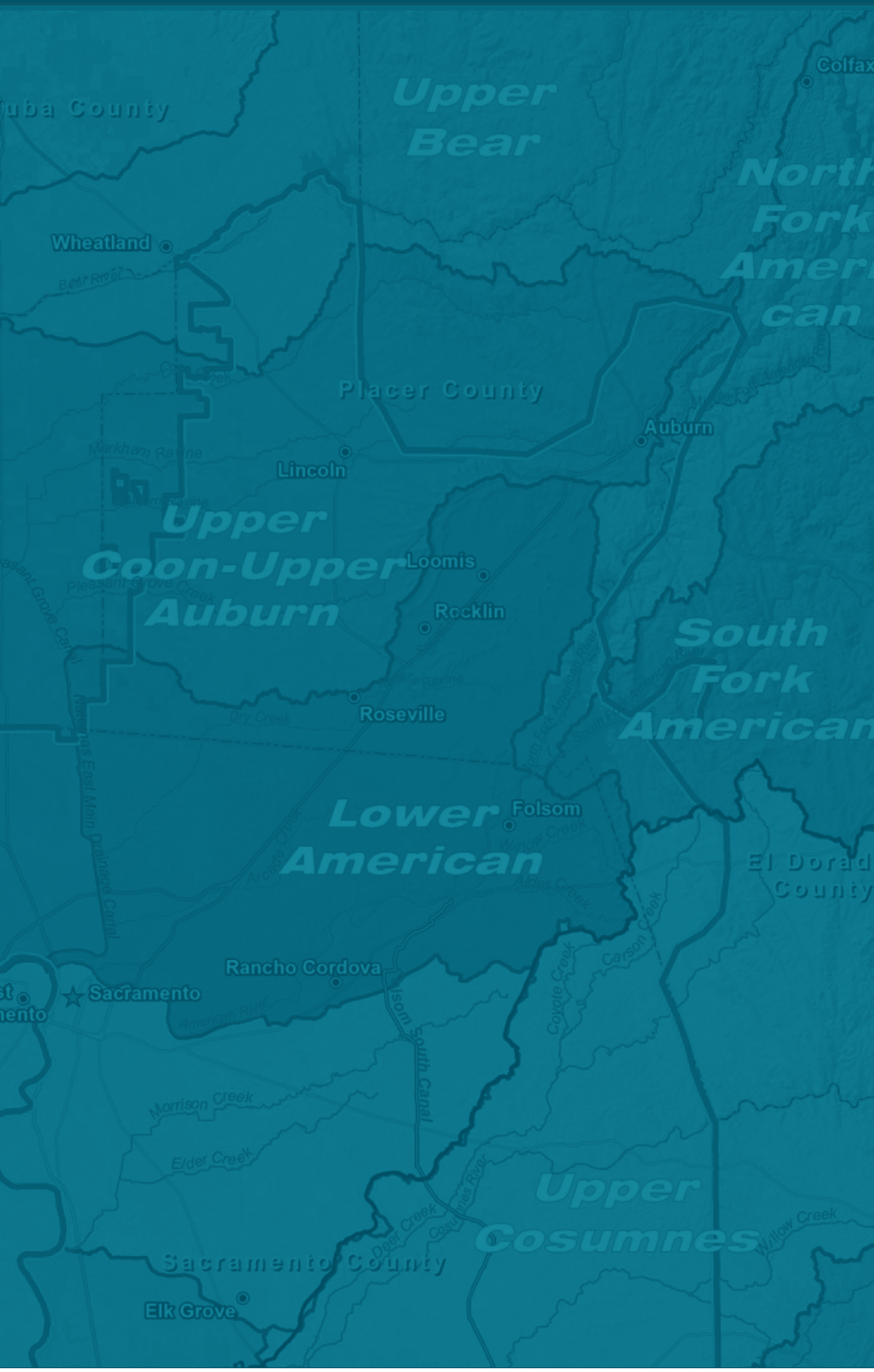
AMERICAN RIVER BASIN

Storm Water Resource Plan | April 2019

Final



Funding for this project has been provided in full or in part through an agreement with the State Water Resources Control Board using funds from Proposition 1. The contents of this document do not necessarily reflect the views and policies of the foregoing, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

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1.0 INTRODUCTION

1.1 Intent and Content

This document, a stormwater resource plan (SWRP), describes an ongoing process to identify watershed-based runoff management methodologies for the American River Basin (ARB) in northern California. This SWRP contains processes for developing and implementing projects and programs that manage stormwater and dry weather flows to improve water quality, reduce localized flooding, increase water supplies, protect the environment, and enhance communities. Projects will be developed both for new development and for existing landscapes to restore watershed processes and provide a variety of benefits.

In addition to better managing stormwater on a watershed scale, this SWRP allows runoff capture projects to be eligible for certain state grants, so long as those projects adhere to the eligibility conditions of each grant. California Water Code §10560 et seq. (as amended by Senate Bill 985) requires a SWRP as a condition of receiving funds for runoff capture projects from any water bond measure approved by voters after January 1, 2014. The amended Water Code also requires the California State Water Resources Control Board (State Water Board) to develop guidelines for developing a SWRP. This SWRP is based on and includes the required elements of those guidelines (State Water Board 2015c) and the Water Code.

In accordance with the Water Code and SWRP guidelines, this ARB SWRP is being submitted to the Regional Water Authority (RWA), the regional organization that oversees the Integrated Regional Water Management Plan for the American River Basin (ARB IRWMP; RWA 2013). The ARB IRWMP identifies regional approaches to provide long-term reliable water supplies for urban, agricultural, environmental, and recreational water needs. Many of the elements presented in this SWRP are based on information or processes already identified or used by the ARB IRWMP, with new methodologies and tools developed and integrated as required. Upon submittal, the RWA will incorporate the SWRP into the IRWMP.

Table 1-1 summarizes the required SWRP elements and the relevant sections of the SWRP guidelines, Water Code, and ARB IRWMP. Appendix A of this SWRP provides a self-certification checklist of the elements and provisions (sub-elements) required by the guidelines, including relevant section references.

This SWRP is a “living document.” It outlines regional plans for adaptive management, which provide stakeholders opportunities to modify, update and improve watershed management methodologies, along with developing and implementing current and future projects. Ultimately, this SWRP provides a framework for achieving regional goals to manage stormwater and dry weather flows as a resource and maximizing multiple water quality, water supply, flood control, environmental, and community benefits on a watershed scale.

Table 1-1. Water Code and SWRP Guideline Elements

Element	SWRP Guideline Section	Water Code Section	ARB SWRP Section
Watershed Identification	VI.A	10565(c) 10565(b)(1)	2.0
Water Quality Compliance	V	10562(d)(7) 10562(b)(5&6)	3.0
Organization, Coordination, Collaboration	VI.B	10565(a) 10562(b)(4)	4.0
Quantitative Methods	VI.C	Not applicable	5.0
Identification and Prioritization of Projects	VI.D	10562(b) (2&8) 10562(d)(1) to 10562(d)(6)	6.0
Implementation Strategy and Schedule	VI.E	10562(b)(7) 10562(d)(8)	7.0
Education, Outreach, Public Participation	VI.F	10562(b)(4)	8.0

1.2 Goals and Objectives

This SWRP outlines regional strategies for undertaking runoff capture projects that provide water supply, water quality, flood control, environmental, and community benefits. These directly align with the goals of the ARB IRWMP, as demonstrated in Table 1-2. Likewise, this SWRP adopts the objectives of the IRWMP, as shown in Table 1-3.

Table 1-2. SWRP and IRWMP Goals for the ARB Region

SWRP Goal	IRWMP Goal (RWA 2013)
Increase water supply	Provide reliable and sustainable water resources, sufficient to meet the existing and future needs.
Improve water quality	Protect and enhance the quality of surface water and groundwater.
Support flood management	Protect the people, property, and environmental resources of the region from damaging flooding.
Protect the environment	Protect and enhance the environmental resources of the watersheds within the region.
Enhance communities	Promote community stewardship of the ARB region's water resources.

Table 1-3. SWRP and IRWMP Objectives

SWRP and IRWMP Objectives (RWA 2013)
1. Meet current and future water resources needs.
2. Increase water use efficiency.
3. Improve ability to reliably meet water demands during dry or emergency conditions.
4. Increase the use of recycled water for appropriate uses. *
5. Remediate contaminated groundwater and reuse it to the extent feasible. *
6. Improve protection of beneficial uses of surface water and groundwater.
7. Recharge and reuse stormwater and urban runoff to the extent practicable.
8. Maintain and improve the ecosystem function of area streams and watersheds.
9. Maintain and improve habitat of area watersheds.
10. Conserve natural riparian buffers in undeveloped portions of local watersheds and restore buffers in developed areas when possible.
11. Increase the capacity of the flood management system to meet applicable standards for designated areas and land uses.
12. Maintain and improve levees and other flood-related infrastructure to reduce flood risk. *
13. Maintain and restore/reconnect floodplains to provide flood storage and other benefits.
14. Improve management of residual flood risks.
15. Increase awareness of the need for, benefits of, and practices for maintaining sustainable water resources.
16. Improve integration of water resources planning with land-use planning.
17. Increase sharing of information, studies, and reports to further advance integrated regional water management.

**IRMP objectives 4, 5, and 12 do not apply to the SWRP.*

2.0 WATERSHED IDENTIFICATION

The ARB IRWMP provides extensive information, including detailed maps, regarding the ARB region's watershed boundaries, resources, priorities, and natural watershed processes. This section summarizes that information and includes references to specific sections of the 2013 IRWMP where applicable, as denoted in parenthesis after each subsection title.

2.1 Watershed Boundaries (IRWMP Section 2.1)

This SWRP's boundaries include the watersheds associated with the existing ARB IRWMP (Figure 2-1). These watersheds are designated as United States Geological Survey (USGS) hydrologic unit code (HUC) 8 watersheds as identified in Table 2-1.

The IRWMP boundaries include the region's major water bodies, groundwater basins, agricultural lands, and highly urbanized areas, but do not include all portions of the affiliated watersheds. To meet the inherent definition of a watershed-based plan, the SWRP boundaries include these watersheds in their entireties, although projects and objectives will focus on the specific needs of the ARB region.

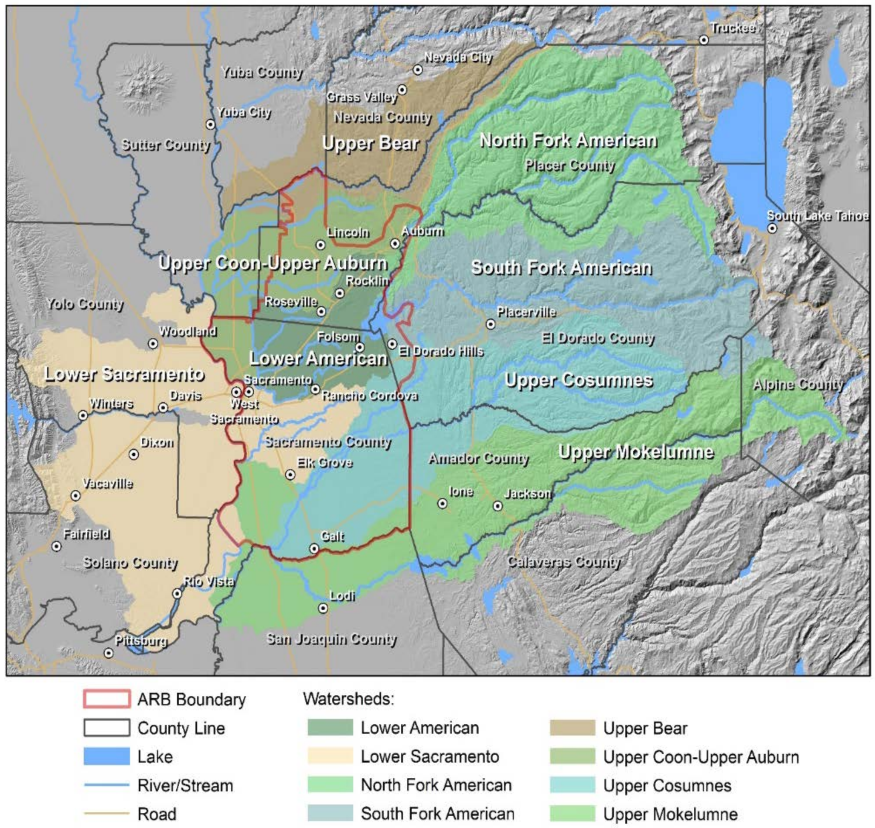

Figure 2-1. ARB SWRP Watersheds and Vicinity

Although the SWRP covers some watersheds not draining to the American River, the plan is titled the "American River Basin Stormwater Resource Plan" to reflect the close relationship between this plan and the ARB IRWMP. As identified in the IRWMP, the ARB region was defined based on the key surface water bodies cited above because collectively they provide a substantial portion of the region's water supply. These and other surface water bodies are shown in Figure 2-2. The portion of the Sacramento River that runs by the City of Sacramento and Sacramento County acts as the western boundary of the ARB region.

A SWRP that includes the watersheds associated with the ARB IRWMP is deemed appropriate because the IRWMP already manages water resources under a regional multi-benefit approach. Inclusion of runoff management practices that seek to achieve the same multiple benefits is a natural fit.

Table 2-1. HUC 8 Watersheds of the ARB Region

Watershed	HUC 8 #	Watershed	HUC 8 #
Lower American	18020111	Upper Bear	1820126
Lower Sacramento	18020163	Upper Coon-Upper Auburn	18020161
North Fork American	18020128	Upper Cosumnes	18040013
South Fork American	18020129	Upper Mokelumne	18040012

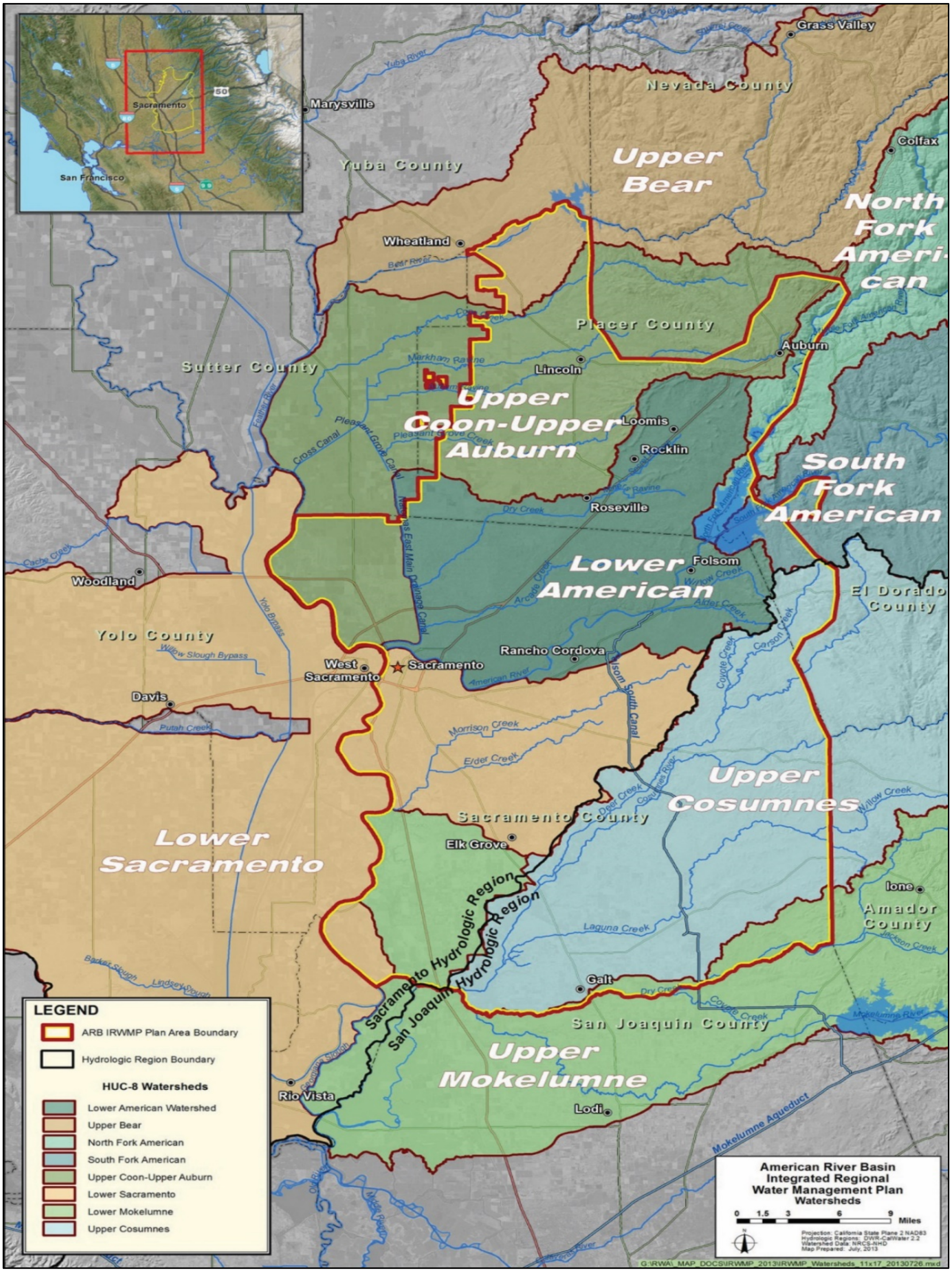

Figure 2-2. ARB SWRP and IRWMP Boundaries and Primary Water Bodies (RWA 2013)
Note that 2018 IRWMP will extend the ARB border to follow the Sutter/Placer County border

2.2 Internal Boundaries (IRWMP Sections 2.2, 2.8, & 2.9)

The ARB region has historically supported agriculture, with the City of Sacramento located at the confluence of the American and Sacramento Rivers and serving as a regional hub since the gold rush era and the state capital since four years after statehood. In the past several decades, urban and residential development have spread from Sacramento outward—upstream and easterly, along the American River, toward Folsom and El Dorado Hills; north into the Natomas Basin and western Placer County; and south to the cities of Elk Grove and Galt. Today, the region still contains considerable agricultural land in private holdings, but it is rapidly urbanizing. The result is a densely populated region, with many complicated water resource-related needs. To meet these challenges, the region has many well-established agencies that independently and collectively address local and regional needs associated with sustainable water management. The following sections describe the relevant municipal, water, wastewater, land-use, and groundwater sustainability agencies. Table 2-2 lists these agencies and the relevant services each provides. Several of these entities will be key players in implementation of SWRP projects.

Table 2-2. Water-Related Agencies within the ARB Region (RWA 2013)

Agency	Water-Related Activities			
	Water Supply/ Groundwater**	Wastewater/ Recycled Water	Stormwater/ Flood Management	Land-Use Planning
American River Flood Control District			X	
California American Water*	X			
Carmichael Water District*	X			
Central Valley Flood Protection Board Maintenance Area 9			X	
Citrus Heights Water District*	X			
City of Auburn		X	X	X
City of Citrus Heights			X	X
City of Elk Grove			X	X
City of Folsom*	X	X	X	X
City of Galt	X	X	X	X
City of Lincoln*	X	X	X	X
City of Rancho Cordova			X	X
City of Rocklin			X	X
City of Roseville*	X	X	X	X
City of Sacramento*	X	X	X	X
Clay Water District	X			
Del Paso Manor Water District*	X			
El Dorado County	X		X	X
El Dorado Irrigation District*	X	X		
Elk Grove Water District*	X			
Fair Oaks Water District*	X			
Florin County Water District	X			
Freeport Regional Water Authority	X			
Fruitridge Regional Water Authority*	X			
Galt Irrigation District	X			
Golden State Water Company*	X			
Natomas Central Mutual Water Company	X			
Omochumne-Hartnell Water District	X			
Orangevale Water Company*	X			
Placer County		X	X	X
Placer County Flood Control & Water Conservation District			X	

Agency	Water-Related Activities			
	Water Supply/ Groundwater**	Wastewater/ Recycled Water	Stormwater/ Flood Management	Land-Use Planning
Placer County Water Agency*	X			
Rancho Murieta Community Services District*	X	X	X	
Reclamation District 1000			X	
Reclamation District 1001	X		X	
Rio Linda/Elverta Community Water District*	X			
Sacramento Area Council of Governments				X
Sacramento Area Flood Control Agency			X	
Sacramento Area Sewer District		X		
Sacramento Central Groundwater Authority	X			
Sacramento County			X	X
Sacramento County Water Agency*	X			
Sacramento Groundwater Authority	X			
Sacramento Regional County Sanitation District*		X		
Sacramento Suburban Water District*	X			
San Juan Water District*	X			
South Area Water Council	X			
South Placer Utility District		X		
South Sutter Water District	X			
Southeast Sacramento County Ag. Water Authority	X			
Tokay Park Water District	X			
Town of Loomis			X	X

**Agency is a member or associate of RWA, the ARB IRWMP managing group.*
***Groundwater Sustainability agencies (GSAs) are listed in* Table 2-4.

2.2.1 Water, Wastewater, and Land-use Agencies

Appendix B1 of this SWRP includes boundary maps of the region's water and wastewater agencies and treatment plants, stormwater and flood management agencies, and land-use agencies, as provided and described in detail in the ARB IRWMP. The summary excerpts provided below offer an overview of these agencies. Geographic Information System (GIS) shape files of the agency boundaries may be obtained by contacting RWA.

Folsom Dam on the American River and Shasta Dam on the Sacramento River are multi-purpose reservoirs that provide flood control, water supply, recreational use, and ecosystem support upstream of and within the ARB region. In addition to these reservoirs, there are 15 surface water treatment plants (WTPs) and 14 groundwater treatment plants that support the region's water supply, as well as groundwater wells operated by many agencies, some with onsite treatment. The Cosumnes River supplies a large proportion of the groundwater relied upon for water supply by agencies in the South American and Cosumnes sub-basins. In addition, it is the surface water source for Rancho Murieta, all of the upper watershed communities, and agricultural diversions in the lower watershed. There are 28 water delivery agencies within the Sacramento County, western Placer County, and western El Dorado County vicinity. Table 2-3 lists the historic and projected water demands for each water supplier.

Table 2-3. Historic Estimated and Projected Water Demand (RWA 2013)

Water Agency	Estimated/Projected Demand (afy) [1]			WTP Capacity[2] (afy)
	2005	2010	2030	
California American Water	44,970	37,297	51,922	-
Carmichael Water District	12,496	9,732	9,571	24,644
Citrus Heights Water District	19,034	13,725	18,765	-
City of Folsom	24,974	26,243	36,259	56,009
City of Galt	5,300	5,174	9,883	-
City of Lincoln	9,376	9,203	14,040	-
City of Roseville	31,075	28,633	56,507	112,019
City of Sacramento	131,564	108,276	160,100	403,267
Del Paso Manor Water District	1,657	1,409	1,600	-
El Dorado Irrigation District	37,223	32,525	68,290	29,125
Elk Grove Water District	7,915	6,720	10,500	11,202
Fair Oaks Water District	12,454	11,800	11,118	-
Florin County Water District	2,668	2,668	2,668	-
Fruitridge Vista Water Company	4,891	4,157	2,838	-
Golden State Water Company	18,098	16,478	20,626	16,131
Natomas Central Mutual Water Company	37,332	23,438	23,000	-
Orangevale Water Company	4,915	4,585	5,009	-
Placer County—Ag/Ag-Res	56,300	58,300	60,000	-
Placer County Water Agency	92,276	97,839	100,906	94,096
Rancho Murieta Community Services Dist.	2,008	1,710	3,659	7,841
Rio Linda/Elverta Community Water Dist.	3,400	2,720	3,030	-
Sacramento County—Ag/Ag-Res	192,500	192,500	156,300	-
Sacramento County Water Agency	35,971	35,509	68,975	219,556
Sacramento Suburban Water District	41,193	36,386	40,390	-
San Juan Water District	14,270	12,650	16,616	168,028
Tokay Park Water District	142	142	142	-
Regional Total	**844,002**	**779,819**	**952,714**	**1,141,917**

[1] *afy: acre-feet per year*

[2] *ARB IRWMP (RWA 2013)*

In Placer County, sewer collection systems and wastewater treatment plants (WWTPs) are operated by incorporated cities, the South Placer Utility District, and Placer County. The Sacramento Regional County Sanitation District (Regional San) provides wastewater conveyance and treatment services to residential, commercial, and industrial customers in portions of unincorporated Sacramento County as well as the cities of Citrus Heights, Elk Grove, Folsom, Rancho Cordova, and West Sacramento (Yolo County); the communities of Courtland and Walnut Grove; and a portion of the City of Sacramento. An exception is within the City of Sacramento, where the city owns and operates a substantial portion of the sewer collection system. The City of Sacramento also owns and operates a combined sewer system, which includes treatment facilities and associated collection systems. Sacramento Area Sewer District (SASD) provides wastewater collection services for unincorporated Sacramento County as well as the cities of Citrus Heights, Elk Grove, Rancho Cordova, a portion of City of Sacramento, and the communities of Courtland and Walnut Grove. Wastewater services for El Dorado Hills, located in El Dorado County, are provided by El Dorado Irrigation District (EID) and their WWTP.

Flood management boundaries of the ARB region follow city boundaries as well as specific flood agency boundaries, including Reclamation Districts (RDs) 1000 and 1001, the American River Flood Control District (ARFCD), Maintenance Area 9, and the multiagency Sacramento Area Flood Control Agency (SAFCA). SAFCA boundaries encompass Sacramento County as well as the portion of Sutter County within the Natomas Basin.

Municipalities within the ARB region are responsible for their respective stormwater management systems.

