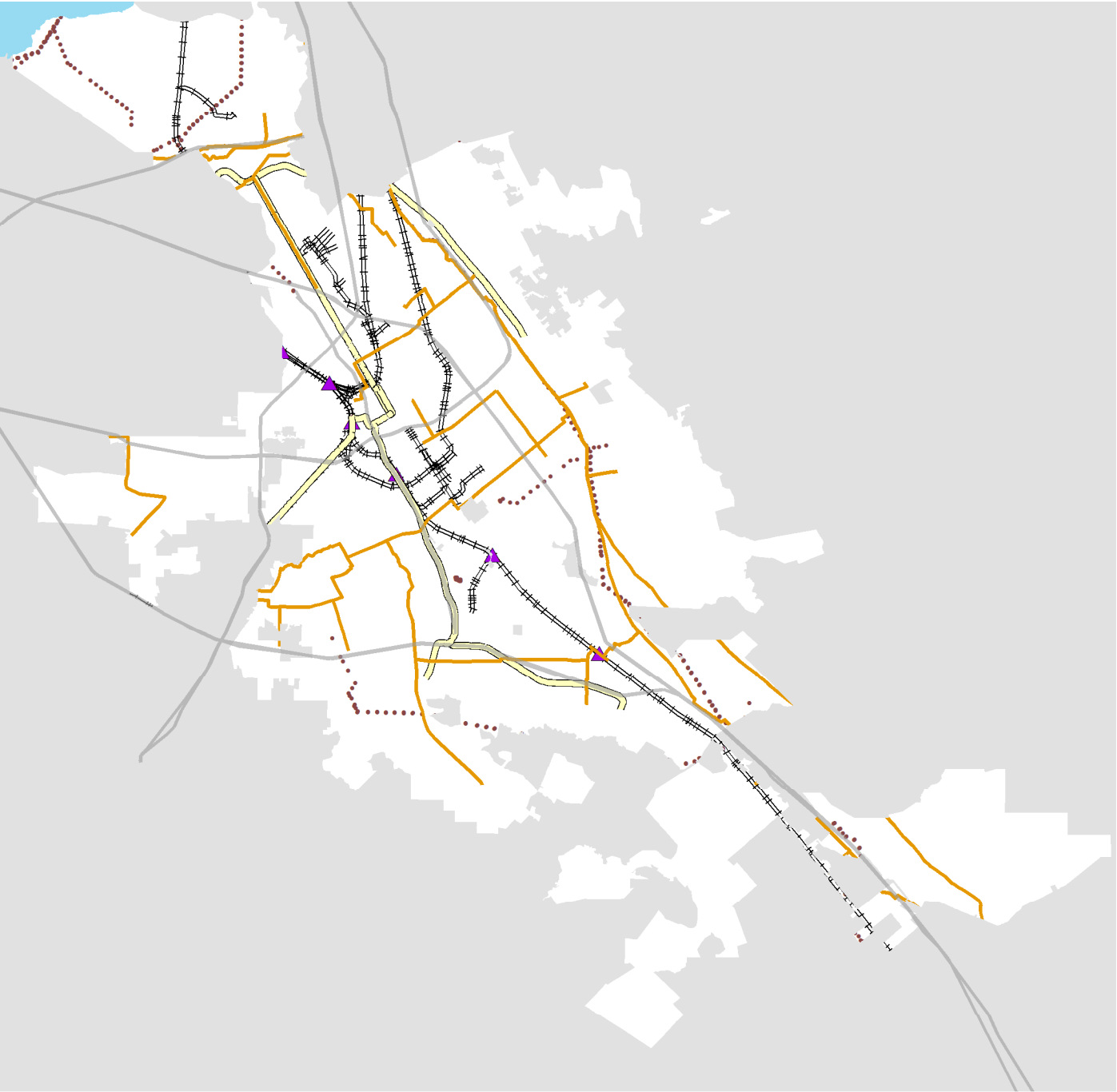


LEGEND

ROW Length Conflict per 1,000 ft

- | | |
|-----------|-------------|
| 0 - 100 | 301 - 400 |
| 101 - 200 | 401 - 500 |
| 201 - 300 | 501 - 1,000 |