The County of Sacramento and cities of Galt, Folsom, Sacramento, Rancho Cordova, Citrus Heights, and Elk Grove share a Phase I Municipal Separate Stormwater Sewer System (MS4) permit and collaborate on many elements through the Sacramento Stormwater Quality Partnership (SSQP). Placer County, the Town of Loomis, and the cities of Roseville, Rocklin, Lincoln, and Auburn are subject to the statewide Phase II MS4 permit and coordinate through the Placer Regional Stormwater Collaborating Group (PRSCG). Section 3.0 provides specific details on the stormwater permits and programs.

Each city, town, and county agency within the ARB region conducts land-use planning activities, as does the Sacramento Area Council of Governments. Land-use planning activities are documented in municipal general development plans (general plans).

2.2.2 Groundwater Basin Boundaries

Most of the ARB region overlies the North American, South American, and Cosumnes groundwater sub-basins, as defined by the California Department of Water Resources (DWR). These sub-basins are bounded by the Sacramento River or Feather River to the west and the Sierra Nevada Mountains to the east. The North American sub-basin boundaries are defined by the Bear and American Rivers, and the South American sub-basin boundaries are defined by the American and Cosumnes Rivers. The Cosumnes sub-basin lies between the Cosumnes and Mokelumne rivers. Each sub-basin has one or more entities that manage its groundwater, as listed in Table 2-4. The groundwater basins and their sustainability agencies are shown in Figure 2-4.

Table 2-4. Groundwater Sustainability Agencies

Groundwater Basin	Groundwater Sustainability Agency[1]
North American Sub-basin	Western Placer County Groundwater Sustainability Agency
	Reclamation District 1001
	Sutter County
	South Sutter Water District
	Sacramento Groundwater Authority
South American Sub-basin	Sacramento Central Groundwater Authority—GSAs 1, 2, & 3
	Sloughhouse Resource Conservation Districts—1 & 2
	County of Sacramento
	Omochumne-Hartnell Water District
	Franklin Drainage District
	Reclamation District 3
	Reclamation Districts 369, 744, 755, & 813
Cosumnes Sub-basin	City of Galt
	County of Sacramento
	Amador County Groundwater Management Authority
	Clay Water District
	Galt Irrigation District
	Omochumne-Hartnell Water District
	Sloughhouse Resource Conservation District

[1]*DWR 2017*

2.2.3 Disadvantaged Communities

The ARB IRWMP identifies the region's disadvantaged communities (DACs), as defined by the Department of Water Resources (DWR). Unlike many areas of the state, most DACs in the ARB region are generally not isolated communities, but instead exist as pockets within larger communities. The water supply and water quality needs of the ARB region's DACs are served by the larger community agencies, as described in the ARB IRWMP. The isolated DACs that do exist are served by small water systems and/or private wells. For these communities, issues with small systems water supply and sanitation are generally related to substandard, aging infrastructure, rather than larger regional issues. As of 2013, there had been no reported problems for small systems monitored within the region, and monitoring is being continued at the IRWMP level to determine if there are specific issues that should be considered.

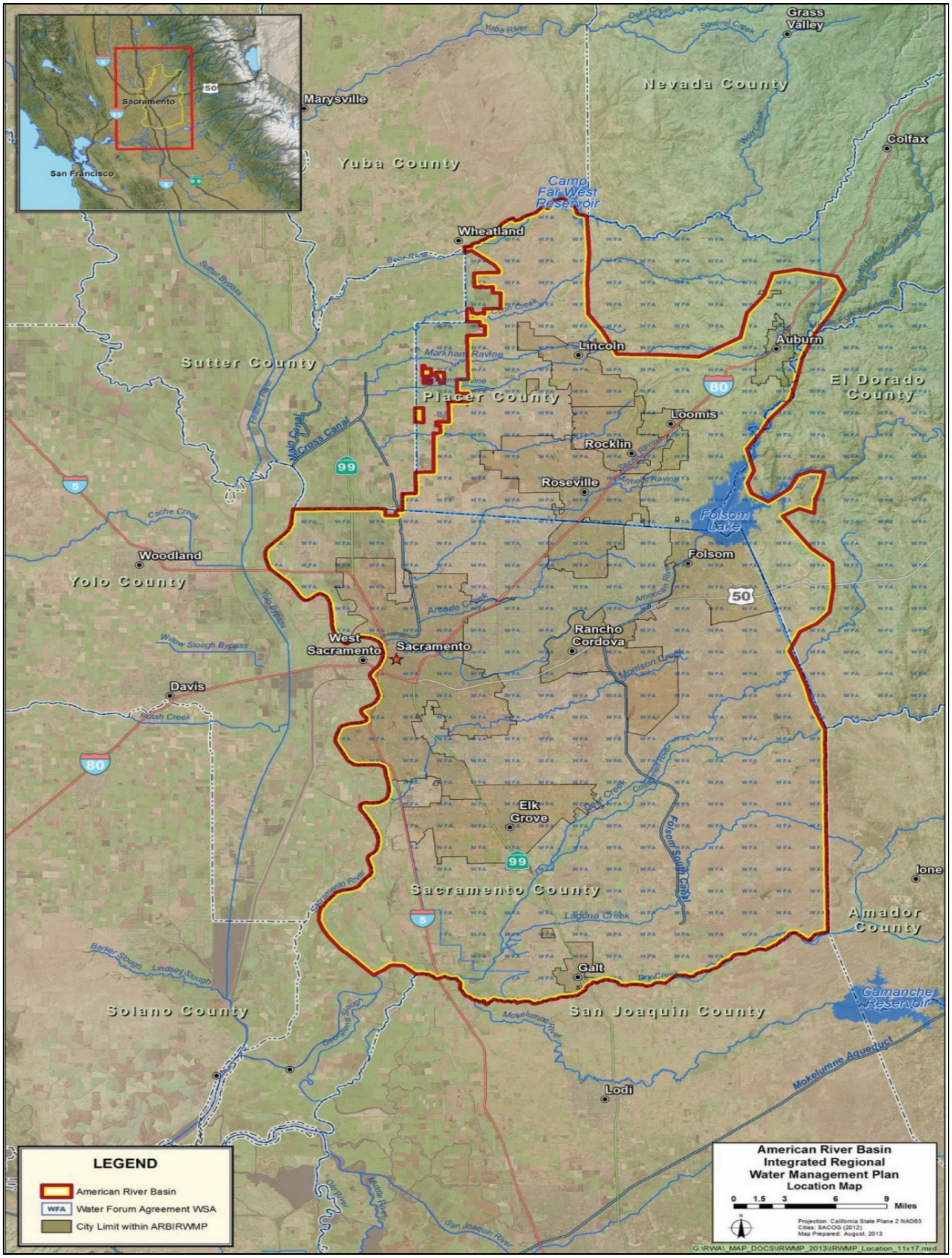

Figure 2-3. Municipal and County Boundaries in the ARB Region (RWA 2013)

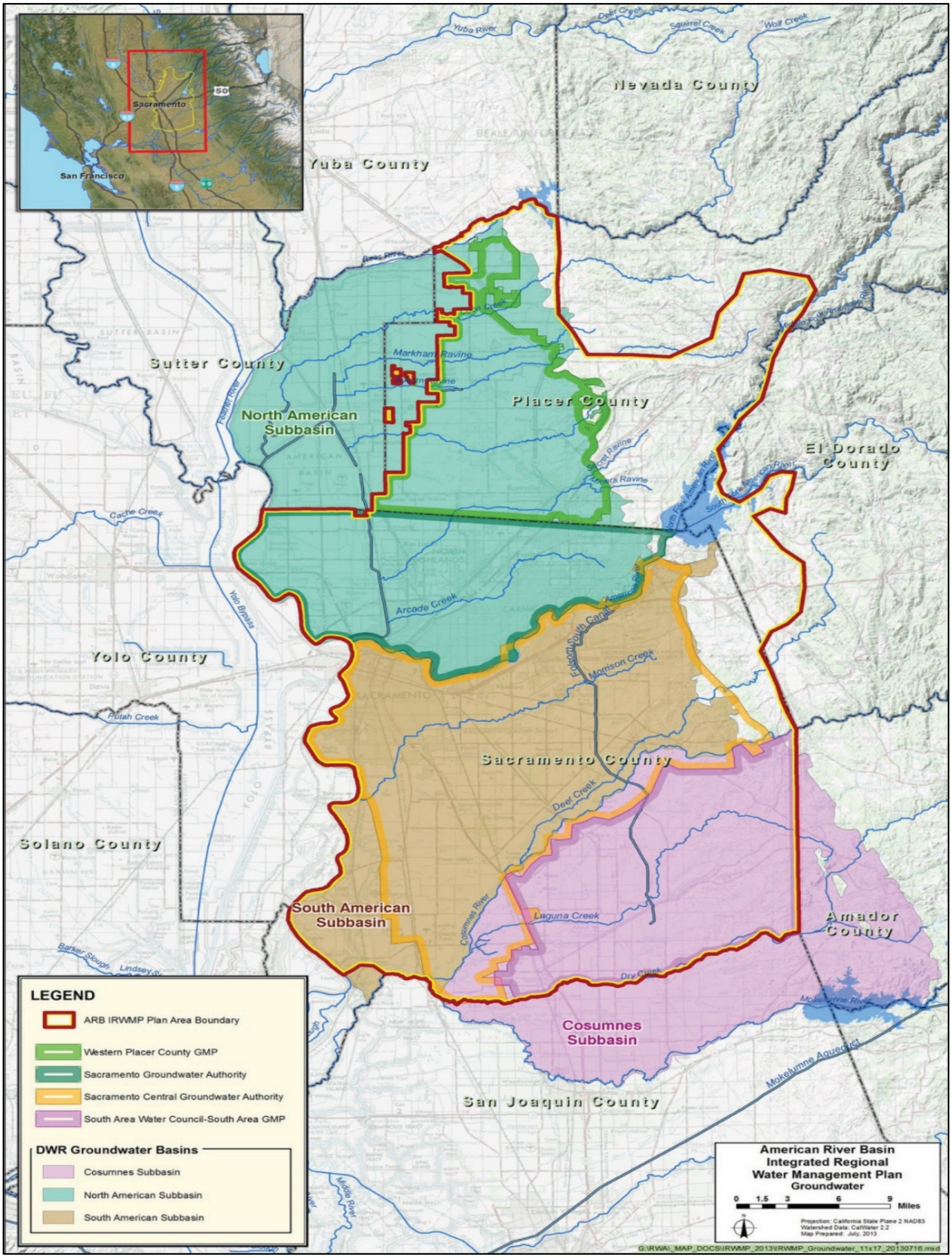

Figure 2-4. Groundwater Basin Boundaries (RWA 2013)

2.3 Water and Environmental Resources (IRWMP Sections 2.6.2, 2.6.3, & 2.8)

2.3.1 Surface Water Resources and Beneficial Uses

Located near the Sacramento-San Joaquin River Delta, the ARB region includes a large portion of the border between two of California's largest hydrologic regions as defined by the California Department of Water Resources (DWR): the Sacramento River and the San Joaquin River. Generally, the southern one-third of the ARB region is within the San Joaquin River hydrologic region and the northern two-thirds is in the Sacramento River hydrologic region.

Figure 2-5 provides a diagram of the primary water bodies within the ARB region. Note that a small portion (66 square miles) of the ARB region's southwestern corner is within the legally defined 1,233-square-mile San Joaquin-Sacramento Delta. The ARB IRWMP provides 27 pages of extensive maps and narrative details of the region's water bodies, including the locations of smaller, local creeks and streams, as well as the hydrology, water quality, habitat and species, and management/stewardship of each watershed plus that of the Sacramento River. Relevant maps are provided in Appendix B2 of this SWRP. GIS shape files of the boundaries may be obtained by contacting RWA.

Beneficial uses of the Sacramento River and its tributaries within the region include municipal and domestic supply, agricultural supply, contact and non-contact water recreation, warm and cold freshwater habitat, migration, spawning, wildlife habitat, and navigation. Beneficial uses of the American and Bear Rivers are the same as the Sacramento River, except they exclude navigation and include hydropower generation. The Cosumnes River's beneficial uses are municipal and domestic water supply, agricultural supply, water contact recreation, warm and cold freshwater habitat, fish migration, spawning, wildlife habitat, and a source of water for the Sacramento-San Joaquin Delta. The Delta's beneficial uses include those for the Sacramento River plus industrial service and process supply and groundwater recharge (Central Valley Regional Water Board 2016).

2.3.2 Groundwater Resources

Groundwater is an important source of water supply within the ARB region and is an integral part of the regional water resources setting. Groundwater supports a significant portion of the region's water needs, and helps reduce impacts to water users in times of shortage. Efforts to increase conjunctive use in the region have included the use of surface water for municipal/industrial use, agricultural use, and groundwater recharge.

The ARB region includes three groundwater sub-basins as introduced in Section 2.2.3 and shown in Figure 2-4 of this SWRP: the North American, South American, and Cosumnes sub-basins. The region has 14 groundwater treatment plants, as well as several groundwater wells operated by various agencies, many with some form of onsite wellhead treatment. The ARB IRWMP documents in-depth information regarding the region's hydrogeology, groundwater quality, and primary contamination plumes, trends, and sustainable yields for each sub-basin. Maps of the sub-basins and relevant authorities are also provided. Detailed maps are included in Appendix B2 of this plan.

All groundwater basins in the region are considered suitable or potentially suitable for municipal and domestic water supply (MUN), agricultural supply (AGR), industrial service supply (IND), and industrial process supply (PRO), unless otherwise designated by the Central Valley Regional Water Quality Control Board (Central Valley Regional Water Board 2016).

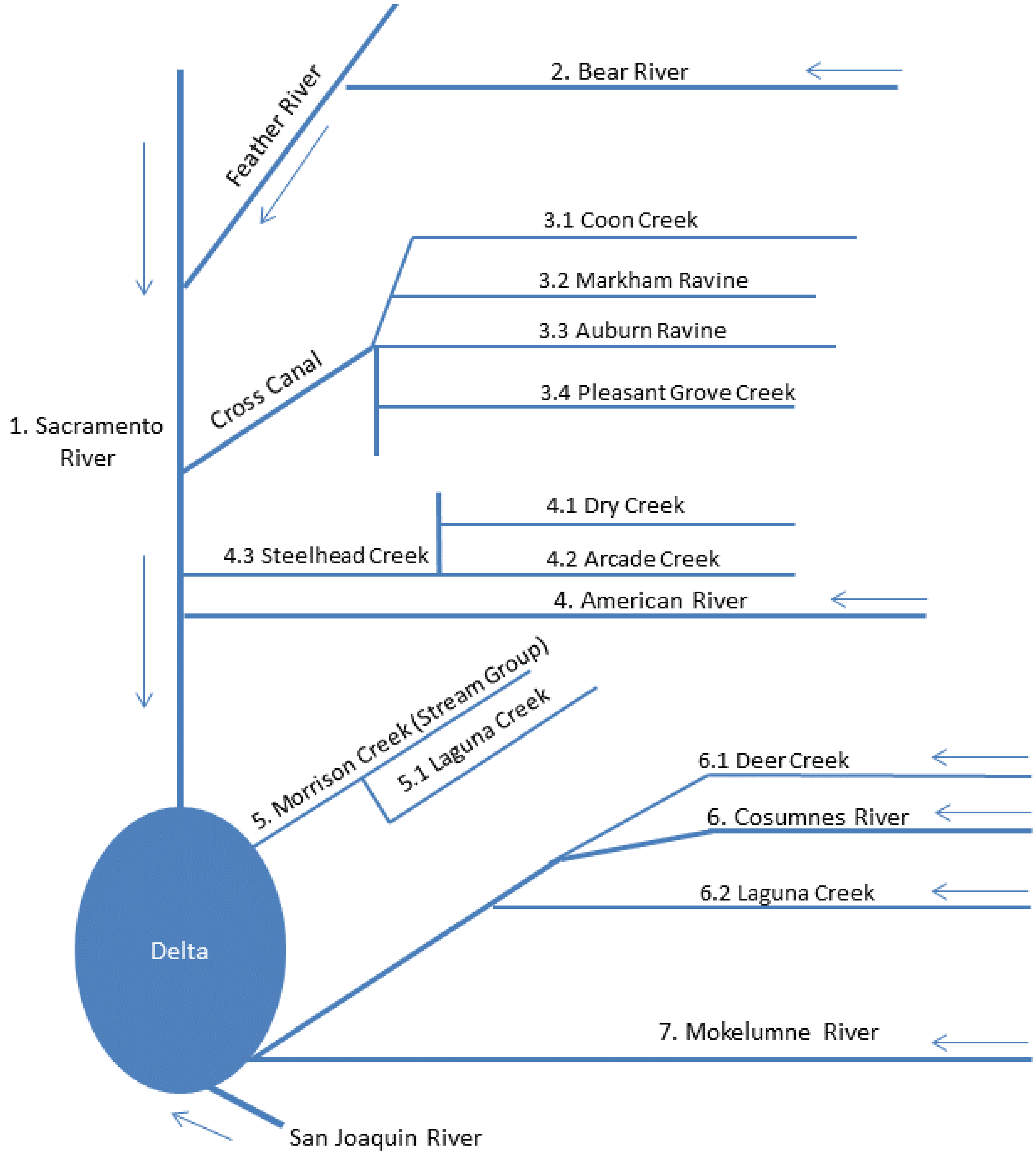

Figure 2-5. Primary Water Bodies within the ARB Region (RWA 2013)

2.3.3 Native Habitat

While much of the habitat within the ARB region has been altered by urbanization and agriculture, some regions remain less impacted and provide important regional habitat for fish and wildlife. Habitat types include wetland, riverine, riparian forests, grassland, emergent marshes, oak woodlands, and vernal pools. A variety of breeding birds reside in the ARB region in the summer, including waterfowl such as mallard, gadwall, cinnamon teal, and wood ducks; herons such as great blue heron, great egret, snowy egret, and black-crowned night hero; songbirds such as song sparrow, red-winged blackbird, house wren, marsh wren, and spotted towhee; and raptors including Cooper's hawk, Swainson's hawk, and red-shouldered hawk. Located within the Pacific Flyway, the ARB region attracts large numbers of migratory birds including waterfowl such as canvasback, greater white-fronted goose, and green-winged teal, and sandhill cranes. Many other special status species call the ARB region home such as vernal pool shrimp species, Swainson's hawk, sandhill crane, giant garter snake, western pond turtle, valley elderberry longhorn beetle, yellow-billed cuckoo, Bell's vireo, burrowing owl, tri-colored blackbird, and the tiger salamander.

A number of small mammals, such as river otter and beavers, depend on regional waterways. All the major rivers and many smaller waterways such as the Dry Creek tributaries provide important habitat for fall run Chinook salmon as well. While the Mokelumne and American Rivers maintain hatcheries for breeding, the area creeks and the Cosumnes River support wild strains of these fish, thus serving as important habitat to preserve genetic diversity of the fall run salmon. Many other native fishes such as hitch and eels also frequent local streams and rivers. It should be noted that the ARB contains two key areas in the southwest portion of the region that provide rare wetlands habitat: the Cosumnes Preserve and Stone Lakes National Wildlife Refuge. The Cosumnes Preserve is primarily managed for migratory water birds, particularly the sandhill crane. Stone Lakes and the adjacent buffer lands, managed by Regional San, provide wetlands utilized by dozens of birds, ducks and geese, and large migratory species as well as small mammals. The ARB IRWMP provides detailed information regarding these habitats and species of primary importance for each of the region's watersheds.

2.3.4 Open Spaces

The communities in the ARB region have multiple open areas that preserve wildlife and natural resources, as well as provide recreational opportunities, aesthetics, and tranquility. The region's municipalities identify recreation, parks, and open space in their general plans and establish relevant goals to assure quality of life is sustained as communities grow. This includes plans to "retain open space, enhance recreational opportunities, conserve fish and wildlife habitat, increase access to natural resource lands and water, and develop parks and recreational facilities," as cited in the Growth Management Act (GMA) of 1991. These plans, which include maps of parks and open spaces, change periodically as new development or redevelopment occurs. The plans are maintained by each community and are available on their websites. Open space and park maps from the ARB region's primary municipalities are provided in Appendix C of this SWRP.

2.4 Natural Watershed Processes (IRWMP Sections 2.6.1, 2.6.2, & 2.6.3)

Watersheds perform three key functions (Figure 2-6): the transport and storage of water, nutrients, pollutants, sediment, and other materials; cycling and transformations of materials such as nutrients, carbon, and minerals as well as the decomposition of plant material performed by microorganisms; and ecological succession involving the evolution of plant communities near waterways and in upland areas. As illustrated in Figure 2-6, precipitation is dispersed through multiple processes, including infiltration, groundwater recharge, evapotranspiration, overland flow, interflow, or base flow.

The distribution of water within these processes is determined by several factors specific to the watershed, including climate, land cover, topography, soil characteristics, and land use. These factors also influence the delivery of sediment and organic matter to receiving waters, as well as chemical and biological processes that affect water quality within the watershed's landscape.

There is no quantitative estimate of these processes in the ARB region, but understanding the climate and geology gives insight to the relative degree of those processes with respect to each other. Located between the Sierra Nevada Mountains to the east and the Pacific Ocean and Coast Range to the west, the region serves, hydrologically, as a thoroughfare for rivers and creeks carrying Sierra mountain drainage, to the Sacramento Delta and, ultimately, the Pacific. The region's water bodies (identified in Section 2.3.1) are fed by moisture-laden, ocean air that drops heavy amounts of precipitation as it blows east, climbing the Sierras. Its location between the ocean and mountains subjects the region to coastal, atmospheric, and elevation influences, so rainfall patterns vary. The average annual precipitation ranges from about 18 inches per year in Sacramento to 34 inches per year in Auburn (about 1,200 feet above mean sea level; RWA 2013). The hot, dry summers and wet winters coincide with higher evaporation rates during summer and lower rates during winter.

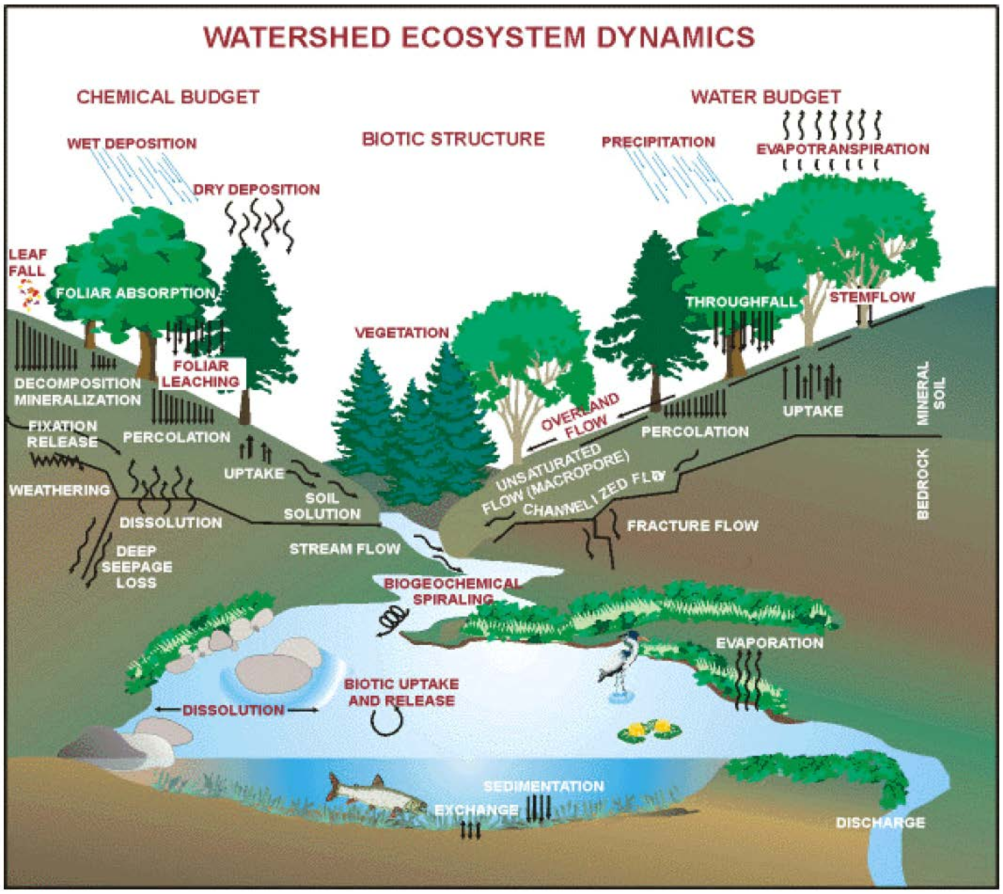

Figure 2-6. Watershed Processes (USEPA 2017)

The ARB region includes an upper aquifer system and a lower aquifer system whose formations are primarily composed of lenses of interbedded sand, silt, and clay, interlaced with coarse-grained stream channel deposits. The deposits generally thicken from east to west to a maximum thickness of about 2,500 feet under the Sacramento River (RWA 2013).

Shallow surface soils in the region range from very poorly draining to excessively draining (USDA SCS 1993), creating sub-regions with varying degrees of infiltration, overland flow, and interflow. Most of the region's shallow surface soils are underlain by cemented hardpan, clayey sediments, or consolidated sediments, which make deep infiltration and groundwater recharge difficult. In contrast, extensive sand and gravel deposits exist along the American, Cosumnes, and Sacramento Rivers as well as numerous streams, making groundwater recharge possible in these areas. Data and evaluations supporting this are provided by the Soil Agricultural Groundwater Banking Index (SAGBI) developed by the UC Davis California Soil Resource Lab and UC Division of Agriculture and Natural Resources (UC ANR; UC Davis 2017). Additionally, ancient subsurface glacial gravel deposits can be found west and southwest of Lake Natoma and south of the Cosumnes River. Infiltration and groundwater recharge could be possible where these subsurface deposits approach land surface.

Historic, pre-urban development land cover in the region includes barren lands of rock, sand, and clay; deciduous, evergreen, and mixed forests; shrub and scrub; grasslands and herbaceous vegetation; pastures and hay fields; woody wetlands; and emergent herbaceous wetlands.

These local climatic and geologic variations in the ARB region, combined with seasonal climatic variations, result in sub-regions with different degrees of natural watershed processes. In general, large amounts of infiltration, interflow, and groundwater recharge occur naturally along river ways and creeks. In between these water bodies, the upper hardpan and clay surface soils hinder infiltration and interflow, resulting in greater amounts of stormwater runoff.

Urban development, along with agricultural and drainage development, have altered the natural watershed processes of the region in typical ways. While some natural, pervious cover such as grassland has been converted to into more varied habitat including trees and other vegetation, extensive amounts land cover have been converted to buildings, roads, and parking lots. The resulting imperviousness has reduced the amount of infiltration, interflow, base flow, and evapotranspiration and increased overland flow volumes, velocities, and peak flow rates. Such hydromodification has caused excess sediment transport into streams; downstream erosion; flooding; disruption of natural drainage patterns, stream flows, and riparian habitat; and elevated water temperatures in some locations (SSQP 2013b). In addition, anthropogenic activities have introduced pollutants, which are transported through overland flow to downstream receiving waters. This overland flow is comprised of stormwater runoff as well as dry-weather runoff—runoff from irrigation water and wash water. Flood control projects and construction of dams for water supply and power generation also result in hydromodification. While intended to improve economic function and citizen quality-of-life, these activities pose threats to a water body's beneficial uses, such as loss of habitat and biotic integrity or poor water quality. Section 2.5 discusses the specific water quality, water supply, flood management, environmental, and community issues related to urbanization within the ARB region watersheds.

It is important to note that climate change also affects watershed processes. Regional changes in weather patterns (e.g., temperature and precipitation intensity, type, and frequency) will directly affect groundwater and surface water supply. They also alter drainage, flooding, and erosion patterns within urbanized areas. These changes, combined with California's growing population, create increased reliance on pumping, conveying, treating, and heating water, all of which are activities associated with the majority of greenhouse gas emissions due to electricity and natural gas consumption (Central Valley Regional Water Board 2016). These activities, which are conducted in response to climate change, actually exacerbate the degree of climate change its contribution to urbanization impacts on the region's watershed processes.

Ideally, effective stormwater control measures should be tailored to the specific watershed processes that have been effected. Practices that might help to restore some of these processes are presented in this SWRP. For example, deep infiltration of stormwater can help return overland flow to a pre-development condition, thereby reducing pollutant and nutrient loading into waterways, minimizing scour and erosion in waterways, and improving the amount of recharge to underlying aquifers. Changes in the management practices near waterways, wetlands, and open spaces in upland areas can improve nutrient cycling, decomposition, delivery of sediment to waterways, and plant community succession.

There is currently no regional, quantitative estimate of how much natural watershed processes (infiltration, interflow, overland flow, etc.) have been altered. However, some regional tools such as the Sacramento Area Hydrology Model (SAHM; Clear Creek Solutions 2013) and the Western Placer County Runoff Reduction Calculator (County of Placer et al. 2016) can simulate these processes on a site scale, and are currently being used for designing post-construction LID and hydromodification measures for some areas. UC Davis is creating an in-depth guide to sands and gravels appropriate for recharge in the S. American and Cosumnes sub-basins. These tools and their associated management programs are helping to maintain natural watershed processes within the region for new development and restore natural watershed processes for redevelopment. Some agencies are also beginning retrofit projects to accelerate the restoration of natural watershed processes in built-out areas that may not undergo redevelopment.

2.5 Watershed Issues and Priorities (IRWMP Sections 2.6.2, 2.7 to 2.9, & Apdx. B)

2.5.1 Water Quality

The ARB watersheds face multiple water quality issues that threaten the regional water body beneficial uses. Key among them are elevated concentrations of total suspended solids, pesticides, and metals. Chlorpyrifos and/or diazinon total maximum daily loads (TMDLs) are in place for many local waterways, including Elder, Elk Grove, Arcade, and Morrison Creeks. Numerous current stormwater pollutants (i.e., pyrethroids, suspended sediment, and nutrients) and legacy pollutants (i.e., banned organochlorine pesticides, chlordane, DDT, dieldrin) affect local waterways. The effects of hydromodification have also been observed in some regional streams and creeks. The Sacramento-San Joaquin Delta is listed as impaired for mercury and methylmercury; some National Pollutant Discharge Elimination System (NPDES) permittees within the ARB area have points of discharge within and upstream of the mitigation program area. The Lower American River may soon be listed as impaired for bacteria (Regional Water Board 2017). In addition, as California develops a statewide mercury TMDL program, upstream discharges may be subject to separate TMDL-like regulatory requirements (State Water Board 2017).

Local municipalities are following mandatory NPDES permit requirements to achieve compliance with existing or pending TMDLs and Basin Plan water quality objectives. This includes implementing pesticide plans, monitoring some waterways and urban discharges for regional pollutants of concern, and preparing for structural improvements to address requirements from the 2015 Trash Amendment. In addition, several regional agencies are addressing a waste load allocation for methylmercury as part of the Delta Mercury Control Program (DMCP). The agencies include the City of Sacramento Combined Sewer System (CSS); Regional San; the Department of Water Resources; and the SSQP municipalities. Section 3.0 of this SWRP cites all relevant TMDLs, NPDES permits, Waste Discharge Requirements (WDRs), and MS4 permits. Section 3.0 also describes the region's water quality compliance efforts, including how this SWRP will contribute.

The water quality and aquatic habitat issues (see Section 2.5.4) in the region have led to a variety of voluntary efforts to explore low impact development (LID) and stormwater reuse practices suitable for local soil and climate conditions. Examples include several green street and LID retrofits on public lands, construction of the Elk Grove Rain Garden Plaza, a major LID retrofit on the Sacramento State campus, and a study to evaluate the risks of using deep infiltration technology (drywells with pretreatment).

2.5.2 Water Supply

The region has significant water demands from municipal/industrial (M&I) and agricultural uses. The estimated 2010 regional M&I water demand was 780,000 acre-feet (ACF), and the projected 2030 demand is 950,000 ACF (a 22% increase). Potential water supplies include groundwater and surface water, which provide 40% and 60% of the regional water demand, respectively. Water demands will continue to be a challenge due to rapid population growth, increasing conflicts among water users, aging infrastructure and limited capacity, calls to decrease energy use, and uncertainties posed by climate change. It is anticipated that water supplies for the region will meet projected demands through 2030 only if conservation and demand management efforts (including increasing water supply capacities) are successful.

To meet water demand, climate change uncertainties, drought conditions, and regulatory requirements, water conservation is actively promoted in the region. Many municipalities fund "Cash for Grass" programs and "River-Friendly Landscape" training to promote water-wise gardening. Along with water districts, RWA also provides opportunities for water conservation through its water use efficiency programs (water meters; appliance rebates; irrigation scheduling for commercial agriculture; public education; plumbing retrofit) and training for river friendly landscaping. Conjunctive use of surface and groundwater supplies is a key water resource management strategy in the region, including over 20 years of promoting surface and groundwater supply interconnectivity. This has allowed for the reduction of surface water diversions during dry conditions in the watershed thereby protecting aquatic life in the Lower American River.

The SWRP will augment these water conservation and conjunctive use programs by promoting stormwater capture and use practices. Regional stakeholders are working with the State and Regional Water Boards to develop standards for use of drywells to allow for larger infiltration volumes and to increase groundwater recharge. Cisterns can store runoff for later discharge, thereby reducing peak discharge rates and hydromodification efforts. Other LID devices such as infiltration galleries and basins can recharge groundwater supplies. SWRP stakeholders will also coordinate with IRWMP members, including RWA, to develop "in-lieu recharge" projects, where surface water and runoff is conveyed to groundwater services areas during high-precipitation years, allowing the relevant communities to bank the groundwater for use during drier years. SWRP projects that include flooding of agricultural areas and other open areas will promote infiltration and recharge of groundwater supplies. In addition, Regional San is planning a project, in the South County area, to capture and use stormwater to dilute its recycled water from the Sacramento Regional Wastewater Treatment Plant and recharge groundwater through surface spreading, thus helping to reduce the region's demand on surface water use; dilution of the recycled water is required by Title 22 §60320.114 of the California Code of Regulations.

2.5.3 Flood Management

The ARB region is subject to flooding from small streams and creeks as well as the American, Sacramento, and Cosumnes Rivers. Regional creeks are vulnerable to localized flooding in the winter. Large levees along the banks of the major rivers are needed to safely contain the run-off produced by extreme floods in the watershed. If not contained, such flooding could close down Interstate 5 and State Route 99, interrupt many of the region's heavily used rail lines, and cause billions of dollars of damage to structures in levee-protected floodplains. Because the region is the largest urban area in the northern Central Valley, the risk of such damage is a major concern.

Flooding is controlled in the ARB region largely through federal- and state-authorized facilities such as Folsom Dam and the levees along the American and Sacramento Rivers and their tributaries. These federal- and state-funded facilities are under the shared jurisdiction of the U. S. Army Corps of Engineers and the Central Valley Flood Protection Board. These agencies work with DWR and the regional flood control agency (SAFCA) to develop and implement regional flood management projects aimed at protecting urban areas against extreme flood events (less than 1/200 annual risk of occurrence).

LID or green street SWRP projects provide an opportunity to alleviate site-level flooding such as that often experienced in streets or parking lots. For example, replacement of standard drain inlets with LID stormwater planters can allow for filtration and capture of leaf debris, but still allow runoff to infiltrate and be treated (and discharged if needed). This prevents clogging of storm drains and subsequent inundation of roadways. LID and green street projects may also be used to replace failing storm infrastructure such as settled pavement, inlets, or piping that cause localized street or parking lot flooding. Agencies and developers can use SWRP projects to help reduce peak stream discharges and minimize downstream impacts.

SWRP projects have the potential to alleviate larger, creek-level flooding in the long term as more LID and green streets are implemented and more runoff is infiltrated and captured. Projects involving diversion of runoff or storm flows to agricultural lands or other open areas would also supplement localized flood control efforts, as would projects involving habitat or flood plain preservation and enhancement. Finally, LID projects can reduce storm-related flows in combined sewer systems, and thereby help minimize CSS outflows and overflows, protecting public health and water quality.

2.5.4 Environmental

Urban development has increased the region's reliance on electricity and natural gas consumption for water sector activities like pumping, conveying, treating, and heating water. These activities are significant contributors to greenhouse gas emissions and reduced air quality, posing threats to human and ecosystem health. Urban development in the region has also introduced water quality pollutants and altered channel morphology to the region's rivers, creeks, and streams, ultimately resulting in reduced biotic richness. Groundwater overdraft in the South American and Cosumnes sub-basins has caused Cosumnes River base flows to instead interflow to groundwater, resulting in salmon passage and stranding challenges, and affecting the riparian habitat along the river corridor. Species and habit concerns related to these environmental issues are well documented in the ARB IRWMP, as are each watershed's management and stewardship efforts.

Within the ARB region, there are eight sensitive terrestrial communities and two sensitive aquatic communities. There are also 17 sensitive plant and animal species that are listed as or candidates for rare, threatened, or endangered status under the federal Endangered Species Act (ESA) and/or the California Endangered Species Act (CESA). These species are strongly impacted by nonnative invasive species, which occur in every type of habitat in the region. Areas dominated by nonnative weeds prevent native plants from becoming established, provide poor habitat quality for wildlife, and discourage recreational uses. Infestations of weed species alter the hydraulic roughness during high-flow events and capacity of the floodway compared to these conditions in the presence of native plants. Some species increase evapotranspiration, which can be detrimental to native species. Appendix B of the ARB IWRMP tabulates the region's sensitive species and habitats, as well as the invasive species.

Capture, infiltration, and use of runoff and storm flows through this SWRP's projects will help mitigate erosion and hydromodification effects, as well as reduce pollutant loads in receiving waters to protect and restore aquatic habitats. In the long-term, there will be reduced reliance on pumping, conveyance, and other water management activities that result in greenhouse gas emissions as more projects are implemented. Other SWRP projects, such as stream bank stabilization or removal of invasive species, will help restore and protect native habitat.

2.5.5 Community

While most DACs in the region are well served by the larger municipal agencies in which they exist in terms of water supply, water quality, flood control, and environmental needs, there are other community aspects that are left wanting. Several areas of the region, particularly DACs within larger municipalities, have dense populations that lack open and recreational spaces. There is also intense competition for jobs and housing, all of which can result in stress, crime, and health issues. The LID and green street projects implemented under this SWRP will help revitalize, maintain, and promote healthy communities through the creation of green and open spaces that improve neighborhood aesthetics. The resulting community benefits could include increases in jobs, sense of place, community focal point, well-being, and safety, and provide connectivity to their creek corridors.

The SWRP projects will also help protect beneficial, recreational uses of the region's waterbodies. Many ARB region communities thrive on citizen and visitor recreation such as swimming, wading, waterskiing, fishing, picnicking, sunbathing, hiking, camping, boating, hunting, sightseeing, or aesthetic enjoyment.

3.0 WATER QUALITY COMPLIANCE

3.1 Activities that Degrade Regional Water Bodies

The SSQP 2009 Stormwater Quality Improvement Plan (SQIP) provides a good summary of the activities that contribute to runoff pollution, degrade water bodies, and impair beneficial uses within the region:

> "Creeks and rivers are a vital environmental and community resource, and their health depends on good water quality. One of the ways that pollutants can enter water bodies is through stormwater runoff. When land is developed, vegetation is replaced with impervious surfaces such as streets and rooftops; when it rains, water can no longer soak into the ground to the extent it previously could, and instead becomes stormwater runoff. Urban areas also generate what is referred to as dry-weather urban runoff (also called nuisance flows) – runoff from irrigation water and wash water, rather than from rain. Runoff collects pollutants as it flows along the ground surface. Streets and other vehicle-related areas accumulate sediments and other contaminants such as metals, oils and petroleum hydrocarbons. Urban runoff itself may also contain pollutants. For example, runoff from lawn or garden watering may carry pesticides, fertilizers or sediment. Runoff from vehicle and equipment washing typically carries detergents and other pollutants. The pollutants that are potentially exposed to/picked up by runoff vary depending on land use and activities. In developed areas, runoff flows into gutters, stormwater pipes (called storm drains) and channels, which, in the Sacramento area, discharge directly into creeks and rivers, along with any pollutants washed away with the runoff. Development also affects creeks by changing the volume and flow rate of water that flows into the creeks; the increased flows can cause erosion, degrade the creek habitat and also increase flood risks. Studies have demonstrated that runoff from the frequent small storms can cause downstream erosion, sedimentation and habitat impairment. Conventional flood detention approaches seek to manage (detain and slowly release) runoff associated with major storms, but do not address the runoff flows that cause chronic erosion and habitat impacts."

Table 3-1 summarizes the various land uses, activities, and associated water quality impacts for the ARB region's water bodies.

3.2 TMDL and Permit Compliance

TMDLs for chlorpyrifos and/or diazinon are in place for Delta Waterways, Elder Creek, Elk Grove Creek, Morrison Creek, Arcade Creek, Chicken Ranch Slough, and Strong Ranch Slough. The SSQP, City of Sacramento CSS, and Regional San have waste load allocations for the Delta methylmercury TMDL. Additional pollutants of concerns that are 303(d) listed (i.e., impaired) for the region include iron, diazinon, chlorpyrifos, copper, mercury, bacteria, fecal coliform, temperature, malathion, pyrethroids, sediment and unknown toxicity, dissolved oxygen, PCBs, pH, boron, chlordane, DDT, dieldrin, group-A pesticides, invasive species, and salinity. Table 3-2 lists the TMDL and 303(d) listings for the region as of 2016, as approved by USEPA in April 2018.

Table 3-1. Land Use Activities and Water Quality Impacts in the ARB Region

Land Use	Activity	Water Quality Impacts														
		Erosion	Increased Sediment	Increased Mercury	Increased Bacteria/Pathogens	Increased Trash	Increased Oils & Grease	Increased Pesticides	Increased Nutrients	Increased Metals	Increased Organics	Reduced Dissolved Oxygen	Altered/Destroyed Habitat	Channel Incision	Sedimentation	Temperature Changes
Agriculture	Herbicide & pesticide application							X								
	Fertilizer application								X		X	X				
	Land disturbance	X	X								X		X		X	
	Alteration of waterways for irrigation											X	X	X	X	X
	Grazing	X	X		X								X	X	X	
Residential, Commercial, Industrial, & Parks	Construction activities	X	X										X	X	X	
	Industrial activities			X	X	X	X	X	X	X	X	X	X	X		X
	Recreation				X	X										
	Increasing imperviousness	X	X										X	X	X	X
	Flood control improvements												X	X	X	X
	Urban development	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Forestry	Timber Harvesting	X	X										X	X	X	X
Mining	Quarry mining	X	X							X	X		X	X	X	X

Adapted from City of Chico Storm Water Resource Plan Water Quality Technical Memorandum (Chico 2017).

Table 3-2. 2012 TMDL and 303(d) Listings

Water Body	Water Quality Issues	Sources
Lower American Watershed		
• **American River, Lower (Nimbus Dam to confluence with Sacramento River)**	• **303(d) listings—Bifenthrin, indicator bacteria, mercury, PCBs, pyrethroids, toxicity**	• **Source Unknown**
• **Arcade Creek**	• **TMDLs—chlorpyrifos, diazinon**	• **Urban runoff**
	• **303(d) listings—copper, malathion, pyrethroids, toxicity**	• **Source unknown**
• **Chicken Ranch Slough**	• **TMDLs—chlorpyrifos, diazinon**	• **Urban runoff**
	• **303(d) listings—pyrethroids, toxicity**	• **Source unknown**
• **Dry Creek (Placer and Sacramento Counties)**	• **303(d) listings—indicator bacteria**	• **Source unknown**
• **Folsom Lake**	• **303(d) listings—mercury**	• **Source unknown**
• **Lake Natoma**	• **303(d) listings—mercury**	• **Source Unknown**
• **Miners Ravine (Placer County)**	• **303(d) listings—dissolved oxygen**	• **Source Unknown**
• **Natomas East Main Drainage (Steelhead Creek, downstream of confluence with Arcade Creek)**	• **TMDL—diazinon**	• **Agriculture**
	• **303(d) listings—mercury, PCBs**	• **Source Unknown**
• **Natomas East Main Drainage (Steelhead Creek, upstream of confluence with Arcade Creek)**	• **303(d)listings—PCBs**	• **Source Unknown**
• **Strong Ranch Slough**	• **303(d) listings—mercury, PCBs**	• **Source Unknown**
	• **303(d) listings—pyrethroids, toxicity**	• **Source Unknown**
Lower Sacramento Watershed		
• Delta Waterways (central portion)	• TMDLs—chlorpyrifos, diazinon	• Source Unknown
	• TMDLs—mercury	• Ag. return flows • Atmospheric deposition • Industrial point sources • Municipal point sources • Natural sources • Resource extraction • Urban runoff
	• 303(d) listing—DDT, group A pesticides, invasive species, toxicity	• Source Unknown

Water Body	Water Quality Issues	Sources
• **Delta Waterways (eastern portion)**	• **TMDLs—chlorpyrifos, diazinon**	• **Source Unknown**
	• **TMDLs—mercury**	• **Ag. return flows** • **Atmospheric deposition** • **Hwy/bridge/road runoff** • **Industrial point sources** • **Municipal point sources** • **Natural sources** • **Resource extraction** • **Urban runoff**
	• **303(d) listing—DDT, group A pesticides, invasive species, toxicity**	• **Source Unknown**
• **Delta Waterways (northern portion)**	• **TMDLs—chlorpyrifos, diazinon**	• **Source Unknown**
	• **TMDLs—mercury**	• **Ag. return flows** • **Atmospheric deposition** • **Hwy/bridge/road runoff** • **Industrial point sources** • **Municipal point sources** • **Natural sources** • **Resource extraction** • **Urban runoff**
	• **303(d) listing—chlordane, DDT, dieldrin, group A pesticides, invasive species, PCBs, toxicity**	• **Source Unknown**
• Delta Waterways (northwestern portion)	• TMDLs—chlorpyrifos, diazinon	• Source Unknown
	• TMDLs—mercury	• Ag. return flows • Atmospheric deposition • Hwy/bridge/road runoff • Industrial point sources • Municipal point sources • Natural sources • Resource extraction • Urban runoff
	• 303(d) listing—DDT, electical conductivity, group A pesticides, invasive species, toxicity	• Source Unknown
• Delta Waterways (western portion)	• TMDLs—chlorpyrifos	• Agriculture • Urban runoff

Water Body	Water Quality Issues	Sources
	• TMDLs—diazinon	• Source Unknown
	• TMDLs—mercury	• Ag. return flows • Atmospheric deposition • Hwy/bridge/road runoff • Industrial point sources • Municipal point sources • Natural sources • Resource extraction • Urban runoff
	• 303(d) listing—arsenic, chlordane, DDT, dieldrin, electical conductivity, group A pesticides, invasive species, PAHs, PCBs, total DDT, toxicity	• Source Unknown
• Duck Slough (in Dela Waterways, northern portion)	• TMDL—chlorpyrifos	• Agriculture
• **Elder Creek**	• **TMDL—chlorpyrifos, diazinon**	• **Urban runoff**
	• **303(d) listing—pyrethroids, toxicity**	• **Source Unknown**
• **Elk Grove Creek**	• **TMDL—diazinon**	• **Urban runoff**
• Knights Landing Ridge Cut	• 303(d) listing—dissolved oxygen, salinity	• Source Unknown
• **Morrison Creek**	• **TMDL—diazinon**	• **Urban runoff**
	• **303(d) listing—PCP, pyrethroids, toxicity**	• **Source Unknown**
• **Sacramento River (Knights Landing to the Delta)**	• **303(d) listing—chlordane, DDT, dieldrin, mercury, PCBs, toxicity**	• **Source Unknown**
• Sacramento San Joaquin Delta	• TMDL—mercury, PCBs	• Source Unknown
	• 303(d) listing—chlordane, DDT, dieldrin, dioxin compounds, furan compounds, invasive species	• Source Unknown
• Sweany Creek	• 303(d) listing—toxicity	• Source Unknown
• Tule Canal	• 303(d) listing—boron, indicator bacteria, salinity	• Source Unknown
• Ulatis Creek	• TMDL—chlorpyrifos, diazinon, diuron	• Agriculture
	• 303(d) listing—toxicity	• Source unknown
• Willow Slough (Solano County)	• 303(d) listing—boron, toxicity	• Source unknown
• Willow Slough Bypass (Yolo County)	• 303(d) listing—boron, indicator bacteria, malathion, selenium, SC, toxicity	• Source unknown
	• TMDL—chlorpyrifos, diuron	• Agriculture
• Winters Canal (Yolo County)	• TMDL—diazinon	• Agriculture

Water Body	Water Quality Issues	Sources
North Fork American Watershed		
• **American River, North Fork**	• **303(d) listing—mercury**	• **Source unknown**
• **Folsom Lake**	• **303(d) listing—mercury**	• **Source unknown**
• Hell Hole Reservoir	• 303(d) listing—mercury	• Source unknown
• Loon Lake	• 303(d) listing—mercury	• Source unknown
• Oxbow Reservoir (Ralston Afterbay, El Dorado and Placer Counties)	• 303(d) listing—mercury	• Source unknown
South Fork American Watershed		
• American River, South Fork (below Slab Creek Reservoir to Folsom Lake)	• 303(d) listing—mercury	• Source unknown
• Coon Hollow Creek (El Dorado County	• 303(d) listing—DDE, toxicity	• Source unknown
• Folsom Lake	• 303(d) listing—mercury	• Source unknown
• North Canyon Creek (El Dorado County)	• 303(d) listing—indicator bacteria, toxicity	• Source unknown
• Slab Creek Reservoir (El Dorado County)	• 303(d) listing—mercury	• Source unknown
Upper Bear Watershed		
• **Bear River, Lower (below Camp Far West Reservoir)**	• **TMDL—chlorpyrifos**	• **Agriculture**
	• **303(d) listing—copper, mercury**	• **Source unknown**
• Bear River, Upper (from Comie Lake to Camp Far West Reservoir, Nevada and Placer Counties)	• 303(d) listing—mercury	• Source unknown
• **Camp Far West Reservoir**	• **303(d) listing—mercury**	• **Source unknown**
• French Ravine	• 303(d) listing—indicator bacteria	• Source unknown
• Rollins Reservoir	• 303(d) listing—mercury	• Source unknown
• Wolf Creek (Nevada County)	• 303(d) listing—indicator bacteria	• Source unknown
• **Yankee Slough (Placer and Sutter Counties)**	• **TMDL—chlorpyrifos**	• **Agriculture**
	• **303(d) listing—toxicity**	• **Source unknown**
• Zayak (Swan) Lake	• 303(d) listing—mercury	• Source unknown
Upper Coon – Upper Auburn Watershed		
• **American River, Lower (Nimbus Dam to confluence with Sacramento River)**	• **303(d) listing—biofentrhin, indicator bacteria, mercury, PCBs, pyrethroids, toxicity**	• **Source unknown**
• **Coon Creek (from confluent of Orr and Dry Creeks to East Side Canal,, Placer and Sutter Counties)**	• **303(d) listing—ammonia as N (total), indicator bacteria**	• **Source unknown**
• Coon Creek, Lower (from Pacific Avenue to Main Canal, Sutter County)	• 303(d) listing—dissolved oxygen, indicator bacteria, toxicity	• Source unknown
• **Curry Creek (Placer and Sutter Counties)**	• **303(d) listing—pyrethorids, toxicity**	• **Source unknown**