Utility Constraints



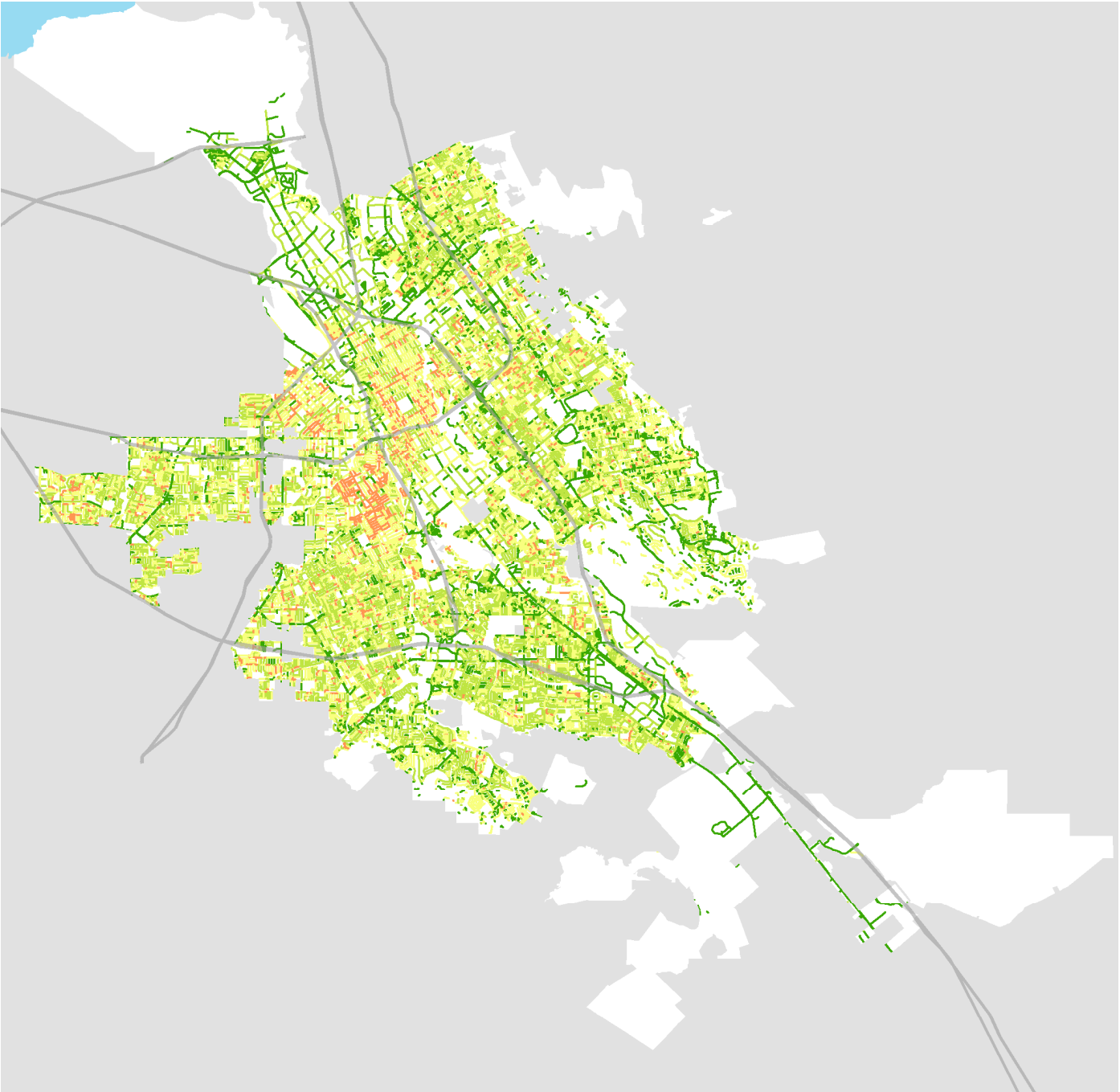
LEGEND

- Natural Gas Pipeline
- Light Rail
- Caltrain Stations
- Caltrain and Rail
- Overhead Power