Water Body	Water Quality Issues	Sources
• **Kaseburg Creek (tributary to Pleasant Grove Creek, Placer County)**	• **303(d) listing—biofenthrin, cyfluthrin, cyhalothrin (lambda), cypermethrin, deltamethrin, pyrethroids, toxicity**	• **Source unknown**
• **Kaseburg Creek, unnamed eastern tributary (from Green Grove Ln to Del Webb Blvd)**	• **303(d) listing—biofenthrin, cyfluthrin, cyhalothrin (lambda), cypermethrin, toxicity**	• **Source unknown**
• **Kaseburg Creek, unnamed southeastern tributary (from Silverado Middle School to Timber Creek Gold Course, Placer County)**	• **303(d) listing—biofenthrin, cyfluthrin, cyhalothrin (lambda), cypermethrin, deltamethrin, toxicity**	• **Source unknown**
• **Kaseburg Creek, unnamed southern tributary (from Baseline Road to Timer Creek Gold Course, Placer County)**	• **303(d) listing—biofenthrin, cyfluthrin, cyhalothrin (lambda), cypermethrin, deltamethrin, toxicity**	• **Source unknown**
• Natomas Cross Canal (Sutter County)	• 303(d) listing—mercury	• Source unknown
• **Pleasant Grove Creek**	• **303(d) listing—biofenthrin, cypermethrin, dissolved oxygen, pyrethorids, toxicity**	• **Source unknown**
• **Pleasant Grove Creek, South Branch**	• **303(d) listing—biofenthrin, cyfurthrin, cypermethrin, deltamethrin, dissolved oxygen, pyrethorids, toxicity**	• **Source unknown**
• **Pleasant Grove Creek, South Branch, unnamed southestern trib (from east of Sierra View Country Club to conf with Pleasant Grove Cr, South Branch)**	• **303(d) listing—biofenthrin, cyfurthrin, cypermethrin**	• **Source unknown**
• **Pleasant Grove Creek, unnamed northern tributary (from Greywood Circel to confluence with Pleasant Grove Creek)**	• **303(d) listing—biofenthrin, cyfurthrin, cypermethrin, toxicity**	• **Source unknown**
• **Pleasant Grove Creek, unnamed northern tributary (from Mt Tamalpais Drive to confluence with Pleasant Grove Creek)**	• **303(d) listing—biofenthrin, cyfurthrin, cypermethrin, toxicity**	• **Source unknown**
• **Rock Creek (Placer County)**	• **303(d) listing—indicator bacteria**	• **Source unknown**
• **Sacramento River (Knights Landing to the Delta)**	• **303(d) listing—chlordan, DDT, dieldrin, mercury, PCBs, toxicity**	• **Source unknown**
Upper Cosumnes Watershed		
• **Cosumnes River, lower (below Michigan Bar; partly in Delta Waterways, eastern portion)**	• **303(d) listing—indicator bacteria, invasive species, toxicity**	• **Source unknown**

Water Body	Water Quality Issues	Sources
• Delta Waterways (eastern portion)	**• TMDLs—chlorpyrifos, diazinon**	**• Source Unknown**
	• TMDLs—mercury	**• Ag. return flows • Atmospheric deposition • Hwy/bridge/road runoff • Industrial point sources • Municipal point sources • Natural sources • Resource extraction • Urban runoff**
	• 303(d) listing—DDT, group A pesticides, invasive species, toxicity	**• Source Unknown**
• Laguna Creek (tributary to Cosumnes River, Sacramento County)	**• 303(d) listing—DDT, group A pesticides, invasive species, toxicity**	**• Source Unknown**
• Mokelumne River, Lower (in Delta Waterways, eastern portion)	**• TMDLs – chlorpyrifos**	**• Agriculture**
	• TMDLs – mercury	**• Ag. return flows • Atmospheric deposition • Hwy/road/bridge runoff • Industrial point sources • Municpal point sources • Natural sources • Resource extraction • Urban runoff/Storm sewers**
	• 303(d) listing – copper, dissolved oxygen, toxicity, zinc	**• Source unknown**
Upper Mokelumne Watershed		
• Amador Lake	• 303(d) listing—pH (high), mercury	• Source unknown
• Bear River	• 303(d) listing—copper, pH (low)	• Source unknown
• Brack Tract Drain, at Woodbridge Rd. (San Joaquin County)	• 303(d) listing—arsenic	• Source unknown
• Camanche Reservoir	• 303(d) listing—mercury, zinc	• Source unknown
• Delta Waterways (central portion)	• TMDLs—chlorpyrifos, diazinon	• Source unknown

Water Body	Water Quality Issues	Sources
	• TMDLs—mercury	• Ag. return flows • Atmospheric deposition • Hwy/road/bridge runoff • Industrial point sources • Municpal point sources • Natural sources • Resource extraction • Urban runoff
	• 303(d) listing—DDT, group A pesticides, invasive species, toxicity	• Source unknown
• **Delta Waterways (eastern portion)**	• **TMDLs—chlorpyrifos, diazinon**	• **Source unknown**
	• **TMDLs—mercury**	• **Ag. return flows** • **Atmospheric deposition** • **Hwy/road/bridge runoff** • **Industrial point sources** • **Municpal point sources** • **Natural sources** • **Resource extraction** • **Urban runoff**
	• **303(d) listing— DDT, group A pesticides, invasive species, toxicity**	• **Source unknown**
• **Delta Waterways (northern portion)**	• **TMDLs—chlorpyrifos, diazinon**	• **Source unknown**
	• **TMDLs—mercury**	• **Ag. return flows** • **Atmospheric deposition** • **Hwy/road/bridge runoff** • **Industrial point sources** • **Municpal point sources** • **Natural sources** • **Resource extraction** • **Urban runoff**
	• **303(d) listing—DDT, dieldrin, group A pesticides, invasive species, PCBs, toxicity**	• **Source unknown**
• **Meadows Slough (Sacramento County)**	• **303(d) listing—mercury**	• **Source unknown**

Water Body	Water Quality Issues	Sources
• **Mokelumne River, Lower**	• **TMDLs—chlorpyrifos**	• **Agriculture**
	• **TMDLs—mercury**	• **Ag. return flows** • **Atmospheric deposition** • **Hwy/road/bridge runoff** • **Industrial point sources** • **Municpal point sources** • **Natural sources** • **Resource extraction** • **Urban runoff**
	• **303(d) listing—copper, dissolved oxygen, toxicity, zinc**	• **Source unknown**
• Pardee Reservoir	• 303(d) listing—mercury	• Source unknown
• Potato Slough, Little (San Joaquin County)	• 303(d) listing—toxicity	• Source unknown
• Rattlesnake Creek	• 303(d) listing—indicator bacteria	• Source unknown

Bold text indicates TMDLs or 303(d) listings within the ARB region

Applicable NPDES permits, WDRs, MS4 permits, and state regulations are listed in Table 3-3. The municipal permits direct agencies on various activities they must do to protect water quality, including achievement of TMDL compliance. For example, the recently adopted Central Valley Regional Municipal Permit (Central Valley Regional Water Board 2016) requires the members of the SSQP—the County of Sacramento and the Cities of Sacramento, Citrus Heights, Folsom, Elk Grove, Rancho Cordova, and Galt—to develop a Stormwater Management Plan (SWMP). The SWMP must:

1. Identify priority water quality constituents (PWQCs) for which the permittee discharges are causing or contributing to exceedances of water quality standards.
2. Identify milestones and strategies that "will ensure that…discharges will no longer cause or contribute to exceedances of water quality standards in any receiving water."
3. Include a reasonable assurance analysis (RAA) to demonstrate that proposed strategies will "succeed in timely achievement of all water quality milestones, and final dates for attaining water quality standards."

At the time of writing this ARB SWRP, the SSQP was in the beginning stages of developing their SWMP. The Partnership submitted the PWQC identification and RAA approach proposal to the Central Regional Water Board in May 2017 and will develop a SWMP within one year of approval of the May 2017 planning documents. SSQP has historically identified target pollutants and developed individual pollutant control strategies to address them. Control strategies included source controls, load reductions through the construction and implementation of new development elements, public outreach, and Integrated Pest Management programs.

The smaller municipalities in the region are subject to the Phase II permit, which requires them to:

1. Reduce pollutant discharges to achieve TMDL waste load allocations.
2. Not cause or contribute to an exceedance of water quality standards.

All SWRP projects will, in some way, support permit compliance through protection of water quality and beneficial uses. Relevant permit requirements are incorporated into the SWRP through project identification tools and benefit quantification tools. Projects installed by public agencies to assist with NPDES permit compliance will be deemed in accordance with this ARB SWRP.

Several SWRP projects will include LID and green infrastructure practices, or site design measures such as use or protection of stream setbacks and buffers or planting/preservation of trees, as cited in the Phase II permit. These projects capture and retain/treat runoff, thereby minimizing stormwater discharge volumes, reducing transport of pollutants to water bodies, and protecting beneficial uses. This directly aligns with the ARB region NPDES permits, which require LID implementation and focus heavily on protection of water quality and preservation of beneficial uses. In addition, the City of Sacramento's CSS NPDES Permit requires the city to implement a combined sewer system improvement plan (CSSIP), which primarily addresses two NPDES permit requirements: the reduction of CSS discharges and in-system surface flooding and outflows. The CSSIP update evaluated LID implementation and showed that LID can augment the benefits of capital projects to the CSS by reducing runoff volume and potentially attenuating the peak flows entering the system.

Other SWRP projects may include diverting storm flows from the region's rivers or tributaries, of which upstream urban runoff is a large contributor, to flood agricultural lands or other large open areas for infiltration and groundwater recharge. Diverting these flows will prevent negative hydromodification and water quality impacts farther downstream and reduce downstream erosion and sedimentation, thereby supporting permit requirements for protecting beneficial uses. SWRP projects that consist of in-lieu recharge would also support permit compliance in this way. In-lieu recharge projects involve modifying infrastructure so communities that regularly rely on groundwater can instead pull water from rivers and tributaries during high flow periods, thereby banking groundwater for drier (lower flow) periods.

Finally, through data sharing, the SWRP can foster collaboration among regional stakeholders so that costs for water quality benefit projects (e.g., costs for monitoring, data assessment, project management, and design) may be shared. This can reduce overall costs, increase the likelihood of funding, and, in turn, facilitate permit compliance.

Table 3-3. Applicable NPDES Permits, WDRs, MS4 Permits, and State Regulations

Permit or Regulation	Note
Central Valley Regional Municipal Permit (Central Valley Regional Water Board 2016)	Effective October 2016
City of Sacramento Wastewater NPDES Permit (Central Valley Regional Water Board 2015b)	Combined wastewater collection and treatment system permit
Statewide Construction General Permit (State Water Board 2009)	As required through MS4 permits
Statewide Industrial General Permit (State Water Board 2015b)	As required through MS4 permits
Statewide Phase II NPDES/WDRs Municipal Stormwater Permit (State Water Board 2013)	Including pending updates to Appendix G (TMDL compliance)
Trash Amendments (State Water Board 2015a)	Only those applicable to inland surface waters
Title 22 of the California Code of Regulations	Direct recycled water recharge projects

4.0 ORGANIZATION, COORDINATION, AND COLLABORATION

4.1 Stakeholder Identification

Key stakeholders in the ARB region include:

- Water and groundwater supply, wastewater, recycled water, stormwater, flood management, and land-use agencies (Table 2-2)
- Groundwater management agencies (Table 2-4)
- RWA, the joint powers authority serving as the ARB region's IRWM group lead
- SACOG
- California Native Plant Society
- Environmental Justice for Water Coalition
- Two federally recognized tribes
    - United Auburn Indian Community of the Auburn Rancheria (UAIC)
    - Wilton Rancheria
- School districts (Appendix D of this SWRP)
- Watershed stewardship groups, including non-governmental organizations that work on storm water and dry weather resource planning or management (Table 4-1)
- The general public, including DACs
- Park districts
- Resource conservation districts

Table 4-1. Watershed Stewardship Groups

Watershed	Stewardship Groups
Lower Sacramento Watershed	Sacramento River Watershed Program Friends of Auburn Ravine Valley Foothill Watershed Collaborative
Upper Bear Watershed	Bear River Work Group Placer County/Placer Legacy Program
Upper Coon-Upper Auburn Watershed	Placer County/Placer Legacy Program Ophir Area Property Owners Association Bear Watershed Stakeholder Group Friends of Auburn Ravine Placer–Nevada–South Sutter–North Sacramento (PNSSNS) Subwatershed Group Placer Nature Center American Basin Council of Watersheds Save Auburn Ravine Steelhead and Salmon Valley Foothill Watershed Collaborative
Lower American Watershed	Sacramento Area Creeks Council American River Parkway Foundation Dry Creek Conservancy Valley Foothill Watershed Collaborative
Upper Cosumnes Watershed	Laguna Creek Watershed Council Cosumnes River Partnership The Nature Conservancy Ducks Unlimited, Inc. Cosumnes Coalition Sacramento Valley Conservancy
Upper Mokelumne	Stone Lakes National Wildlife Refuge Partnership

4.2 Stakeholder Involvement in SWRP Development

During development of this SWRP, local agencies and nongovernmental organizations were consulted, and other stakeholders were given opportunities to participate. Specifically, stakeholder involvement was provided at two levels: a "collaborator" level and a "general outreach" level. Collaborator involvement consisted of attending monthly planning meetings, providing resources such as maps and GIS files, reviewing draft versions of the SWRP and associated tools, and assisting with general outreach efforts. Project collaborators assisting at this level included over 40 individuals from over 20 agencies and organizations within the ARB region. Additionally, RWA provided guidance on integrating this SWRP with the existing IRWMP and updated its online planning tool and information center (OPTI), which disseminates information on ARB IRWMP projects. The tool was updated to accommodate the specific needs of identifying, ranking, and tracking projects developed for this SWRP. Sections 5.0, 6.0, 7.0, and 8.0 describe how OPTI will be used for various aspects of SWRP implementation. Finally, the Office of Water Programs (OWP) at California State University, Sacramento, led the collaborative effort for developing the SWRP by facilitating the planning meetings; developing GIS files, maps, and tools; writing various drafts; and coordinating stakeholder outreach. Table 4-2 lists the collaborating entities and their responsibilities.

General outreach activities for development of the SWRP built upon prior accomplishments of the IRWMP. During the 2013 IRWMP update, extensive stakeholder outreach was conducted among the water community, the public, NGOs, DACS, and federally recognized tribes. For this SWRP effort, stakeholders were notified of activities and progress through (1) postings to RWA/OPTI websites, (2) briefings to the Water Forum Successor Effort, and (3) briefings to IRWMP stakeholders at regular semi-annual meetings. Representatives from DACs, tribes, and school districts were invited to participate in the public review of the SWRP through introductory letters. Finally, as an NGO and primary team collaborator, the Valley Foothill Watershed Collaborative played a significant role in outreach efforts, leveraging the historic experience of their NGO partners in building community support for watershed stewardship. One example of their efforts included hosting a regional watershed conference in March 2018, which included presentations on the development, intent, and initial projects of this SWRP.

4.3 Stakeholder Coordination for SWRP Implementation

Many SWRP projects will be implemented or supported by individual agencies, such as municipalities. These projects will follow each agency's existing planning, design, construction, monitoring, and maintenance procedures, as dictated by jurisdiction. Any necessary authorization or approvals by agency boards or directors will be sought at the project design stage; projects presented in this SWRP are considered to be at the conceptual planning stage. Each stakeholder with a project proposed in this SWRP has submitted a letter confirming that they are vested in the SWRP process (Appendix E). City councils and county boards of supervisors are issuing resolutions acknowledging and supporting this SWRP as well, and these are anticipated to be signed by the end of the 2017-18 fiscal year (June 30, 2018). A template of these resolutions is provided in Appendix F.

Agencies will use ARB IRWMP's OPTI to coordinate plan implementation. As part of this SWRP's development, OPTI was updated to accommodate the project implementation and tracking needs of this SWRP. Each SWRP project will be listed in OPTI during its planning stage and updated upon project completion to record actual field installations and any relevant performance information. In this way, OPTI allows multiple stakeholders, including agencies, to observe and track the various elements and stages of the project.

Table 4-2. SWRP Collaborators and Responsibilities

Collaborating Entity	Responsibilities
City of Auburn City of Citrus Heights City of Elk Grove City of Folsom City of Galt City of Lincoln City of Rancho Cordova City of Rocklin City of Roseville City of Sacramento Cosumnes Coalition/Trout Unlimited County of Sacramento Elk Grove Water Service/Florin Resource Conservation District Placer County Sacramento Area Flood Control Agency Sacramento Central Groundwater Authority Sacramento Regional County Sanitation District Sacramento Stormwater Quality Partnership Town of Loomis Valley Foothill Watershed Collaborative	• Attend planning meetings • Provide resources (GIS files, maps, tools) • Review SWRP drafts • Review of quantitative tools • Assist with public outreach
Regional Water Authority	In addition to above responsibilities: • Guide SWRP integration with IRWMP • Update IRWMP management tool (OPTI) to address needs for ARB SWRP projects
Office of Water Programs at California State University, Sacramento	• Facilitate planning meetings • Develop GIS files, maps, and quantitative tools • Write SWRP • Coordinate stakeholder outreach

4.4 Relevant Documents, Ordinances, and Programs

Due to the large size of the region and number of stakeholders, there are dozens of documents, ordinances, and programs relevant to this SWRP. Appendix F of the ARB IRWMP tabulates several of them, although some have changed since the IRWMP adoption in 2013. A summary of the most relevant documents, programs, and ordinances are provided below.

The ARB IRWMP, in which this SWRP is incorporated, is a primary document that cites the existing resources and programs related to the supply, use, management, and protection of water within the region. The IRWMP serves as a backbone to this SWRP not only by providing a thorough summary of the ARB region watersheds and their stewardship programs, but also by providing an existing platform of stakeholder coordination, which will further the intent of using stormwater as a resource to support improved water quality, water supply, flood control, environmental, and community benefits.

Applicable NPDES permits, WDRs, MS4 permits, state regulations, and associated documents are listed in Table 3-3 and discussed in Section 3.2. To meet permit requirements, the municipal stormwater programs have developed stormwater management and discharge control ordinances, BMP guidance for businesses and charity car washing programs, as well as construction and post-construction runoff programs. Construction runoff programs include multiple resources for compliance such as guidance manuals, stormwater pollution prevention plan (SWPPP) templates, and inspections forms. Post-construction runoff programs include guidance resources for BMP planning, design, and maintenance. Other relevant documents include permit applications for civil improvements, easements, and encroachments. Because these materials are frequently updated, combined with the sheer number of them, the specific titles are not cited. Instead, the reader is referred to the stormwater webpages of each community for access to the most recent information.

The projects listed in this SWRP, as well as future projects, will need to follow the applicable ordinances, guidance, and requirements of the relevant municipality's stormwater program. Planning and design of projects must follow the applicable municipality's design standards. Construction activities must follow those dictated by the municipal stormwater construction program, including development and implementation of a SWPPP. Plans should be developed to ensure proper operation and maintenance of post-construction stormwater management controls, using the applicable municipal guidance. Finally, planning, design, construction, operation, and maintenance must follow all associated ordinances.

Municipal general plans are also important resources for potential SWRP projects, as they list existing and proposed community development plans, including those for protection, restoration, and creation of recreational areas, parks, and open spaces.

Section 9.0 of this SWRP lists the primary references used to develop the ARB SWRP. Appendix G of this SWRP provides an annotated description of these references, along with their relevance to the ARB SWRP.

4.5 Individual Agency Participation

Many SWRP projects will be site-level efforts implemented or supported by individual agencies, such as municipalities, who are limited to spending their taxpayer dollars within their jurisdictions to directly benefit their citizens, although there may be some larger, regional-level projects. This approach of implementing multiple small, isolated projects throughout the watershed is anticipated to meet the objectives of this SWRP, namely improving the management of stormwater as a resource and maximizing watershed benefits related to water supply, water quality, flood control, and the ARB environment and communities.

5.0 QUANTITATIVE METHODS

This SWRP outlines specific methodologies for quantifying and evaluating benefits of projects undertaken by regional stakeholders. Such projects can achieve an array of potential benefits, including increasing local capture, promoting groundwater recharge, reducing hydromodification, or directly improving downstream water quality. In the context of this SWRP, projects are any development and planning process undertaken by a regional stakeholder that upon completion contributes to the benefits outlined as part of the plan. Section 6 describes the SWRP methodology for identifying projects based on a multi-criteria decision-making framework in interest of achieving multiple benefits.

For each project developed under the SWRP decision-making framework, the SWRP provides specified procedures to assess benefits across a variety of habitat, water management, and energy reduction goals. These are introduced below, with detailed methods provided in Appendix H. For purposes of this SWRP, projects are not evaluated on the basis of their financial feasibility or available funding, and designation as a SWRP project does not directly influence its likelihood of completion, only its potential for achieving multiple desirable benefits.

5.1 Integrated Metrics-Based Analysis

Table 5-1 presents the potential benefits and metrics to be evaluated for ARB SWRP projects. The benefits were based on the ability of projects to achieve desirable outcomes that address key watershed issues and priorities for the ARB region presented in Section 2.5. The benefit type (main or additional) listed in Table 5-1 is related to prioritization practices cited in the State Water Board's SWRP guidelines (State Water Board 2015c; see Section 6.3). Table 5-1 also lists references for the quantitative methods to be used for each metric. Metrics for projects incorporating BMPs are calculated using the Appendix H worksheets. Metrics for other projects are calculated using appropriate modeling software, GIS tools or Google Earth, parcel maps, and other resources listed in Table 5-1. The benefits, metrics, and quantitative methods presented in Table 5-1 and Appendix H were developed to provide an integrated watershed-based and metrics-based analysis that demonstrates how SWRP projects will support the ARB region's water management objectives cited in Table 1-3.

The water quality benefits analysis estimates pollutant load reductions and volume reductions that will contribute to preservation and enhancement of natural watershed processes and address NPDES permit requirements. Dissolved copper, TSS, and *E. coli* were selected as representative constituents for quantifying load reductions associated with water quality benefits in the ARB region. These constituents were based on the priority water quality constituents (PWQCs) identified by SSQP as part of their reasonable assurance analysis (RAA) required by the regional NPDES permit. The PWQC list was developed from regional historic data and impairments related to urban runoff. A literature review was then conducted to gather treatment data available for structural BMPs commonly used in the ARB Region. For some PWQCs, insufficient data was available, but TSS, dissolved copper, or *E. coli* was deemed an adequate surrogate. For example, TSS was selected to represent particulates and particle-bound constituents. Dissolved copper was selected to represent metals, and *E. coli* was selected to represent pathogens. For other PWQCs with insufficient data, design practices were determined to be the best way to ensure control measures. For example, trash will be controlled by following BMP selection and design standards. Table 5-2 lists the PWQCs identified by the SSQP and whether or not the PWQCs were included for the SWRP quantification of load reductions. Table 5-3 lists the influent and effluents concentrations used for quantifying load reductions for the included constituents. Appendix I provides a thorough description of the method for selecting constituents and assigning concentrations.

Note that pyrethroids, due to their toxicity, are a constituent of concern for the region, but were not included in the water quality benefit metrics because there is a lack of BMP performance data to make meaningful estimates of mass removed. Future SWRP updates should consider adding pyrethroids, when data becomes available.

A list of initial SWRP projects and their quantified benefits is presented in Section 6.4.

Table 5-1. ARB SWRP Benefits and Metrics

Benefit Category	Benefits	Benefit Type[1]	Metric	Unit[2]	Quantitative Method			
					ARB SWRP Worksheets for BMP Projects	Appropriate Water Quality, Hydrologic, or Flood Model	GIS Tool, Google Earth, Parcel Map, or Topo Survey	Water-Energy Measure Calculator[3]
Water Quality	Reestablishment of natural water drainage and treatment[4]	Main	Volume of runoff reduced	afy	X	X		
	Increase in filtration and/or treatment of pollutants in runoff – TSS	Main	Load of TSS reduced	kg/yr	X	X		
	Increase in filtration and/or treatment of pollutants in runoff – dissolved copper	Main	Load of dissolved copper reduced	kg/yr	X	X		
	Increase in filtration and/or treatment of pollutants in runoff – *E. coli*	Main	Load of *E. coli* reduced	mpn/yr	X	X		
Water Supply	Increase in groundwater supply through infiltration	Main	Volume infiltrated to groundwater	afy	X	X		
	Increase in groundwater supply through in-lieu recharge[5]	Main	Volume captured to offset demand	afy	X	X		
	Increase in surface water supply through direct use[6]	Main	Volume captured to offset demand	afy	X	X		
Flood Management	Decrease in flood risk through reduced peak flow rates of runoff	Main	Rate of peak flow reduced for the 2-, 10-, 25-, 50-, and/or 100-year storm(s) as appropriate	cfs	X	X		
	Increase in area addressed for flood mitigation	Main	Size of area addressed for flood mitigation	acres	X	X		
	Decrease in combined sewer overflows	Additional	Volume of runoff reduced to combine sewer systems	afy	X	X		
Environmental	Enhancement, creation, and/or protection of wetlands, riparian zones, and aquatic habitat	Main	Size of area of wetland, riparian zone, or habitat enhanced, created, or protected	acres	X		X	
	Increase in urban green space	Main	Size of area created	acres	X		X	
	Improvement to instream flow rate	Main	Rate of instream flowrate improved	cfs	X	X		
	Decrease in energy use	Additional	Energy use reduced	kwh/yr	X			
	Decrease in greenhouse gas emissions	Additional	Mass of GHG emissions reduced	tonnes/yr	X			X
	Improvement in Water Temperature	Additional	Degrees of water temperature improved or percent canopy cover increased	Degrees or %	X	X		
Community	Increase in public education	Main	Number of outreach materials provided or events conducted[7] or number of participants	# of outreach types or participants	X			
	Increase in public involvement	Additional	Number of hours volunteered or number of participants	# of hours or participants	X			
	Creation or enhancement of public space	Additional	Size of public space created or enhanced	acres	X		X	

[1] *Benefit types defined in the SWRP guidelines (SWRP 2015c).*
[2] *afy = acre feet per year; kg/yr = kilogram per year; cfs = cubic feet per second; kwh/yr = kilowatt hours per year; mpn/yr: most probable number per year.*
[3] *Water-Energy Measure Calculator (2007): CA Public Utilities Commission Energy Division. June 2017.*
[4] *This benefit involves prevention of hydromodification impacts (and subsequent water quality degradation) by reducing the volumes of runoff discharged*
[5] *In-lieu recharge can be achieved by installing infrastructure that brings surface water to groundwater-dependent communities during high water years, or by capturing and using stormwater. This results in reduced demand on groundwater supplies.*
[6] *Capturing runoff for non-potable indoor use, outdoor use, industrial use, or potable indoor use via wastewater treatment plant. This reduces the demand on existing surface supplies.*

Table 5-2. Constituents Evaluated for Quantifiable Methods

Constituent Group	Included/ Excluded for SWRP Quantification	Representative Constituent	Basis for Inclusion or Exclusion
Trash	*Excluded*	Non-organic material >5mm	Insufficient BMP performance and baseline data. Addressed through design standards adopted by each jurisdiction.
Pyrethroids	*Excluded*	Bifenthrin	BMP performance data are limited. Central Valley TMDL focuses on sediment control BMPs and other non-structural controls.
Legacy OP Pesticide	*Excluded*	None	Urban sources are effectively removed and delisting for urban waters is likely.
Mercury	*Excluded*	Methylmercury and Total Mercury	Insufficient BMP performance data, especially for methylmercury. Delta TMDL relies on sediment control BMPs. Address through design standards ("ensure BMP does not generate methylmercury").
Fipronil	*Excluded*	Fipronil	Insufficient BMP performance data.
Pathogen Indicator	**Included**	***E. coli***	**Sufficient performance data for most evaluated BMPs.**
Metals	**Included**	**Dissolved Copper**	**Sufficient performance data for most evaluated BMPs.**
Dissolved Oxygen	*Excluded*	None	Urban runoff dissolved oxygen issues are flow/volume related (residence time) and are addressed through flow volume factors.
PAHs	*Excluded*	None	Insufficient BMP performance data. Trace contaminants that are addressed through solids and flow reductions.
Legacy OC Pesticide	*Excluded*	None	Insufficient BMP performance data. Addressed through solids reductions.
OP Pesticide	*Excluded*	None	Addressed through other pesticide reduction assessments.
Trace Contaminant	*Excluded*	None	Insufficient BMP performance data. Trace contaminant that is addressed through solids and flow reductions.
Total Solids/ Sediment	**Included**	**TSS**	**TSS BMP performance data most available. Indicator of control efficiency and transport of solids adhered contaminants.**
Salinity	*Excluded*	None	Not considered a significant urban runoff issue and would be addressed through assessment of flow reductions.
Biostimulatory	*Excluded*	None	Biostimulatory effects are "system" managed, and removal of nutrients does not ensure system response. Urban runoff generally not a source of nutrients as flow and residence time are the more significant factors.

Table 5-3. Influent and Effluent Concentrations for Quantifying Load Reductions

BMP Type	TSS		Dissolved Copper		*E. coli*	
	Median Influent	Median Effluent	Median Influent	Median Effluent	Median Influent	Median Effluent
	(mg/L)		(µg /L)		(MPN/100mL)[1]	
Constructed wetland	42	9.4	6.3	2.54	4,900	637
Pervious Pavement	42	24.5	6.3	5.05	4,900	4,900
Stormwater planter/ bioretention	42	9.9	6.3	5.79	4,900	101
Vegetated filter strip	42	19	6.3	5.28	4,900	4,180
Vegetated swale	42	21.6	6.3	5.64	4,900	4,180
Detention basins	42	23.3	6.3	2.86	4,900	3,000

[1] *MPN = Most Probable Number*

5.2 Integrating and Maximizing Benefits

Benefits resulting from the ARB SWRP projects are maximized through the project identification and prioritization process identified in Section 6.0. The project identification methodology screens and rates site conditions from ideal-to-good-to-poor to-"deal breaker" using a numeric point system for various site features (referred to as screening factors) that influence the desired benefits identified in Table 5-1. Prioritization of SWRP projects relies on the number of achievable benefits and the readiness-to-implement of the project (financial viability is not included). Methods for quantifying and tracking specified benefits from a project were described in Section 5.1. The result is a host of feasible projects that have been selected and designed to address the region's watershed issues and priorities. The use of consistent measures for quantifying and tracking benefits will further optimize watershed-based efforts and benefits as new projects are developed and added in the future.

5.3 Data Management

Relevant information for a project must be entered into OPTI (the ARB IRWMP's online planning tool and information center) before the project can be considered as part of the SWRP. Section 5.7.1 of the 2013 ARB IRMWP or the OPTI user guide (accessible through OPTI) provide instructions for adding projects. Project proponents enter all standard information required for any IRWMP projects into OPTI and indicate the project should be included in the SWRP using an OPTI check box. This will trigger a special SWRP tab within OPTI that requests additional information relevant to the SWRP requirements. Pre-project information includes:

- Is the project located on public lands?
- If not, does the relevant municipality have an easement or O&M agreement for the property?
- What type of benefits are expected (see Table 5-1)?
- What are the quantities of each benefit, if calculated?

Upon completion, post-project information to be added after project implementation includes:

- What were the actual benefits achieved (post-project), including their actual quantities?
- What were the actual construction start and completion dates (post-project)?
- What was the actual project cost (post-project)?

During the pre-project phase, the project proponent will enter all required IRWMP information along with details for the first four SWRP questions above. (The last three will be answered post-project, as described below.) OPTI will then run an automated eligibility check and, if the project is deemed eligible, score the project and assign a prioritization tier (see Section 6.3). The project is then considered to be a SWRP project, and subject to stakeholder review following the standard IRWMP process (see Sections 7.0 and 8.0).

During project implementation, data will be collected and evaluated following the relevant monitoring plan (MP), quality assurance project plan (QAPP), performance assessment and evaluation plan (PAEP), reasonable assurance analysis (RAA), permit, or other requirement necessary for the project. The data collection and evaluation activities, including the actual data, and findings, will be documented in relevant annual or mid- or end-term reports. All data will be uploaded to the California Environmental Data Exchange Network (CEDEN), Storm Water Multiple Application and Report Tracking System (SMARTS), the Surface Water Ambient Monitoring Program (SWAMP), the California Integrated Water Quality System (CIWQS), or the Groundwater Ambient Monitoring and Assessment Program (GAMA). Table 5-4 lists the web links for each of these data management programs.

Table 5-4. Data Management Programs and Web Links

Data Management Program	Web Link
California Environmental Data Exchange Network (CEDEN)	http://ceden.org/
Storm Water Multiple Application and Report Tracking System (SMARTS)	https://smarts.waterboards.ca.gov/smarts/faces/SwSmartsLogin.xhtml
Surface Water Ambient Monitoring Program (SWAMP)	http://www.waterboards.ca.gov/water_issues/programs/swamp/
California Integrated Water Quality System (CIWQS)	http://www.waterboards.ca.gov/ciwqs/
Groundwater Ambient Monitoring and Assessment Program (GAMA)	http://www.swrcb.ca.gov/gama/

Finally, upon project completion, the project proponent will need to enter the post-project information as detailed in the last three bullet points listed earlier in this section. This post-project data will serve as a resource for future assessments of the watershed. Such assessments may include identification of data gaps and evaluation of existing water quality monitoring data. Section 7.4 describes the recommended performance assessments for the ARB SWRP.

6.0 IDENTIFICATION AND PRIORITIZATION OF PROJECTS

6.1 Project Opportunities

There are many avenues to identify and develop projects that will benefit stormwater management in the ARB. These methods are discussed below.

6.1.1 Project Intent and Components

Multiple projects have been identified to meet the goals and objectives of this ARB SWRP, and more will continue to be developed during the SWRP's implementation and adaptive management phases. As directed in the SWRP guidelines (State Water Board 2015c), this SWRP includes projects and programs that are intended to capture and use stormwater and dry weather flows for:

- Recharge of groundwater
- Restoration or preservation of natural watershed processes
- Direct use
- Flood control
- Community enhancement
- Protection of beneficial uses, including habitat and improved water quality

Projects included as part of this SWRP are categorized as either an implementation project or a planning project. Many implementation projects will consist of installing LID BMPs (including green streets and drywells) and restoration practices. However, to achieve multiple benefits and maximize feasibility, projects may include other components, as listed in Table 6-1.

Table 6-1. Respective Components of SWRP Projects

Implementation Project Components	
• Install infiltrating LID BMPs, including drywells	• Add infrastructure for in-lieu groundwater recharge
• Install or improve non-infiltrating BMPs (e.g., detention basins or cisterns)	• Add infrastructure for using storm or recycled water in lieu of surface water
• Install infrastructure to improve stream flows	• Improve drainage infrastructure
• Plant native vegetation	• Improve levees/flood walls (heighten, reinforce, add, etc.)
• Remove invasive vegetation	• Replace turf with water wise vegetation (to reduce dry weather flows)
• Install fish screens	• Modify agricultural practices
• Enhance creeks/streams	• Create or restore wetlands or riparian buffers
• Remove legacy sediment	• Other
• Breach levees	
Planning Project Components	
• Acquire/preserve land/open space	• Participate in true source control effort
• Conduct pilot and/or feasibility study	• Plan an implementation project
• Conduct monitoring	• Develop/update tools
• Provide education & outreach	• Other
• Develop stewardship program	

6.1.2 Methods for Identifying Project Opportunities

SWRP projects may be identified through existing regional efforts or by using new methodology and tools created to support the SWRP planning efforts, as shown in Figure 6-1. The following subsections provide details for existing efforts, as well as the new opportunity methodology and tools.

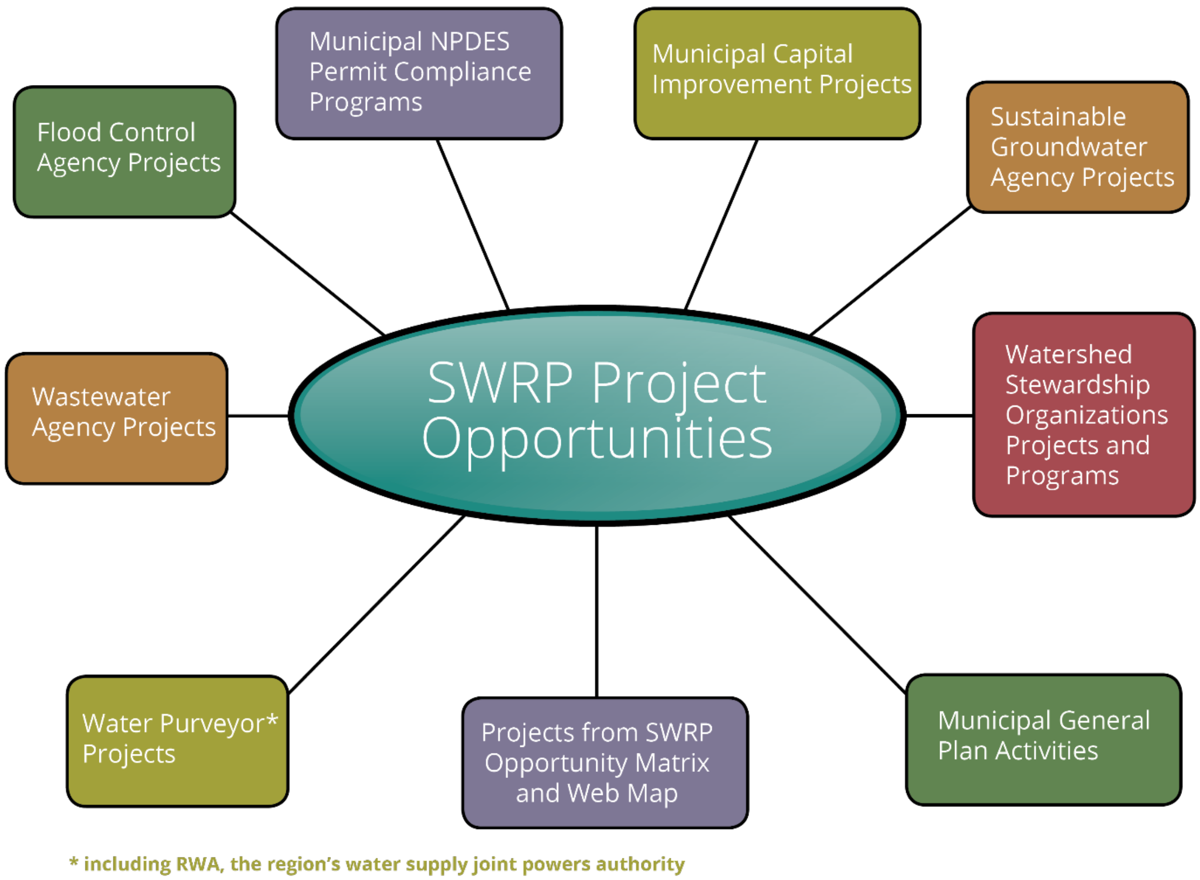

Figure 6-1. Existing Efforts and New Methods for Developing SWRP Projects

6.1.2.1 Existing Efforts

Prior to development of this SWRP, there were already many existing efforts in the ARB region to develop multiple benefit projects and many of them incorporate managing stormwater as a resource. These efforts will continue during implementation of this SWRP, and relevant projects will be incorporated into the SWRP through the project tracking process described in Section 5.3. In addition, this SWRP encourages these existing efforts that do not already include stormwater capture and use elements to include them where possible. The existing regional efforts include all those presented in Figure 6-1, with the exception of "Projects from SWRP Opportunity Matrix and Web Map", which is discussed in Section 6.1.2.2. Summaries of example existing efforts and their relevance to SWRP projects are described in Appendix J.

6.1.2.2 SWRP Opportunity Matrix, Scoring Worksheet, and GIS Tool

This SWRP expands on existing regional efforts to formalize a methodology that may be used by any stakeholder to identify multi-benefit, stormwater resource projects. The method involves evaluating site conditions to identify potential locations where infiltrating BMPs (including infiltration LID devices and green streets), drywells, non-infiltrating BMPs, and restoration practices can be implemented to maximize benefits. As noted, these may include water supply, water quality, flood management, environmental, and community benefits for the ARB watersheds. Note that drywells are considered separately from infiltrating

BMPs because drywell performance does not rely on the hydrologic group of the surface soils, while performance and feasibility of other infiltrating BMPs do. The specific BMP types and practices are based on the ARB region's four stormwater design manuals, as described in Section 6.2.

Table 6-2 presents a matrix that tabulates screening factors, site conditions, and various considerations that can be used for evaluating potential projects. The matrix is intended to (1) help stakeholders identify projects with ideal site conditions and (2) provide a ranking system that can help choose among potential opportunities. Note that this ranking scheme is only intended for use prior to project design as a means to screen opportunities. It is to be used by agencies to identify and compare projects; the score is not intended to prioritize all of the projects submitted. The matrix's screening factors are site characteristics that typically influence the SWRP's desired benefits. In this way, the matrix combines evaluations of areas in need (e.g., high imperviousness, land cover, draining to TMDL/303(d)-listed waters) with site conditions that influence BMP performance and feasibility (e.g., subsurface soil types, depth to groundwater). The screening factors are categorized as surface factors, subsurface factors, infrastructure factors, environmental factors, and community factors. The matrix also lists the different site conditions that may exist for each factor. A point value is assigned to each opportunity type (i.e., infiltrating BMPs, drywells, non-infiltrating BMPs, restoration practices) depending on the site condition. The associated points are multiplied by the weight for each screening factor to calculate the total weighted points for each factor. These points are divided by the total possible number of points for the relevant project component (infiltrating BMP, non-infiltrating BMP, drywell, or restoration practice). This weighted methodology allows comparison among different project components. The matrix includes notes describing why certain point values are assigned for certain site conditions, as well as other considerations a project proponent should keep in mind when selecting potential project locations. Finally, the matrix lists GIS and mapping resources where the specific site conditions for each screening factor can be determined.

The factors, conditions, points, and considerations used in developing the matrix are based on current design practices, including many cited in regional stormwater quality manuals approved by the State and Regional Water Boards. These practices are based on available research, technology, and regulatory policies, but do not reflect every potential impact from every potential pollutant. Potential impacts are influenced by the properties of individual constituents and the soil/media through which they pass. The matrix may therefore be updated during adaptive management of the SWRP, as new research, technology, and practices are developed.

To support use of the Project Opportunity Matrix, the ARB SWRP includes a Project Opportunity Scoring Worksheet. This is a Microsoft Excel-based worksheet that allows users to enter project information and automatically scores the project using the Project Opportunity Matrix point system. A screenshot of a worksheet example is provided in Appendix K.

Another primary resource developed to support project identification is the newly released ARB SWRP GIS tool. This is a dynamic and interactive web-based GIS tool and spatial data repository, which provides information on surface, subsurface, environmental, and community characteristics for eastern Sacramento county, western Placer county, and surrounding regions. The tool maps multiple data layers collected from throughout the region, with references for the GIS layers located in the help section of the tool, as well as in Appendix K. Figure 2-2 displays a screen shot of one map in the ARB SWRP GIS tool, showing the ARB boundaries and open space, parks, and protected land GIS layers turned on. The web tool may be accessed at http://www.owp.csus.edu/ARBSWRP/map.htm.

Most of the GIS layers available on the tool were obtained from resources at the regional, state, or national scale, and may therefore not be accurate at high geographic resolutions such as individual project sites. The tool is therefore intended as a planning tool; all site characteristics should be field verified before investing in full design. The GIS layers of the tool may be transferred to local agency GIS systems, which likely have more accurate, site-level characteristics. For example, the 303(d) List and TMDLs and Soil

Hydrologic Group layers from the tool could be overlain with municipal parcel and outfall shape files to assist in identifying public properties that directly drain to 303(d)-listed water bodies, with underlying soil types ideal for infiltration.

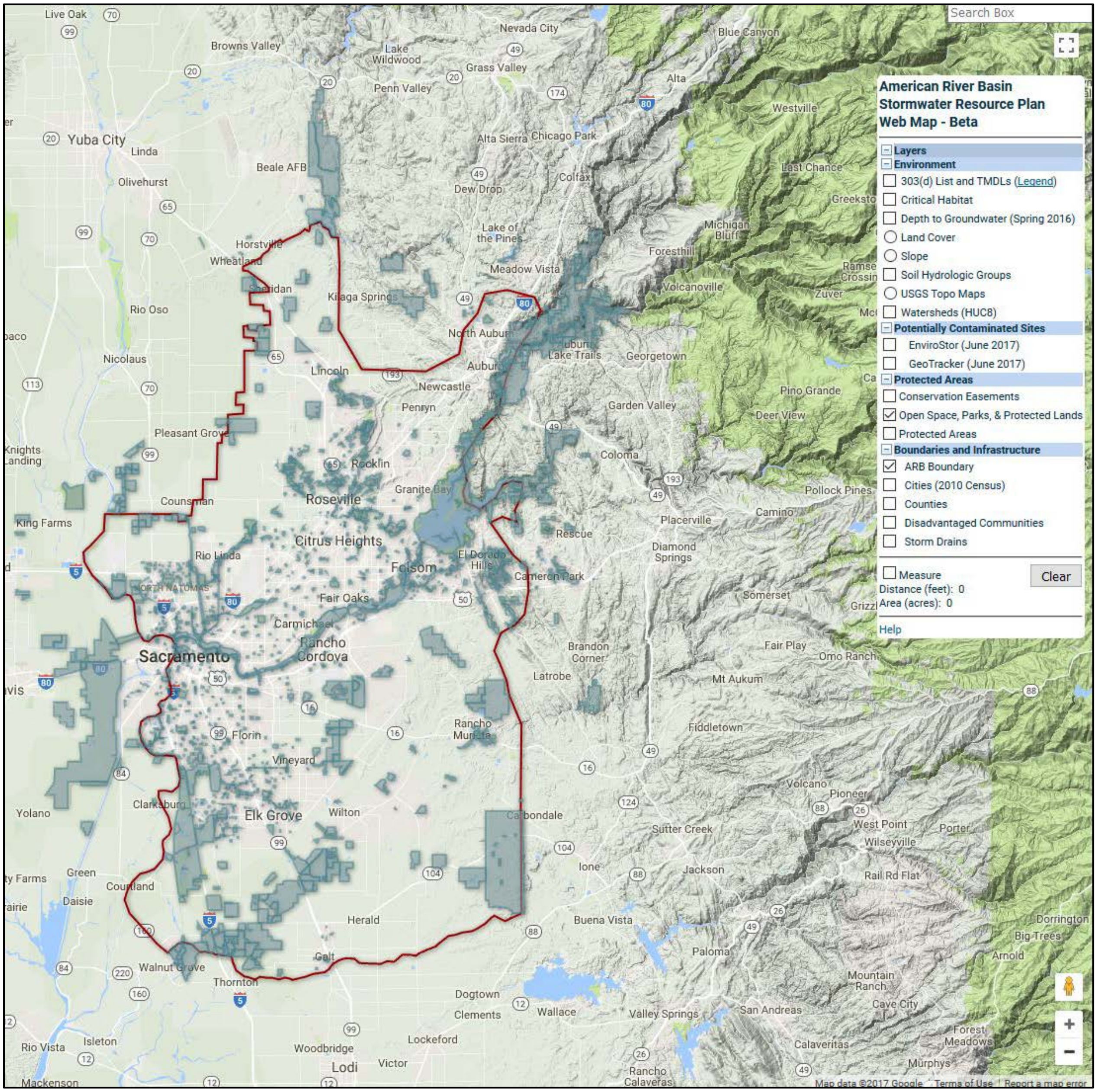

Figure 6-2. Screen Shot of the ARB SWRP GIS Tool

Table 6-2. Project Opportunity Matrix

Screening Factor	Site Condition	Points for Different Project Components (Total Possible Points): Infiltrating BMP (70)	Drywells (64)	Non-Infiltrating BMP (49)	Restoration Practice (34)	Weight	Reasoning and Considerations	GIS/Map Resources
Surface Factors								
Imperviousness	>70%	3	3	3	0	2	• Greater imperviousness results in greater runoff, allowing for greater potential benefits • Moderate imperviousness can still have potential benefits • Lower imperviousness may not generate enough runoff to make project worthwhile	• ARB SWRP GIS Tool *Google Maps Satellite Imagery* • Agency land-use maps
	60-70%	2	2	2	0			
	50-60%	1	1	1	0			
	<50%	0	0	0	0			
Land Ownership	Public	3	3	3	3	2	• SWRP guidelines & Water Code emphasize use of public lands; future grants could include use of public lands as part of the scoring criteria • While use of private lands is not discouraged, their eligibility for grants will depend on grant terms; O&M agreements between property owners and municipalities should be developed or easements obtained	• ARB SWRP GIS Tool *Google Maps Satellite Imagery* *Conservation Easements* *Open Space, Parks, & Protected Lands* *Protected Areas* *Schools* • Agency land-use maps
	Private	2	2	2	2			
Land Use	Street, parking lot, park, open space, school	3	3	3	3	2	• Some locations may provide more opportunities for multiple benefits, such as greater runoff capture due to greater imperviousness • Industrial land uses such as recycling or auto repair may have too many potential runoff quality hazards, while others (such as distribution warehouses)may not have such hazards • Industrial runoff is a large contributor of runoff pollutants, and may require significant pretreatment, especially for drywells	• Assessor parcel maps • ARB SWRP GIS Tool *Google Maps Satellite Imagery* *Conservation Easements* *Land Cover* *Open Space, Parks, & Protected Lands* *Protected Areas*
	Commercial, residential	2	2	2	2			
	Industrial	1	0	1	1			
Slope	< 5%	3	3	3	0	2	• Regrading is typically easier at sites with lower slopes • Moderately sloped sites may still have potential for multiple benefits • Costs to address site grading for steep slopes may be too high	• ARB SWRP GIS Tool *Slope*
	5-10%	2	2	2	0			
	10-20%	1	1	1	0			
	>20%	0	0	0	0			
TMDL/303(d) Listing	Discharge to a listed water body	3	3	3	3	2	• SWRP guidelines & Water Code emphasize projects that address TMDLs • Reduction of runoff discharge to any water body (listed nor not) will protect beneficial uses	• ARB SWRP GIS Tool *303(d) List & TMLDs*
	Discharge to any water body	2	2	2	2			
Subsurface Factors								
Depth to Groundwater	Bottom of excavation > 10 feet from high GW level	3	3	0	0	2	• Industry rule of thumb is to provide 10 feet of clearance to high groundwater table to allow filtration/adsorption of stormwater pollutants (based on historic leach field criteria)	• ARB SWRP GIS Tool *Depth to Groundwater*
	Bottom of excavation < 10 feet from high GW level	-100[1]	-100[1]	0	0			
Hydrologic Soil Group	A or B	3	0	0	0	2	• A&B are best condition for surface infiltration • C soils can achieve some surface infiltration, but may not be appropriate for some LID devices (e.g., infiltration basins) • D soils achieve minimal surface infiltration, but may not be appropriate for some LID devices (e.g., infiltration basins) • Above statements assume soil type extends beyond LID excavation depth • Hydrologic soil group is not applicable for drywell installations (surface soils are bypassed) • Apply recent UC Davis recharge modeling results if available for the project area	• ARB SWRP GIS Tool *Hydrologic Soil Group*
	C	2	0	0	0			
	D	1	0	0	0			