TBD
Water Lines

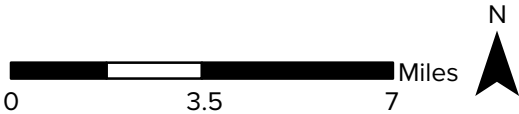


Site Space Constraints - Desktop Suitability Rating

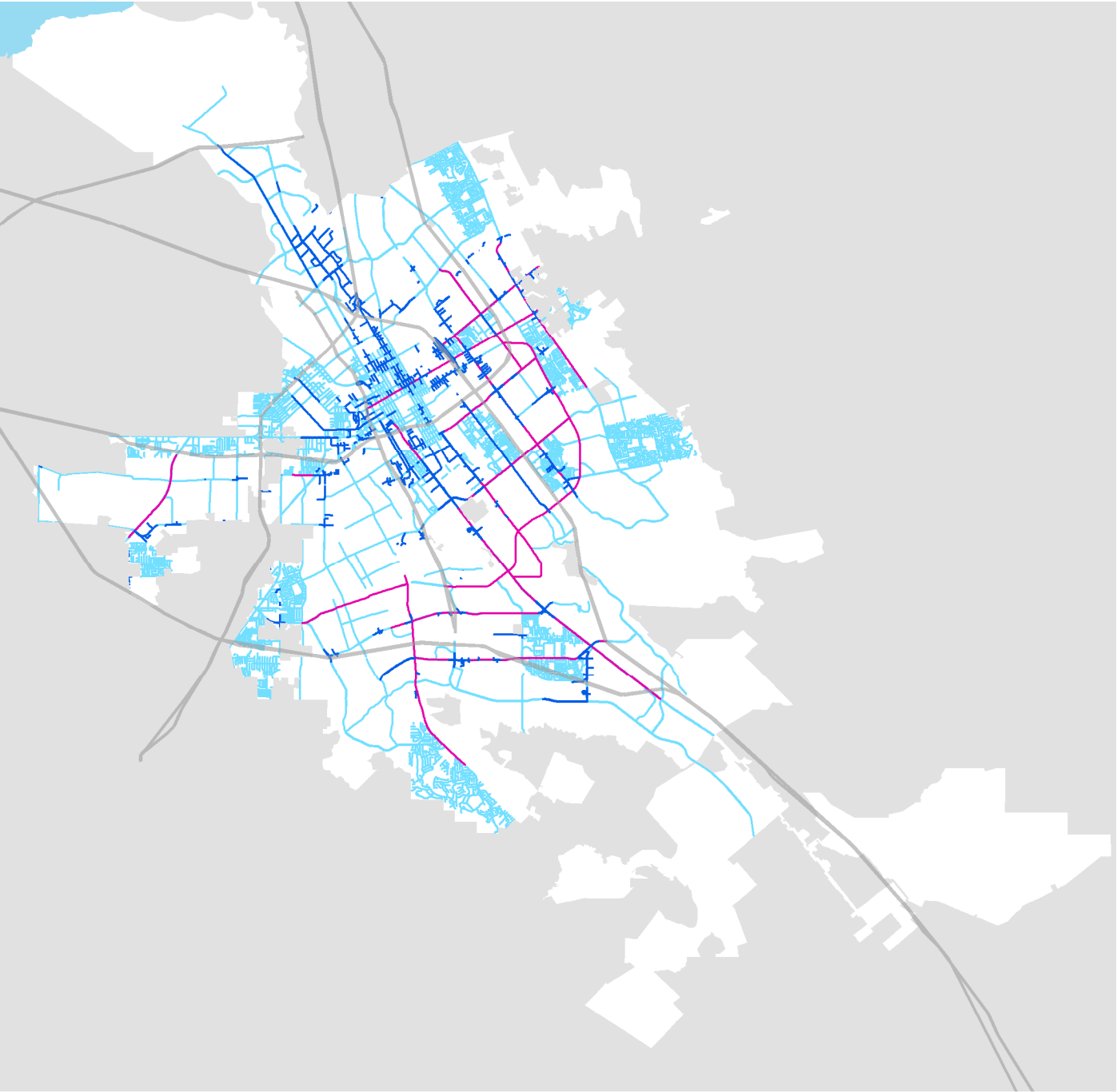


LEGEND

- Widest by class and < 200 ft length loss
- Average width by class or 200-300 ft length loss
- Skinniest by class or > 300 ft length loss
- Skinniest by class and > 300 ft length loss

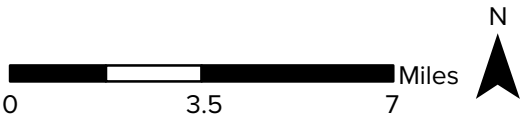


Synergies & Co-Benefits



LEGEND

- Synergies
- Near-Term Capital Improvement Projects & Planned Projects
 - Priority Streets for Safety or Bike/Ped Improvements
 - Priority Street for Conditions Improvements



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