Screening Factor	Site Condition	Points for Different Project Components (Total Possible Points)				Weight	Reasoning and Considerations	GIS/Map Resources
		Infiltrating BMP (70)	Drywells (64)	Non-Infiltrating BMP (49)	Restoration Practice (34)			
Infrastructure Factors								
Active Domestic Wells	> 100 feet away from a private well[2] or >500 feet away from a public well	3	3	0	0	1	• Avoid infiltration in areas of active well water use[1]	• Local water purveyor
	< 100 feet away from a private well[2] or <500 feet away from a public well	-100[1]	-100[1]	0	0			
Septic Systems	> 100 feet away[3]	3	3	0	0	1	• Infiltrating BMPs, including drywells, should not be installed near septic systems[2]	• Local sewer district • Field reconnaissance
	<100 feet away[3]	-100[1]	-100[1]	0	0			
Stormwater Infrastructure	Close proximity to existing municipal surface conveyance or drain inlet	3	3	3	0	1	• Access to tie into existing infrastructure can be a cost saving measure • LID may be appropriate for "No/limited access" condition if on-site surface soils are of hydrologic group A or B	• ARB SWRP GIS Tool *Storm Drains* • Municipal stormwater programs
	Access to existing buried storm drain	2	2	2	0			
	No/limited access	1	1	1	0			
Environmental Factors								
Contaminated Soils, Plumes, or Underground Storage Tanks (USTs)	No	3	3	0	0	1	• Avoid infiltration in or near contaminated soils or groundwater plumes • Refer to local regulating agency for specific project approvals or limitations	• ARB SWRP GIS Tool *EnviroStor* *GeoTracker*
	Yes	-100[1]	-100[1]	0	0			
Critical Habitat for Threatened and Endangered Species	Project can reduce discharges to critical habitat	3	3	3	3	1	• LID project locations adjacent to or within critical habitat may include components to protect or restore those habitats	• ARB SWRP GIS Tool *Critical Habitat* • Conservation plans • Valley Foothill Watershed website • EcoAltas
	Project location does not discharge to critical habitat	0	0	0	0			
Impacts of Hydromodification	Project location discharges to area impacted by hydromodification	3	3	3	3	2	• LID project locations that discharge to areas impacted by hydromodification will restore or protect those areas through reduced runoff volumes, flow rates, and pollutant transport • Reduction or treatment of runoff discharged to any water body has other water quality benefits	• Valley Foothill Watershed website *Historic watershed assessments* • Hydromodification management plans
	Project location does not discharge to area impacted by hydromodification	0	0	0	0			
Connectivity of Conservation Areas	Project location can improve connectivity of conservation areas	3	3	3	3	1	• Projects with potential for connecting conservation areas may have greater environmental benefits	• ARB SWRP GIS Tool *Critical Habitats* *Conservation Easements* *Open Space, Parks, & Protected Lands* *Protected Areas*
	Project location cannot improve connectivity of conservation areas	0	0	0	0			
Protected Area	Project location discharges to a protected area	3	3	3	3	1	• Projects within protected areas may address priority needs already identified for the watershed	• ARB SWRP GIS Tool *Conservation Easements* *Open Space, Parks, & Protected Lands* *Protected Areas*
	Project location does not discharge to a protected area	0	0	0	0			

Screening Factor	Site Condition	Points for Different Project Components (Total Possible Points)				Weight	Reasoning and Considerations	GIS/Map Resources
		Infiltrating BMP (70)	Drywells (64)	Non-Infiltrating BMP (49)	Restoration Practice (34)			
Community Factors								
Disadvantaged Community or Economically Distressed Area	Within a DAC or EDA	1	1	1	1	1	• DACs & EDAs often have great need, with potential for greater community benefits • Grants often give extra credit for project applications involving DACs & EDAs	• ARB SWRP GIS Tool *Disadvantaged Communities* • Economically distressed areas
	Other communities	0	0	0	0			

[1] A point value of "-100" is assigned when a condition renders a project risky or impractical. For example, a project that includes infiltrating stormwater within 100 feet of contaminated soil would be given -100 points, effectively eliminating the project from consideration.
[2] The 100-foot separation is based on the California State Water Resource Control Board Division of Drinking Water Sacramento District Office Well Siting Inspection Checklist. The distance is increased to 500 feet for public drinking water wells because they often have a greater sphere of influence and greater consequences if impacted.
[3] The 100-foot separation is based on Sacramento County and Placer County septic system setback requirements for wells and surface waters.

6.2 Project Design Criteria and BMP/Restoration Types

There are four primary stormwater design resources in use in the ARB region: the SSQP Stormwater Quality Design Manual (SSQP 2018), the West Placer Storm Water Quality Design Manual (County of Placer et al. 2016), the City of Rocklin Post-Construction Manual (City of Rocklin 2015), and the El Dorado County West Slope Development and Redevelopment Standards and Post Construction Stormwater Plan Requirements webpage (El Dorado County 2017). At the time of writing this SWRP, El Dorado County was developing a comprehensive stormwater manual that updates and merges individual guidance from their West Slope webpage.

Table 6-3 lists the jurisdiction applicable to each resource. The manuals and webpage documents establish the required design criteria for new and redevelopment projects as defined in each of the MS4 permits, and are considered to be the most appropriate design sources for retrofit projects that can maximize performance and maintain consistency. Therefore, all SWRP BMP projects will be designed following criteria in the manual from the project's relevant jurisdiction. Design criteria for project components other than BMPs, including restoration practices, should follow the applicable local, federal, or state standards or best professional practice as appropriate.

Note that the manuals below do not provide design criteria for drywells. As of issuance of this SWRP, there also was no state or regional criteria, or guidance, although the State Water Board was preparing to develop statewide guidelines. In the absence of such information, a subset of the ARB SWRP collaborators developed guidance to be used in the ARB region. Appendix L provides information developed by this work team based on practices from the states of Oregon and Washington and the City of Portland, along with literature and best professional judgement.

Table 6-3. Stormwater Manuals for Each ARB Jurisdiction

Manual	Applicable Jurisdiction
SSQP Stormwater Quality Design Manual (SSQP 2018)	City of Citrus Heights
	City of Elk Grove
	City of Folsom
	City of Galt
	City of Rancho Cordova
	City of Sacramento
	Sacramento County
West Placer Stormwater Design Manual (County of Placer et. al. 2016)	City of Auburn
	City of Lincoln
	City of Roseville
	Town of Loomis
	Placer County
City of Rocklin Post-Construction Manual (City of Rocklin 2015b)	City of Rocklin
El Dorado County West Slope Development and Redevelopment Standards and Post Construction Stormwater Plan Requirements (County of El Dorado 2017)	Western El Dorado County

Table 6-4 classifies different types of BMPs and restoration practices that may be implemented in the ARB watersheds as infiltrating BMPs, non-infiltrating BMPs, and restoration practices. Alternative terms used among the region's four different stormwater manuals are also listed (in parenthesis) for clarification.

Table 6-4. BMP/Restoration Types

Project Opportunity	BMP/Restoration Type
Infiltrating BMPs (Including LID & Green Streets)	Bioretention planter (Stormwater planter [infiltration])[1,4] (Bioretention facility)[2,3,4]
	Biostrip[3] (Vegetated filter strip)[1]
	Bioswale (Vegetated filter swale)[1,2] (Swale)[3] (Vegetated swale)[1,4]
	Green roof[1,2,4]
	Green street[1]
	Infiltration basin[1,3,4], gallery, or trench[1,4]
	Porous pavement[1,2,4] (Pervious pavement)[3]
	Rain garden[3] (Compost amended soil)[1] (Soil quantity improvement and maintenance)[2]
	Disconnected impervious surfaces (Disconnected pavement or roof drains)[1] (Rooftop and impervious area disconnection) [2,4]
	Tree planting and preservation [2] (Interceptor trees)[1]
	Alternative driveways[1]
	Wet pond or wetland
Non-Infiltrating BMPs	Rain barrel or cistern[2,4] (Capture and re-Use)[1]
	Detention basin[1]
	Lined (non-infiltrating) planter (Stormwater planter [flow-through]) [1,4] (Flow-through planter) [2] (Tree box biofilter) [2]
	Media filter (Sand filter)[1] (In-vault media filter)[2]
	Vortex separator or drain inlet insert (Proprietary device) [1]
Restoration Practices[5]	Bed and bank stabilization
	Riparian buffer enhancement and protection[2]
	In-stream enhancement
	Floodplain reconnection

[1] *Term used in SSQP Stormwater Design Manual (SSQP 2018)*
[2] *Term used in West Placer Storm Water Quality Design Manual (County of Placer et al. 2016)*
[3] *Term used in City of Rocklin Post-Construction Manual (City of Rocklin 2015)*
[4] *Term used in El Dorado County Site Design Measures Manual (El Dorado County 2017)*
[5] *WERF 2016*

6.3 Project Prioritization Methodology

SWRP projects will be prioritized based on the number of benefits they are expected to achieve, whether those benefits have been quantified, and the implementability of the project. The prioritization scheme encourages development of projects that maximize the number of benefits and are ready or nearly ready to proceed. This makes projects more likely to qualify for funding.

Projects will be prioritized through an automated process within OPTI, following a similar tiered approach that is used for IRWMP projects. For SWRP projects, OPTI will first assess project eligibility by checking that:

- Project will achieve at least 2 main benefits (as identified in Table 5-1)
- Project will achieve at least 1 additional benefit (as identified in Table 5-1)

For eligible projects, OPTI then uses the inputted data for the project to calculate and assign a score for each project's benefits:

- Provides ≥ 1 water supply benefit (+1)
- Provides ≥ 1 water quality benefit (+1)
- Provides ≥ 1 flood management benefit (+1)
- Provides ≥ 1 environmental benefit (+1)
- Provides ≥ 1 community benefit (+1)
- Benefits claimed above have been quantified (+3)

Based on the total benefits score, the project is assigned to one of four tiers:

  - Score of 7–8 → Tier i
  - Score of 5–6 → Tier ii
  - Score of 3–4 → Tier iii
  - Score of 0-2 → Tier iv

Next OPTI will assign a score for implementability:

- Readiness—project can be constructed within 2 years (+1)
- Feasibility—task schedule developed and necessary permits identified (+1)
- Budget—cost estimate complete and funding needs identified (+1)
- O&M—located on public parcel or local agency has easement or O&M agreement with land owner (+1)

Similar to the project benefits, an implementability tier is assigned to the project:

  - Score of 4 → Tier a
  - Score of 3 → Tier b
  - Score of 2 → Tier c
  - Score of 0-1 → Tier d

These tiers are combined into a matrix, as shown in Figure 6-3, to give each project a final prioritization. Projects with maximum benefits and implementability will fall into Tier ia, while projects with the lowest, but still eligible, benefits and implementability will fall into Tier ivd. Note that unlike IRWMP projects (for which RWA assigns the project ranking manually), no entity will be overseeing the real-time prioritization of SWRP projects. It will be up to the project proponent to determine how to increase a SWRP's priority and update the project information in OPTI, accordingly.

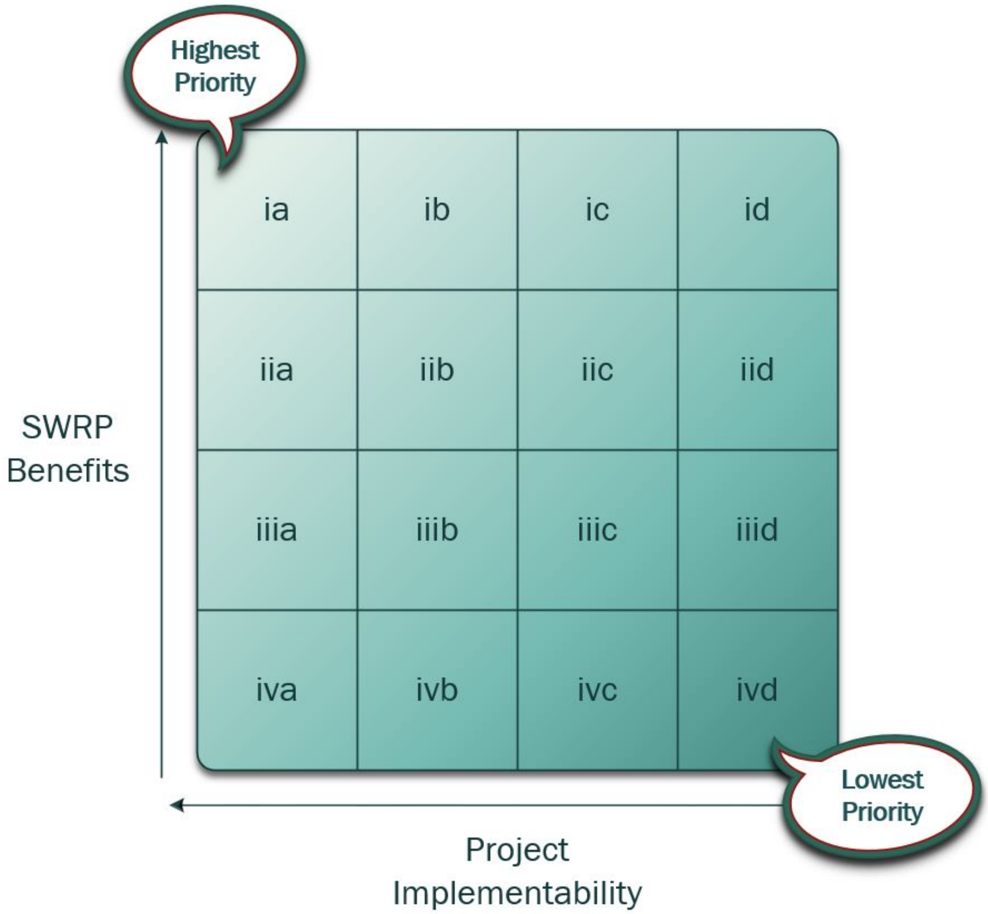

Figure 6-3. Prioritization Matrix for SWRP Projects

6.4 ARB Initial Project Listing and Rankings

Between September 2017 and March 2018, OWP and the SWRP TAC solicited projects for inclusion in the SWRP. The projects that were submitted were vetted by stakeholders through review of multiple drafts of this SWRP. The projects were then set into the prioritized tiers following the previously described methodology (Section 6.3). Table 6-5 lists the projects, lead organization, watershed and general location, and components. Table 6-6 lists the prioritization tiers and benefits for each project. A copy of the project scoring results is provided in Appendix O.

Table 6-5. ARB SWRP Projects

Project #	Watershed	Project Title	Lead Organization	Relevant Water Body	Location	Project Components
1	Lower American	Department of Utilities River Friendly Landscape and Water Efficient Irrigation System Demonstration Project	City of Sacramento	Sacramento River	Sacramento: 1395 35th St	• Plant native vegetation • Install LID features • Enhance existing treatment BMPs • Install cisterns for rain water harvesting • Provide education & outreach
2	Lower Sacramento	Combined Sewer Green Infrastructure Pilot Projects 1-5	City of Sacramento	Sacramento River	Sacramento: TBD	• Install LID features • Conduct pilot study • Conduct monitoring
3	Lower Sacramento	SW Pollution Reduction at Riverfront Parks: Tiscornia Park	City of Sacramento	Sacramento and American Rivers	Sacramento: Tiscornia Park	• Add infrastructure for in lieu recharge • Plant native vegetation • Install treatment BMPs • Acquire/preserve land/open space • Install LID features
4	Lower Sacramento	Stormwater Pollution Reduction at Riverfront Parks: Sand Cove Park, Miller Park, Garcia Bend Park, Chicory Bend Park	City of Sacramento	Sacramento River	Sacramento: Sand Cove Park Miller Park Garcia Bend Park Chicory Bend Park	• Add infrastructure for in-lieu recharge* • Plant native vegetation • Install treatment BMPs • Acquire/preserve land/open space • Install LID features
5	Lower Sacramento	SW Pollution Reduction at Riverfront Parks: Glen Hall Park	City of Sacramento	American River	Sacramento: Glen Hall Park	• Add infrastructure for in-lieu recharge • Plant native vegetation • Install treatment BMPs • Acquire/preserve land/open space • Install LID features
6	Lower Sacramento	Railyards Green Streets	City of Sacramento	Sacramento River	Sacramento: The Railyards (bordered by B, I, 12th, and 7th Sts)	• Install LID features • Install treatment BMPs • Plant native vegetation and trees

Project #	Watershed	Project Title	Lead Organization	Relevant Water Body	Location	Project Components
7	Lower Sacramento	SW Pollution Reduction at Riverfront Parks: Del Paso Regional Park	City of Sacramento	Arcade Creek	Sacramento: Del Paso Regional Park	• Add infrastructure for in-lieu recharge • Plant native vegetation • Install treatment BMPs • Acquire/preserve land/open space • Install LID features
8	Lower Sacramento	Broadway Green Infrastructure Project	City of Sacramento	Sacramento River	Sacramento: Broadway (Stockton Blvd to 53rd St)	• Install LID features • Install treatment BMPs • Plant native vegetation and trees • Improve drainage infrastructure and address flooding in the area
9	Lower Sacramento	Monier Circle Detention and Water Quality Retrofit Project	City of Rancho Cordova	Morrison Creek	Rancho Cordova: Sunrise Blvd	• Add/improve existing detention basin
10	Lower American	Mather Feld Road Rehabilitation	City of Rancho Cordova	Boyd Creek	Rancho Cordova: Mather Field Rd (Folsom Blvd to Rockingham Rd)	• Install LID • Plant Native Vegetation
11	Lower American	Sunrise Blvd. Rehabilitation – Phase I	City of Rancho Cordova	American River	Rancho Cordova: Sunrise Blvd (Folsom Blvd to Citrus Rd)	• Install LID features • Plant native vegetation
12	Lower American	Sunrise Blvd. Rehabilitation – Phase II	City of Rancho Cordova	Buffalo Creek/Boyd Creek	Rancho Cordova: Sunrise Blvd (Citrus Road to Folsom South Canal)	• Install LID features • Plant native vegetation
13	Lower Sacramento	Sunrise Blvd. Rehabilitation – Phase III	City of Rancho Cordova	Morrison Creek	Rancho Cordova: Sunrise Blvd (Folsom South Canal to White Rock Road)	• Install LID features • Plant native vegetation
14	Lower American	Rockingham Drive Rehabilitation	City of Rancho Cordova	Boyd Creek	Rancho Cordova: Rockingham Drive	• Install LID features • Plant native vegetation

Project #	Watershed	Project Title	Lead Organization	Relevant Water Body	Location	Project Components
15	Lower Sacramento	White Rock Road Rehabilitation	City of Rancho Cordova	Morrison Creek	Rancho Cordova: White Rock Rd (Sunrise Blvd to Fitzgerald Rd)	• Install LID features • Plant native vegetation
16	Lower American	Dry Creek Urban Stream Restoration Project	City of Roseville	Dry Creek	Roseville: Royer/ Saugstad Park	• Recontour creek bank • Plant riparian vegetation • Restore creek and flood plain • Enhance public space
						•
18	Upper Cosumnes	Omochumne Hartnell Water District (OHWD) Off Season Irrigation Project Expansion	Omochumne Hartnell Water District	Cosumnes River	South Sacramento County	• Design/install water conveyance infrastructure to flood crop fields and recharge groundwater • Install groundwater level monitoring wells • Install infrastructure to improve stream flows
19	Lower American	Bushy Lake Enhancement	SAFCA	Bushy Lake American River	Sacramento: Ethan Way	• Install infrastructure to improve stream flows
20	Lower American	Strong Ranch Slough Restoration Project – Cottage Park	Fulton-El Camino Recreation and Park District	Strong Ranch Slough and American River	Sacramento: Cottage Park	• Remove invasive plants • Plant native vegetation • Provide education & outreach
21	Upper Cosumnes	South County Ag Program Dilutant Stormwater Project	RegionalSan	Groundwater	South Sacramento County: agricultural fields adjacent to north side of Cosumnes River (Hwy 99 to Badger Creek)	• Capture and use runoff to dilute recycled water for groundwater recharge • Conduct feasibility study

Project #	Watershed	Project Title	Lead Organization	Relevant Water Body	Location	Project Components
22	Lower American	Amsell Detention Basin	City of Citrus Heights	Arcade Creek	City park, Sacramento Municipal Utility District easement	• Alleviate flooding in location #9 in the City of Citrus Heights Storm Drainage Master Plan • Design/install 0.6 acre detention basin to hold approximately 1.2 acre-ft during the peak of the 100-year storm • Add water quality and infiltration functions to the detention function for lesser storms
23	Lower American	Baird Way Grassy Swale	City of Citrus Heights	Cripple Creek	North Colony Way to Cripple Creek	• Design/install 383 ft long grassy swale
24	Lower American	Minnesota Drive Detention Basin	City of Citrus Heights	Arcade Creek	Private lot TBD	• Alleviate flooding in location #12 in the City of Citrus Heights Storm Drainage Master Plan • Design/install 0.36 acre basin to hold approximately 1 acre-ft during the peak of the 100-year storm • Add water quality and infiltration functions to the detention function for lesser storms
25	Upper Auburn / Upper Coon	Channel and Floodplain Rehabilitation Strategies	County of Placer	Coon Creek and Doty Ravine	Middle and lower portions of the Coon Creek watershed	• Channel Form Rehabilitation • Channel Meander Reconnection • Channel Re-profiling • Large Wood Reintroduction • Biotechnical Bank Stabilization • Riparian Vegetation Enhancement • Secondary Channel Enhancement / Creation • Berm Removal, Notching and Setbacks • Floodplain Re-contouring • Floodplain Lowering

Project #	Watershed	Project Title	Lead Organization	Relevant Water Body	Location	Project Components
26	Upper Auburn / Upper Coon	Riparian Corridor Enhancement	County of Placer	Coon Creek and Doty Ravine	Middle and lower portions of the Coon Creek watershed, along Coon Creek and Doty Ravine	• Improving Channel and Floodplain Processes Channel Meander Reconnection • Improving Riparian Habitat Quality • Developing Voluntary Land Management Programs
27	Upper Auburn / Upper Coon	Strategies for Improving Juvenile Salmonid Rearing Success	County of Placer	Coon Creek and Doty Ravine	Middle and lower portions of the Coon Creek watershed, along Coon Creek and Doty Ravine	• Improving Availability and Quality of Floodplain Rearing Habitat • Improving In-Channel Habitat Quality and Cover • Addressing Unscreened Diversions and Pumps • Addressing Anthropogenic Migratory Barriers • Improving Water Quality and Quantity
28	Upper Auburn / Upper Coon	Strategies for Improving Juvenile Salmonid Emigration Success	County of Placer	Coon Creek and Doty Ravine	Middle and lower portions of the Coon Creek watershed, along Coon Creek and Doty Ravine	• Improving Availability and Quality of Floodplain Habitat • Improving In-Channel Habitat Quality and Cover • Addressing Unscreened Diversions and Pumps • Addressing Anthropogenic Migratory Barriers • Improving Water Quality and Quantity
29	Upper Auburn / Upper Coon	Biotechnical Bank Stabilization	County of Placer	Coon Creek and Doty Ravine	Along the middle and upper regions of Coon Creek	• Use environmentally sensitive techniques to address bank erosion while also improving stream habitat complexity and diversity

Project #	Watershed	Project Title	Lead Organization	Relevant Water Body	Location	Project Components
30	Upper Auburn / Upper Coon	Voluntary Land Management: Cattle Exclusion Program	County of Placer	Coon Creek and Doty Ravine	Along Coon Creek and Doty Ravine where cattle are present	• Reduce cattle impacts on the riparian zone, and improve fish habitat and water quality. • Combine voluntary conservation with state and federal programs to provide financial & technical support • Implement fish-friendly agriculture practices
31	Upper Auburn / Upper Coon	Voluntary Land Management: Riparian Corridor Conservation Easement Program	County of Placer	Coon Creek and Doty Ravine	Along Coon Creek and Doty Ravine	• Limit the use of lands in order to protect, enhance, and restore riparian habitat values, such as corridor width and continuity and ecosystem functions
32	Upper Auburn / Upper Coon	Voluntary Land Management: Soil Conservation Best Management Practice Implementation	County of Placer	Coon Creek and Doty Ravine	Coon Creek Watershed	• Provide incentives to encourage a large range of soil conservation practices
33	Upper Auburn / Upper Coon	Voluntary Land Management: Agricultural Runoff Capture and Treatment	County of Placer	Coon Creek and Doty Ravine	Agricultural sites within the Coon Creek Watershed	• Provide incentives to encourage agricultural best management practices (BMPs)
34	Upper Auburn / Upper Coon	Voluntary Land Management: Urban Stormwater Management	County of Placer	Coon Creek and Doty Ravine	Developed areas within the Coon Creek Watershed	• Require stormwater management practices for new development • Provide incentives to encourage stormwater management retrofits

Project #	Watershed	Project Title	Lead Organization	Relevant Water Body	Location	Project Components
35	Upper Auburn / Upper Coon	Coppin Dam and Auburn Extension Diversion Retrofit	County of Placer	Coon Creek	Coppin Dam and Auburn Extension Canal	• Install self-cleaning fish screen on the Auburn Extension Canal diversion • Concentrate flow over Coppin Dam across a lesser width • Implement management changes • Design and implement involved structural changes
36	Upper Auburn / Upper Coon	Lower Coon Creek Channel and Floodplain Rehabilitation I - Placer County	County of Placer	Coon Creek	Coon Creek between Brewer Road and Pleasant Grove Road	• Reconnect the historic meander bend to serve as the primary channel • Fill in or convert the straightened channel to an overflow channel
37	Upper Auburn / Upper Coon	Lower Coon Creek Channel and Floodplain Rehabilitation - Sutter County	County of Placer	Coon Creek	Coon Creek between the Placer-Sutter County Boundary (Line 1 Canal crossing) and Brewer Road	• Partial or complete removal of berms • Manage fields as floodplain rearing habitat for juvenile salmonids during the winter/early spring months
38	Upper Auburn / Upper Coon	Lower Coon Creek Channel and Floodplain Rehabilitation II - Placer County	County of Placer	Coon Creek	Coon Creek between Placer-Sutter County Boundary (Line 1 Canal crossing) and Dowd Road	• Reconnect the historic meander bend to serve as the primary channel • Regrade and revegetate floodplain to enhance topographic complexity and provide greater habitat diversity • Manage fields as floodplain rearing habitat for juvenile salmonids during the winter/early spring months

Project #	Watershed	Project Title	Lead Organization	Relevant Water Body	Location	Project Components
39	Upper Auburn / Upper Coon	Sundance-Lakeview Farms Rehabilitation Site Enhancement	County of Placer	Coon Creek	Coon Creek immediately downstream of Dowd Road	• Additional berm removal/setbacks • Regrade floodplain • Create/enhance overflow channel • Establish additional inset floodplain terraces to the north or south of the channel
40	Upper Auburn / Upper Coon	Channel and Floodplain Rehabilitation Project - Middle Coon Creek	County of Placer	Coon Creek	Coon Creek between Gladding Road & McCourtney Road	• Install engineered large wood jams and/or bed level controls • Remove berms • Enhance historic floodplain channel alignments with grading • Widen existing riparian corridor
41	Upper Auburn / Upper Coon	Doty Ravine South at Head Diversion Dam Retrofit	County of Placer	Doty Ravine	Doty Ravine	• Install fish screen at or immediately upstream of the diversion inlet • Install a small and low-cost fish passage ladder along the side of the channel • Retrofit or redesign the downstream rock ramp to improve passage • Replace wicket-gate dam with adjustable weir or dam
42	Upper Auburn / Upper Coon	Garden Bar Road Culvert Replacement	County of Placer	Doty Ravine	Doty Ravine at Garden Bar Road Bridge over Doty Ravine	• Replace existing bridge with an open-span bridge or bottomless culvert • Implement fish friendly grade control structures and channel re-profiling measures

Project #	Watershed	Project Title	Lead Organization	Relevant Water Body	Location	Project Components
43	Lower American	American River Basin Collaborative for Watersheds	Valley Foothill Watersheds Collaborative	American River Basin	Regional Water Authority office	• Connect local agencies, special districts, nonprofits and the public sector to coordinate projects that they've identified to improve water quality and supply as well as ecological health of local watersheds
44	Lower American	American River Basin Creek Week	Sacramento Area Creeks Council	American River Basin	American River Basin	• Coordinate annual Creek Week program including use of citizen science for monthly data collection at selected sites
45	Lower American	Morrison Creek Revitalization Plan	Environmental Justice Coalition for Water	Morrison Creek	Morrison Creek between Power Inn Road and 65th Street	• Create capacity for community leadership • Encourage community stewardship • Transform Morrison Creek from a fenced, concrete storm water channel into a more naturalized waterway • Improve community livability and cohesion • Provide an alternative transportation corridor for bicycle and pedestrian connections
46	Lower American	Dry Creek Fish Passage Improvement	City of Roseville	Dry Creek	Dry Creek Cirby Creek near Riverside Ave.	• Complete design drawings environmental permits, and supporting documents to ensure a shovel ready project to establish safe fish passage over one of the remaining fish barriers located within the Dry Creek Watershed
47	Lower American	Secret Ravine Riparian Restoration Project	Dry Creek Conservancy	Secret Ravine	Sierra College Campus, Rocklin	• Install up to 50 engineered wood structures throughout a 4,000 foot section of channel

Project #	Watershed	Project Title	Lead Organization	Relevant Water Body	Location	Project Components
48	Lower American	Outfall BMP Design Pilot	Valley Foothill Watersheds Collaborative	Dry Creek Watershed	City of Roseville	• Develop template for standards for plants, terracing, etc. related to using stormwater as a resource • Collaborate with streets/drainage department • Use VRF process for permit and CEQA (CDFW stream maintenance agreement)
49	Lower American	Owl Creek Terrace	Sacramento Area Creeks Council	Owl Creek and Arcade Creek	Del Paso Park	• Remove fill and re-contour wetland to capture, retain and treat stormwater • Install bioswales • Plant native vegetation • Remove non-native vegetation •
50	Lower American	Auburn Ravine Floodplain Reconnection	Friends of Auburn Ravine	Auburn Ravine	Lincoln	• Investigate potential for levee setbacks and modifications to reduce flooding and increase habitat
51	Lower American	Auburn Ravine Erosion Survey	Valley Foothill Watersheds Collaborative	Auburn Ravine	Lincoln	• Identify projects to improve aquatic habitat conditions and reduce sediment from bank erosion
52	Lower American	Raccoon Creek Watershed Stakeholder Group	Valley Foothill Watersheds Collaborative	Raccoon Creek	Placer County	• Use the findings and recommendations from Coon Creek Watershed Assessment to develop Raccoon Creek watershed action plan

Project #	Watershed	Project Title	Lead Organization	Relevant Water Body	Location	Project Components
53	Upper Auburn-Upper Coon	Hidden Falls Regional Park	County of Placer, Department of Public Works and Facilities	Raccoon Creek	Placer County	• Provide access to park features for recreation and education • Add wildlife and habitat restoration elements like nesting boxes; fish passage amenities; natural erosion control along streambanks, roadbeds, etc; native plantings;
54	Lower American	Antelope Creek Flood Control Project - Upper and Lower Weirs	Placer County Flood Control District	Antelope Creek	Placer County	• Add 2 fish-friendly, on-channel weirs to mitigate for increases in urban runoff and peak flood flow due to development • Include stream channel and habitat restoration for salmon and steelhead trout. • Remove non-native plants and re-plant with natives. • Improve public access and provide educational opportunities
55	Upper Cosumnes	Groundwater Recharge/ Swainson's Hawk Habitat Property Acquisition	Sacramento Valley Conservancy	Cosumnes River	South Sacramento County	• Purchase of a geologically favorable recharge property • Create a Swainson's Hawk conservation easement • Allows winter GW recharge when hawks are absent

**Use surface, storm, or recycled water instead of groundwater*

Table 6-6. Prioritization and Benefits of the Initial ARB SWRP Projects

Priority Tier	Project #	Project Title	Benefits: Water Quality		Water Supply			Flood Management			Environmental						Community		
			WQ1. Reestablishment of natural water drainage and treatment	WQ2. Increase in filtration and/or treatment of pollutants in runoff	WS1. Increase in groundwater supply through infiltration	WS2. Increase in groundwater supply through in-lieu recharge	WS3. Increase in surface water supply through direct use	FM1. Decrease in flood risk through reduced peak flow rates of runoff	FM2. Increase in area addressed for flood mitigation	FM3. Decrease in combined sewer overflows	E1. Enhancement, creation, and/or protection of wetlands, riparian zones, and aquatic habitat	E2. Increase in urban green space	E3. Improvement to instream flow rate	E4. Decrease in energy use	E5. Decrease in greenhouse gas emissions	E6. Improvement in water temperature	C1. Increase in public education	C2. Increase in public involvement	C3. Creation or enhancement of public space
iiib	1	Department of Utilities River Friendly Landscape and Water Efficient Irrigation System Demonstration Project	X	X								X			X		X		X
iiic	2	Combined Sewer Green Infrastructure Pilot Projects	X		X			X	X	X									
iiid	3	SW Pollution Reduction at Riverfront Parks: Tiscornia Park	X	X	X														X
iiic	4	Stormwater Pollution Reduction at Riverfront Parks: Sand Cove Park, Miller Park, Garcia Bend Park, Chicory Bend Park	X	X	X														X
iiic	5	SW Pollution Reduction at Riverfront Parks: Glen Hall Park	X	X	X														X
iiic	6	Railyards Green Streets	X	X	X														X

Priority Tier	Project #	Project Title	Benefits																			
			Water Quality		Water Supply			Flood Management			Environmental						Community		
			WQ1. Reestablishment of natural water drainage and treatment	WQ2. Increase in filtration and/or treatment of pollutants in runoff	WS1. Increase in groundwater supply through infiltration	WS2. Increase in groundwater supply through in-lieu recharge	WS3. Increase in surface water supply through direct use	FM1. Decrease in flood risk through reduced peak flow rates of runoff	FM2. Increase in area addressed for flood mitigation	FM3. Decrease in combined sewer overflows	E1. Enhancement, creation, and/or protection of wetlands, riparian zones, and aquatic habitat	E2. Increase in urban green space	E3. Improvement to instream flow rate	E4. Decrease in energy use	E5. Decrease in greenhouse gas emissions	E6. Improvement in water temperature	C1. Increase in public education	C2. Increase in public involvement	C3. Creation or enhancement of public space
iiic	7	SW Pollution Reduction at Riverfront Parks: Del Paso Regional Park	X	X	X														X
iic	8	Broadway Green Infrastructure Project	X	X	X	X		X	X	X		X			X		X		
iiid	9	Monier Circle Detention and Water Quality Retrofit Project	X	X				X											X
iiid	10	Mather Field Road Rehabilitation	X	X	X			X											X
iiid	11	Sunrise Blvd. Rehabilitation, Phase I	X	X	X			X											X
iiid	12	Sunrise Blvd. Rehabilitation, Phase II	X	X	X			X											X
iiid	13	Sunrise Blvd. Rehabilitation, Phase III	X	X	X			X											X
iiid	14	Rockingham Drive Rehabilitation	X	X	X			X											X
iiid	15	White Rock Road Rehabilitation	X	X	X			X											X
iiic	16	Dry Creek Urban Stream Restoration Project		X							X	X				X			X

Priority Tier	Project #	Project Title	Benefits																
			Water Quality		Water Supply			Flood Management			Environmental						Community		
			WQ1. Reestablishment of natural water drainage and treatment	WQ2. Increase in filtration and/or treatment of pollutants in runoff	WS1. Increase in groundwater supply through infiltration	WS2. Increase in groundwater supply through in-lieu recharge	WS3. Increase in surface water supply through direct use	FM1. Decrease in flood risk through reduced peak flow rates of runoff	FM2. Increase in area addressed for flood mitigation	FM3. Decrease in combined sewer overflows	E1. Enhancement, creation, and/or protection of wetlands, riparian zones, and aquatic habitat	E2. Increase in urban green space	E3. Improvement to instream flow rate	E4. Decrease in energy use	E5. Decrease in greenhouse gas emissions	E6. Improvement in water temperature	C1. Increase in public education	C2. Increase in public involvement	C3. Creation or enhancement of public space
ivd	18	Omochumne Hartnell Water District Off Season Irrigation Project Expansion			X						X		X						
iiic	19	Bushy Lake Enhancement		X		X					X			X					X
iiib	20	Strong Ranch Slough Restoration Project – Cottage Park		X							X		X				X	X	X
iiic	21	South County Ag Program Dilutant Stormwater Project	X	X	X	X					X		X				X	X	X
iiid	22	Amsell Detention Basin		X	X			X			X		X						X
iib	23	Baird Way Grassy Swale		X	X				X		X								X
iid	24	Minnesota Drive Detention Basin		X	X			X			X		X						X
iiid	25	Channel and Floodplain Rehabilitation Strategies	X					X			X					X			
iiid	26	Riparian Corridor Enhancement	X	X	X			X			X					X			

Priority Tier	Project #	Project Title	Benefits																
			Water Quality		Water Supply			Flood Management			Environmental						Community		
			WQ1. Reestablishment of natural water drainage and treatment	WQ2. Increase in filtration and/or treatment of pollutants in runoff	WS1. Increase in groundwater supply through infiltration	WS2. Increase in groundwater supply through in-lieu recharge	WS3. Increase in surface water supply through direct use	FM1. Decrease in flood risk through reduced peak flow rates of runoff	FM2. Increase in area addressed for flood mitigation	FM3. Decrease in combined sewer overflows	E1. Enhancement, creation, and/or protection of wetlands, riparian zones, and aquatic habitat	E2. Increase in urban green space	E3. Improvement to instream flow rate	E4. Decrease in energy use	E5. Decrease in greenhouse gas emissions	E6. Improvement in water temperature	C1. Increase in public education	C2. Increase in public involvement	C3. Creation or enhancement of public space
iiid	27	Strategies for Improving Juvenile Salmonid Rearing Success	X					X			X					X			
NR	28	Strategies for Improving Juvenile Salmonid Emigration Success									X					X			
NR	29	Biotechnical Bank Stabilization									X					X			
iiid	30	Voluntary Land Management: Cattle Exclusion Program	X	X				X			X					X			
iiid	31	Voluntary Land Management: Riparian Corridor Conservation Easement Program	X	X				X			X					X			
NR	32	Voluntary Land Management: Soil Conservation Best Management Practice Implementation	X	X															
NR	33	Voluntary Land Management: Agricultural Runoff Capture and Treatment	X	X	X			X											

Priority Tier	Project #	Project Title	Benefits: Water Quality		Water Supply			Flood Management			Environmental						Community		
			WQ1. Reestablishment of natural water drainage and treatment	WQ2. Increase in filtration and/or treatment of pollutants in runoff	WS1. Increase in groundwater supply through infiltration	WS2. Increase in groundwater supply through in-lieu recharge	WS3. Increase in surface water supply through direct use	FM1. Decrease in flood risk through reduced peak flow rates of runoff	FM2. Increase in area addressed for flood mitigation	FM3. Decrease in combined sewer overflows	E1. Enhancement, creation, and/or protection of wetlands, riparian zones, and aquatic habitat	E2. Increase in urban green space	E3. Improvement to instream flow rate	E4. Decrease in energy use	E5. Decrease in greenhouse gas emissions	E6. Improvement in water temperature	C1. Increase in public education	C2. Increase in public involvement	C3. Creation or enhancement of public space
iiid	34	Voluntary Land Management: Urban Stormwater Management	X	X	X							X					X	X	X
NR	35	Coppin Dam and Auburn Extension Diversion Retrofit									X						X		
iiid	36	Lower Coon Creek Channel and Floodplain Rehabilitation I - Placer County	X	X	X			X			X					X			
iiid	37	Lower Coon Creek Channel and Floodplain Rehabilitation - Sutter County	X	X	X			X			X					X			
iiid	38	Lower Coon Creek Channel and Floodplain Rehabilitation II - Placer County	X	X	X			X			X					X			
iid	39	Sundance-Lakeview Farms Rehabilitation Site Enhancement	X	X	X			X			X								X
NR	40	Channel and Floodplain Rehabilitation Project - Middle Coon Creek	X	X	X			X			X								

Priority Tier	Project #	Project Title	Benefits: Water Quality		Water Supply			Flood Management			Environmental						Community		
			WQ1. Reestablishment of natural water drainage and treatment	WQ2. Increase in filtration and/or treatment of pollutants in runoff	WS1. Increase in groundwater supply through infiltration	WS2. Increase in groundwater supply through in-lieu recharge	WS3. Increase in surface water supply through direct use	FM1. Decrease in flood risk through reduced peak flow rates of runoff	FM2. Increase in area addressed for flood mitigation	FM3. Decrease in combined sewer overflows	E1. Enhancement, creation, and/or protection of wetlands, riparian zones, and aquatic habitat	E2. Increase in urban green space	E3. Improvement to instream flow rate	E4. Decrease in energy use	E5. Decrease in greenhouse gas emissions	E6. Improvement in water temperature	C1. Increase in public education	C2. Increase in public involvement	C3. Creation or enhancement of public space
ivd	41	Doty Ravine South at Head Diversion Dam Retrofit									X					X	X		
ivd	42	Garden Bar Road Culvert Replacement									X						X	X	
iiic	43	American River Basin Collaborative for Watersheds	X	X	X	X	X				X	X			X	X	X	X	
iiib	44	American River Basin Creek Week		X							X						X	X	
iiid	45	Morrison Creek Revitalization Plan	X	X				X			X	X				X	X	X	X
ivb	46	Dry Creek Fish Passage Improvement	X	X							X					X			
iiib	47	Secret Ravine Riparian Restoration Project	X	X				X			X					X	X	X	
iiib	48	Outfall BMP Design Pilot	X	X							X					X	X	X	
iiic	49	Owl Creek Terrace Restoration	X	X	X						X		X				X		X

Priority Tier	Project #	Project Title	Benefits																
			Water Quality		Water Supply			Flood Management			Environmental						Community		
			WQ1. Reestablishment of natural water drainage and treatment	WQ2. Increase in filtration and/or treatment of pollutants in runoff	WS1. Increase in groundwater supply through infiltration	WS2. Increase in groundwater supply through in-lieu recharge	WS3. Increase in surface water supply through direct use	FM1. Decrease in flood risk through reduced peak flow rates of runoff	FM2. Increase in area addressed for flood mitigation	FM3. Decrease in combined sewer overflows	E1. Enhancement, creation, and/or protection of wetlands, riparian zones, and aquatic habitat	E2. Increase in urban green space	E3. Improvement to instream flow rate	E4. Decrease in energy use	E5. Decrease in greenhouse gas emissions	E6. Improvement in water temperature	C1. Increase in public education	C2. Increase in public involvement	C3. Creation or enhancement of public space
iic	50	Auburn Ravine Floodplain Reconnection	X	X	X			X	X		X						X	X	
ivb	51	Auburn Ravine Erosion Survey	X	X							X		X			X			
iiic	52	Raccoon Creek Watershed Rehabilitation Action Plan	X		X						X					X	X	X	
iiib	53	Hidden Falls Regional Park	X	X							X								X
iiic	54	Antelope Creek Flood Control Project - Upper and Lower Weirs	X					X	X		X						X	X	
iiic	55	Groundwater Recharge/Swainson's Hawk Habitat Project			X						X		X						X

7.0 IMPLEMENTATION STRATEGY AND SCHEDULE

Implementation of the SWRP will occur at two levels: the project level and the watershed level. The project level includes activities such as planning, designing, executing, and/or constructing projects. The watershed level covers activities such as tracking projects and their benefits and revising the SWRP as data is gathered, lessons are learned, regulations change, and technologies advance. Project level implementation will be conducted by individual project proponents. Watershed level implementation will be coordinated by regional stakeholders as funding becomes available or needs develop. The following subsections describe the implementation resources and activities, adaptive management, and performance measures for these two implementation levels.

7.1 Resources Needed for SWRP Implementation

Table 7-1 summarizes the resources needed to implement the SWRP, as cited in the SWRP guidelines (State Water Board 2015c), as well as the ARB region's relevant procedures to meet those needs at the project level and the watershed level. Funding and resources required for individual projects will be determined on a project-by-project basis by individual stakeholders (project proponents), who will also be responsible for securing the funding. Estimated costs and additional funding needs and resources for projects will be posted in OPTI; costs for initial SWRP projects were under development as of issuance of this SWRP. Many of the initial projects will be submitted for grant awards from the State Water Board's Proposition 1 Round 2 Stormwater Grant Program and possibly from future IRWM or other grant programs. These awards and any other project funding will be listed in OPTI.

As of March 2019, project cost estimates were developed for 16 of the SWRP projects, with a total present cost of approximately $31.5 million. Individual project costs are listed in OPTI. For the remaining 38 projects, total costs could be near $100 million. This is a gross estimate that may be off by an order of magnitude. Note that dozens or more additional projects are anticipated to be added to this SWRP in the next few years as stakeholders continue to address their fairly new permit requirements, specifically TMDL compliance and alternative compliance pathway approaches. Until these approaches are developed, there is no way to accurately project those future costs.

At the watershed level, this SWRP will be updated to reflect changes in regulations, technologies, or watershed health. Funding for future updates, including evaluations of performance data, will be obtained or provided as needed by one or more of this SWRP's technical advisory committee members or a team of stakeholders. Specific watershed level implementation activities are identified in Sections 7.2 through 7.4. One of this SWRP's initial projects is to oversee and conduct these activities.

Table 7-1. Implementation Resources Needed and Acquisition Procedures

<table>
<tr><th>Need[1]</th><th>Project Level Procedures</th><th>Watershed Level Procedures</th></tr>
<tr><td>Projection of additional funding needs and resources for administrating and implementing SWRP</td><td rowspan="2">• Determined and obtained on a project-by-project basis
• Project costs will be posted in OPTI
• Costs for future projects identified in OPTI</td><td rowspan="2">• Determined and obtained by stakeholders as regulations, technologies, and knowledge of watershed health and needs change</td></tr>
<tr><td>Schedule for arranging and securing SWRP implementation financing</td></tr>
</table>

[1] *Needs listed in the SWRP guidelines (State Water Board 2015c)*

7.2 Activities Needed for Implementation

Table 7-2 summarizes the implementation needs cited in the SWRP guidelines and the ARB region's relevant procedures to meet those needs.

Table 7-2. Implementation Needs and Procedures

Need[1]	Project Level Procedures	Watershed Level Procedures
Identify projects/ programs to ensure effective SWRP implementation and achievement of multiple benefits	• Individual stakeholders identify projects following SWRP processes (Section 6.0)	• Initial projects listed in Table 6-5 Future projects listed in OPTI
Identify decision support tools and relevant data	• ARB SWRP Project Opportunity Matrix, Scoring Workbook, & Web Tool • ARB SWRP Quantitative Methods Worksheets & Tools • ARB SWRP Project Level Performance Assessments • OPTI • Others identified on a project-by-project basis	• OPTI • ARB SWRP Watershed Level Performance Assessments
Timeline for submitting SWRP to existing plans, including regional IRWMP	• NA	• Submittal to RWA for IRWMP incorporation by May 25, 2018
Specific actions to implement SWRP	• Planning, design, implementation, and reporting to occur on a project-by-project basis, as needed	• Agency resolutions supporting SWRP implementation
Identify all entities responsible for project implementation	• Project implementation done by project proponents on a project-by-project basis	• NA
Description of community participation strategy	• OPTI process • Municipal/organization-specific public review processes	• Stakeholders present updates at semi-annual IRWMP meetings as needed, or request RWA to distribute information to IRWMP stakeholders
Procedure to track status of each project	• Project proponents to enter information into OPTI, including actual post-project benefits	• NA
Timelines for all active or planned projects	• Developed on a project-by-project basis • Listed in OPTI	• Initial projects listed in Table 6-5; Timelines and narrative details for select projects provided in OPTI • Future projects listed in OPTI
Procedures for ongoing review, updates, and adaptive management of the SWRP	• NA	• See Adaptive Management Section 7.3
Strategy and timeline for obtaining necessary permits	• Project proponents identify and obtain on a project-by-project basis	• NA

[1] *Needs listed in the SWRP guidelines (State Water Board 2015c)*

7.3 Adaptive Management

An important component to effective, long-term stormwater planning is the capacity for regional agencies to implement adaptive management. Adaptive management emphasizes the potential to evolve current guidelines and practices in response to new data on how regional conditions respond to management actions. For stormwater, this means adjusting planning needs, monitoring guidelines, benefit quantifications, and project priorities based on the assessed health of regional watersheds. Table 7-3 summarizes the adaptive management needs as cited in the SWRP guidelines and procedures for the ARB SWRP.

In general, the SWRP will be adaptively managed by:

1) Developing projects, quantifying their benefits, and adding them to OPTI, which will be an ongoing process conducted by individual stakeholders (as is done for the ARB IRWMP);
2) Evaluating the need for the watershed level performance assessments described in Section 7.4, which may be done approximately every 5 years when the IRWMP is updated (pending available funding); and,
3) Re-evaluating sources and updating metrics and analyses based on findings from the assessments.

When watershed assessments are conducted, OPTI will be reviewed to remove and update SWRP projects as appropriate.

Table 7-3. Needs and Procedures for Adaptive Management

Need[1]	Project Level Procedures	Watershed Level Procedures
Re-characterizing water quality priorities	• NA	• Stakeholders to coordinate updates using ARB SWRP Watershed Level Performance Assessment
Re-evaluating sources	• NA	• Stakeholders to coordinate updates using ARB SWRP Watershed Level Performance Assessment
Conducting effectiveness assessments	• Project proponents conduct assessments on a project-by-project basis using ARB SWRP Project Level Performance Assessment	• Stakeholders to coordinate updates using ARB SWRP Watershed Level Performance Assessment
Updating metrics and quantitative analyses	• NA	• Stakeholders to coordinate updates using ARB SWRP Watershed Level Performance Assessment
Deleting or adding projects	• Individual project proponents add or delete projects in OPTI	• Stakeholders to conduct OPTI reviews during ARB SWRP Watershed Level Performance Assessments
Identifying completed projects	• Individual project proponents identify completed projects in OPTI	• Stakeholders to conduct OPTI reviews

[1] Needs listed in the SWRP guidelines (State Water Board 2015c)

7.4 Performance Measures

Table 7-4 summarizes the needs and procedures to establish and use performance measures. These occur at two scales. First, at the project level, project proponents will be responsible for conducting an ARB SWRP Project Level Performance Assessment to quantify and evaluate project benefits, both expected and realized. Performance measure procedures include monitoring, assessing, and reporting data. Project proponents will also be responsible for adjusting implementation of future projects to conform to any future revisions of the SWRP as appropriate.

Second, at the watershed level, a lead organization or team of stakeholders will coordinate an ARB SWRP Watershed Level Performance Assessment as described in Section 7.4.2. This includes comparing expected and actual benefits; obtaining and evaluating data from OPTI, CEDEN, and SMARTS; obtaining and assessing watershed health indicators; and adapting the SWRP based on the findings. The lead organization will also coordinate with RWA to present performance assessment updates at IRWMP meetings. Watershed level performance assessments will occur approximately every five years, depending on available funding. The project level and watershed level assessment methods are described in the following subsections.

Table 7-4. Needs and Resources for Performance Measures

Need[1]	Project Level Procedures	Watershed Level Procedures
Evaluations of expected vs actual benefits	• Project proponents conduct an ARB SWRP Project Level Performance Assessment • Project proponents enter estimated and actual project benefits in OPTI	• Obtain estimated and actual benefits from OPTI • Stakeholders coordinate ARB SWRP Watershed Level Performance Assessment
Quantification of actual benefits	• Project proponents conduct an ARB SWRP Project Level Performance Assessment	• Stakeholders coordinate ARB SWRP Watershed Level Performance Assessment
Monitoring and information-management systems for gathering performance data	• Project proponents enter data into OPTI, CEDEN, and/or SMARTS • Project proponents conduct an ARB SWRP Project Level Performance Assessment	• Stakeholders coordinate and obtain data from OPTI, CEDEN, and/or SMARTS • Stakeholders coordinate ARB SWRP Watershed Level Performance Assessment
How to adapt projects and SWRP implementation based on performance data	• For future projects, project proponents to follow updated procedures cited in future SWRP revisions	• Stakeholders coordinate ARB SWRP Watershed Level Performance Assessment Procedures
How to share performance data with stakeholders	• Project proponents enter data into OPTI, CEDEN, and/or SMARTS	• Stakeholders coordinate presentations at IRWMP meetings

[1] Needs listed in the SWRP guidelines (State Water Board 2015c)

7.4.1 ARB SWRP Project Level Performance Assessments

Historically, the State Water Board's Stormwater Grant Program required Performance Assessment & Evaluation Plans (PAEPs) as part of applying for and receiving grant funding for projects. To guide stakeholders in evaluating the success of a project, PAEPs identified project goals, desired outcomes, outcome indicators, measurement tools and metrics, and performance targets. The ARB SWRP includes a similar methodology for evaluating the performance of each individual project. Table 7-5 summarizes the relevant performance measures for these project level assessments. Potential project goals are based on the benefit categories identified in the SWRP: improving water quality, increasing water supply, supporting flood management, protecting the environment, and enhancing communities. The potential project outcomes are based on the benefit types identified in this SWRP: reestablishment of natural water drainage and treatment, reduction in pollutant loads, increase in groundwater supply, etc. Indicators for these outcomes are the specific metrics for each benefit: volume of runoff reduced and/or treated, load of TSS reduced, etc. For any project, performance assessments are only conducted for the benefits claimed when the project was added to the SWRP (i.e., added to OPTI). For each benefit claimed, the project proponent should attempt to obtain or provide funds to conduct the relevant monitoring or measurements identified in Table 7-5. The project proponent will then calculate the relevant outcome indicator (metric) based on the gathered data, and calculate the percent of the estimated benefit that actually occurred. The estimated benefit would be the value entered into OPTI, as calculated from the SWRP Quantitative Methods (Section 5.0). Finally, that percentage will be compared to an established performance target.

This level of assessment provides an evaluation of the estimation methods and techniques for improving project planning, design, and construction. Most grants require monitoring/performance assessments, so this effort will likely be at least partly funded for grant-awarded projects. Performance assessments will involve simple calculations with results that can be reported in OPTI for use in a later watershed level assessment (Section 7.4.2).

Table 7-6 presents an example of assessing performance at the project level for a hypothetical installation of multiple BMPs at a facility, including development of educational brochures, project signage, and a project website. When the project was added to OPTI, the project team identified the following SWRP benefits: reestablishment of natural water drainage and treatment, increase in filtration and/or treatment of particles and particle-bound constituents in runoff, increase in groundwater supply through infiltration, and increase in public education. These benefits serve as the desired outcomes for the performance assessment, and their relevant benefit categories (improve water quality, increase water supply, and encourage community stewardship) are the project goals. The outcome indicators are the metrics for each relevant SWRP benefit. The desired quantities are the benefit values listed in OPTI, as calculated from the SWRP Quantitative Benefits: 11.6 afy of runoff reduced and treated (10.8 ac-ft infiltrated and 0.8 ac-ft treated), 1,500 kg of TSS reduced annually, 10.8 ac-ft of runoff infiltrated annually, and over 4,000 participants. Before and after construction of the project, the project team conducted monitoring to measure the volumes and loads that were actually infiltrated, treated, and discharged. The team also tracked the outreach activities conducted. Then, for each metric, the actual quantity measured was divided by the desired quantity to calculate a percentage that represents the performance achieved. Each percentage was compared to the relevant performance target. For this project, three of the four targets were met. The volume infiltrated to groundwater was overestimated due to a design that assumed a soil type not reflective of actual site conditions, resulting in much less infiltration than was intended. This assessment resulted in the recommendation that future projects include infiltration testing of on-site soils to better inform design.

Table 7-5. Project Level Performance Assessments

Performance Goals[1,2]	Desired Outcomes (SWRP Benefits[1,3])	Outcome Indicators (SWRP Metrics)	Measurement Tools and Methods[4]	Performance Targets[5]
Improve Water Quality	WQ1. Reestablishment of Natural Water Drainage and Treatment	Volume of runoff reduced and/or treated	• Conduct field monitoring of pre- and post-project runoff volumes • Calculate annual average volume reductions • Calculate % of estimated volume reduction that actually occurred	80% of estimated volume
	WQ2.a Increase in Filtration and/or Treatment of Particles and Particle-Bound Constituents in Runoff	Load of TSS reduced	• Conduct field monitoring of pre- and post-project TSS loads • Calculate annual average TSS load reductions • Calculate % of estimated load reduction that actually occurred	64% of estimated load
	WQ2.b Increase in Filtration and/or Treatment of Metals in Runoff	Load of dissolved copper reduced	• Conduct field monitoring of pre- and post-project dissolved copper loads • Calculate annual average dissolved copper load reductions • Calculate % of estimated load reduction that actually occurred	64% of estimated load
	WQ2.c Increase in Filtration and/or Treatment of Indicator Bacteria in Runoff	Load of *E. Coli* reduced	• Conduct field monitoring of pre- and post-project *E. coli* loads • Calculate *E. coli* load reductions • Calculate % of estimated *E. coli* load reduction that actually occurred	64% of estimated load
Increase Water Supply	WS1. Increase in Groundwater Supply through Infiltration	Volume infiltrated to groundwater	• Conduct field monitoring of pre-and post-project runoff volumes • Calculate volume infiltrated • Calculate % of estimated volume infiltrated that actually occurred	80% of estimated volume
	WS2. Increase in Groundwater Supply through In-lieu Recharge/Conjunctive Use	Volume captured to offset demand through in-lieu recharge	• Conduct field monitoring of pre- and post-project runoff volumes • Calculate volume captured • Calculate % of estimated volume captured that actually occurred	80% of estimated volume
	WS3. Increase in Surface Water Supply through Direct Use	Volume captured to offset demand through direct use[4]	• Conduct field monitoring of pre- and post-project runoff volumes • Calculate volume captured • Calculate % of estimated volume captured that actually occurred	80% of estimated volume
Support Flood Management	FM1. Decrease in Flood Risk through Reduced Peak Flow Rates of Runoff	Rate of peak flow of runoff reduced	• Conduct field monitoring of pre- and post-project flow rates • Calculate flow rate reductions • Calculate % of estimated flow rate reduction that actually occurred	80% of estimated peak flow rate
	FM2. Increase in Area Addressed for Flood Mitigation	Size of area mitigated	• Conduct field survey of final area mitigated • Calculate % of estimated area that was actually mitigated	95% of estimated area
	FM3. Decrease in Combined Sewer System Overflows	Volume of runoff reduced in jurisdictions with combined sewer systems	• Conduct field monitoring of runoff reductions • Calculate volume reductions • Calculate % of estimated volume reduction that actually occurred	80% of estimated volume
Protect the Environment	E1. Enhancement, Creation, or Protection of Wetlands, Riparian Zones, or Habitat	Area of wetland, riparian zone, or habitat enhanced, created, or protected	• Conduct field survey of final area enhanced, created, or protected • Calculate % of estimated area that was actually enhanced, created, or protected	95% of estimated area
	E2. Increase in Urban Green Space	Area of urban green space created	• Conduct field survey of final area created • Calculate % of estimated area that was actually created	95% of estimated area
	E3. Improvement of Instream Flow Rate	Amount of instream flow rate improved	• Conduct field monitoring of instream flow rates • Calculate flow rate improvement • Calculate % of estimated flow rate improvement that actually occurred	80% of estimated flow rate
	E4. Decrease in Energy Use	Energy use reduced	• Measure pre- and post-project energy use • Calculate energy reduction • Calculate % of estimated energy reduction that actually occurred	80% of estimated energy use
	E5. Decrease in Greenhouse Gas (GHG) Emissions	Mass of greenhouse gas emissions reduced	• Calculate GHG reduction based on observed energy reduction • Calculate % of pre-project estimated GHG reduction that actually occurred	80% of estimated mass
	E6. Improvement in Water Temperature	Degrees of water temperature improved or Percent canopy cover increased	• Conduct field monitoring of pre- and post-project temperatures or estimate pre- and post-project canopy cover • Calculate temperature or canopy cover improvement • Calculate % of estimated temperature or canopy cover improvement that actually occurred	80% of estimated degrees or canopy cover

Performance Goals[1,2]	Desired Outcomes (SWRP Benefits[1,3])	Outcome Indicators (SWRP Metrics)	Measurement Tools and Methods[4]	Performance Targets[5]
Enhance Communities	C1. Increase in Public Education	Number of outreach materials provided or events conducted[5]	• Count number of materials provided and/or events conducted • Calculate % of desired number that was actually produced/conducted	95% of estimated number
	C2. Increase in Public Involvement	Number of participants	• Track and sum actual number of participants • Calculate % of desired hours that were actually provided	95% of estimated number
	C3. Creation or Enhancement of Public Space	Area of public space created or enhanced	• Conduct field survey of final space created or enhanced • Calculate % of estimated space that was actually created or enhanced	95% of estimated area

[1]Not all goals or benefits will apply to all projects. Project proponents will determine which apply when submitting project to OPTI and conduct assessments only for goals and benefits claimed.
[2]Project goals are based on the multi-benefit categories established in the SWRP guidelines (State Water Board 2015c): water supply, water quality, flood management, environmental, and community.
[3]Desired project outcomes are based on the SWRP benefits listed in Tables 3 and 4 of the SWRP guidelines (State Water Board 2015c).
[4]Estimated/desired metrics should be taken from the quantified methods in the pre-project design.
*[5]It is assumed there should be no to minimal uncertainty or data variability in area- and count-based outcome indicators, so the performance targets are set at 95%. For all other indicators except those that are load-based, a 20% error associated with technology/equipment and methodologies is typical. The performance targets for these indicators are therefore set at 80%. For load-based indicators, there is a 20% error for volume measurements and a 20% error for concentration measurements. These are not mutually exclusive, and the resulting total error is therefore calculated as 1-(0.2+0.2-(0.2*0.2)) = 0.64.*

Table 7-6. Example of Project Level Performance Assessment: Construction of an Infiltrating Stormwater Planter

Performance Goals	Desired Outcomes (SWRP Benefits)	Outcome Indicators (SWRP Metrics)	Desired Quantity	Actual Quantity	Performance Achieved	Performance Target[1]	Target Met?	Discussion	Recommendation
Improve Water Quality	WQ1. Reestablishment of Natural Water Drainage and Treatment	Volume of runoff reduced and/or treated	11.6 afy	11.0 afy	95%	80%	Yes	—	—
	WQ2.a Increase in Filtration and/or Treatment of Particles and Particle-Bound Constituents in Runoff	Load of TSS reduced	1,500 kg/yr	1,100 kg/yr	73%	64%	Yes	—	—
Increase Water Supply	WS1. Increase in Groundwater Supply through Infiltration	Volume infiltrated to groundwater	11.0 afy	7.7 afy	70%	80%	No	Project design assumed hydrologic soil group type B, but actual on-site soils were type C, resulting in much less infiltration	Test on-site soils to determine infiltration rates prior to design
Enhance Communities	C1. Increase in Public Education	Number of outreach materials provided or events conducted	3	3	100%	95%	Yes	1. Developed project brochures 2. Installed on-site signage 3. Created virtual walking tour	—

[1] Targets established for the ARB region, as listed in Table 7-5.

7.4.2 ARB SWRP Watershed Level Performance Assessment

The technical advisory committee for this SWRP determined that a variety of performance-assessment approaches is needed to best address the diversity of needs, interests, and limitations of the region's stakeholders. The ARB municipalities can only provide services (including tasks associated with performance assessments) within their jurisdictions. The SSQP has proposed using a stochastic model approach for compliance with the RAA requirements of their NPDES permit. They are awaiting approval from the Central Valley Regional Water Board, and timelines for future updates have not been developed. This model will only focus on water quality in SSQP jurisdictions; it does not evaluate flood control, water supply, or other performance goals nor does it cover areas outside the SSQP jurisdictions. Municipalities in Placer County are Phase II permittees and do not have regulatory drivers or funding to commit to sophisticated watershed-wide performance assessment models, so a cumulative project benefits approach is proposed to address these constraints but still provide data to quantify improvements over time. This option is also reasonable from a scalability perspective: most SWRP projects will be site-scale and LID. A large number of projects will need to be implemented before a difference is observable in receiving waters and sub-watersheds to make informed decisions for adaptive management. Finally, watershed stewardship stakeholders would like to see aquatic indicator performance assessments done, but there is a lack of regulatory drivers and funding to commit to these. This option was included in the case that funding becomes available in the future, as it was deemed a valuable option, especially for watershed health from an aquatic habitat perspective.

With this in mind, watershed level performance assessments for the ARB region will be conducted in various ways, according to the specific needs of the agency or stakeholders leading the effort. The assessments may be done across one or all of the ARB region's watershed or sub-watersheds. A watershed level assessment for the ARB region could use cumulative project benefits, a watershed model, or aquatic indicators to evaluate the impact of projects on watershed health, as described below.

7.4.2.1 Cumulative Project Benefits

A simple watershed assessment sums the benefits achieved across all SWRP projects within a defined watershed, sub-watershed, or group of watersheds. This information can be used to estimate how much SWRP projects are contributing to ARB IRWMP and SWRP goals and objectives. In the future, these cumulative quantities could be used to quantify the potential for SWRP projects to contribute to future IRWMP targets; as of the time of writing this SWRP, the ARB IRWMP did not have numeric targets for its goals and objectives.

7.4.2.2 Modeled Benefits

Watershed models can simulate the long-term effects of land use changes on watershed processes, uses/diversions, and pollutant loadings. The affected watershed processes include overland flow, groundwater recharge and infiltration, interflow, evapotranspiration, in-stream delivery of sediment and organic matter, and chemical and biological transformations. The simulations are based on user-defined parameters such as topography; land use, cover, and slope; stream locations, flows, and depths; runoff outfall locations, discharges, and pollutant concentrations; hydrologic soil groups; and precipitation and evaporation rates. Models can estimate watershed-scale benefits, such as meeting critical in-stream flow criteria, critical in-stream temperature criteria, receiving water limitations, and beneficial uses.

Such models would be most useful in refining the locations of BMP, flood control, and restoration projects to reduce runoff discharge volumes and pollutant loads, increase water supply, mitigate hydromodification effects, and reduce greenhouse gas emissions and flooding. Such a model could quantify the SWRP benefits through a more dynamic, holistic, watershed scale, possibly in lieu of the project-site scale. Many forms of such models are being used by California municipalities to plan and demonstrate compliance with their MS4 permits. For example, SSQP submitted an approach for conducting a reasonable assurance analysis (RAA) on their alternative compliance pathway (ACP) for meeting receiving water limitations to the

Central Valley Regional Water Board in May 2017, fulfilling a requirement of their NPDES permit (SSQP 2017). Appendix M provides a more thorough discussion of potential watershed model approaches.

7.4.2.3 Aquatic Indicators

Aquatic indicators are key environmental parameters of water quality and flow, which are deemed to be significant for critical species. They are often specific to watersheds and individual species. Aquatic indicators could support more thorough assessments of aquatic habitat quality in the ARB region's watersheds, beyond the environmental metrics identified for the SWRP benefits (Section 5.0).

The region has a detailed relevant example that regional runoff management efforts and the SWRP can build upon. In 2015, the California Office of Environmental Health Hazard Assessment (OEHHA) and Dry Creek Conservancy developed aquatic indicators to assess aquatic habitat quality in the Dry Creek Watershed (OEHHA and DCC 2015). The Dry Creek project involved conducting a sub-watershed level study to identify parameters that best indicated Dry Creek Watershed's conditions and stressors. The resulting indicators included biological measurements (e.g., fall-run Chinook salmon fish counts and benthic macroinvertebrate measures), water quality concentrations/loads (TSS, metals, pesticides, and dissolved oxygen), physical habitat measures (streambed sediments, vegetative cover or shade, flow diversity, and temperature), instream flashiness (i.e., the frequency and rapidity of short term changes in streamflow, especially during runoff events), and urban development (land use and cover). To use this method for other areas of the ARB region, studies would need to identify appropriate indicators for each subwatershed; each waterbody has its own unique physical habitat and aquatic health conditions, and, therefore, aquatic indicators are not identical from one waterbody to another. The indicators would need to be monitored over time, and desired (quantified) outcomes would need to be identified.

8.0 EDUCATION, OUTREACH, AND PUBLIC PARTICIPATION

The ARB region has multiple existing opportunities that will be used to engage the public in development and implementation of the SWRP and its projects. These mechanisms include:

- OPTI
- IRWMP semi-annual meetings
- RWA announcements
- Municipal programs
- VFWC activities
- 2018 Watershed/LID Conference

The following subsections describe how these opportunities support public participation. Table 8-1 summarizes which opportunities address various public participation elements required by the SWRP guidelines (State Water Board 2015c).

Table 8-1. Opportunities to Engage the Public in SWRP Implementation

Public Participation Element	Opportunities to Engage the Public					
	OPTI	IRWMP Semi-Annual Meetings	RWA Announcements	Municipal Programs	VFWC Activities	2018 Watershed/LID Conference
Mechanisms, Processes, and Milestones for Facilitating Public Participation during SWRP Development and Implementation	X	X	X	X	X	X
Mechanisms to Engage Communities during Project Design and Implementation	X	X		X	X	
Identification and Inclusion of Specific Audiences		X		X	X	
Strategies to Engage Disadvantaged and Vulnerable Communities		X		X	X	
Efforts to Identify and Address Runoff-related Environmental Injustice Issues		X		X	X	
Schedule for Public Engagement and Education*	X	X		X	X	X

**Timelines for public participation activities are described in the relevant opportunity subsections.*

8.1 OPTI

OPTI was originally developed to add and track projects for the ARB IRWMP. During development of this SWRP, OPTI was updated to add capabilities for submitting and tracking information relevant to SWRP projects. To add SWRP projects to OPTI, project proponents enter the same information as that required for IRWMP projects, along with several additional details used in OPTI for prioritizing projects (as described in Section 6.3). In this way, SWRP projects will also potentially qualify as IRWMP projects, subject to the vetting process described below. Figure 8-1 shows a screen shot of the user interface for the specific information that is needed for SWRP projects.

Stakeholders can access OPTI using the guest mode to view and comment on projects. Alternatively, they can create usernames to become members of the "community," allowing them to add and edit projects. Projects can be added and edited at any time, and the project proponent can share the project information with any member of the community. The project is not visible to the remainder of the community until the proponent selects the "submit" button. The project then undergoes a stakeholder vetting process. At the close of each quarter (i.e., March 31, June 30, September 30, and December 31), RWA distributes a summary of projects submitted over the previous quarter and allows stakeholders one month to comment.

The link for accessing OPTI is: http://irwm.rmcwater.com/rwa/login.php

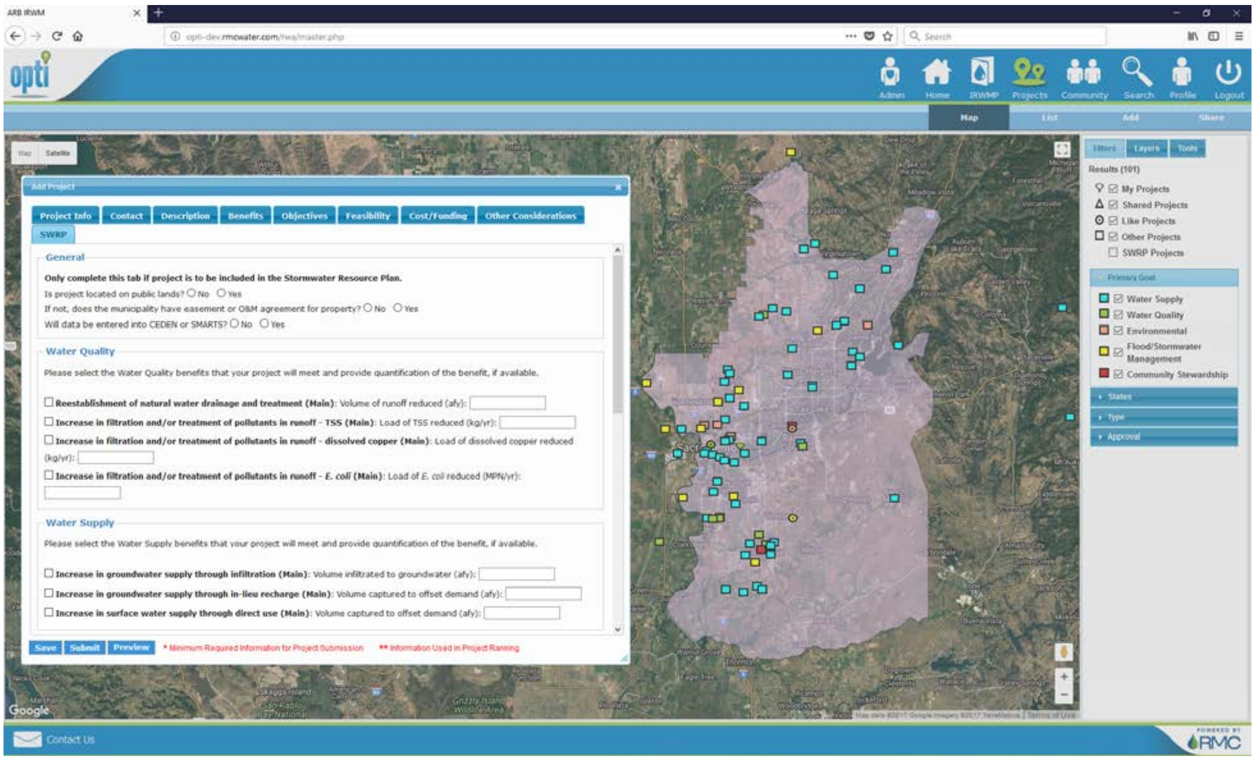

Figure 8-1. Screen Shot of IRWM On-line Planning Tool Information Center (OPTI) Update

8.2 IRWMP Semi-Annual Meetings

RWA hosts semi-annual IRWMP meetings (in April and October) to discuss relevant projects, updates, and issues. All stakeholders are welcome to attend, and may request that SWRP topics, including specific projects, appear on the agenda for any of these meetings. These IRWMP meetings will also serve as opportunities to discuss how to (1) identify and include audiences impacted by SWRP activities, (2) engage DACs and vulnerable communities, and (3) identify and address environmental injustice issues.

8.3 RWA Announcements

RWA maintains an email distribution list of OPTI members that is used to announce IRWMP information. As needed, stakeholders may request that RWA use this list to disseminate specific SWRP information.

8.4 Municipal Programs

Each municipality within the ARB region has established processes to allow the public to review and comment on plans, documents, and projects developed by their programs. These processes will be followed as needed for SWRP implementation. For example, prior to the approval of design or construction of a project, that project may go through a public vetting process required by the local jurisdiction. (However, most but not all projects will be vetted as applicable; it will depend on the size and scope of the project.) The process will engage local ratepayers, developers, commercial and industrial stakeholders, nongovernment organizations, and the general public.

Through their individual networks, the municipalities within the ARB region will also announce activities related to implementation of the SWRP, including identifying additional projects. Targeted audiences may include parks, transportation, drainage, and capital improvement departments. Appendix O includes the call-for-projects template that assists the SWRP development collaborators in describing the intent of the SWRP and in gathering the initial list of SWRP projects. The call-for-projects period occurred September 2017 through March 2018. This template may be adapted as needed in the future to solicit additional projects or information for SWRP updates.

As previously cited, most of the disadvantaged and vulnerable communities in the ARB region exist as pockets within larger municipalities and are served by those municipal agencies. Municipal staff will engage DACs directly on a project-by-project basis. In addition, the needs of isolated DACs are being tracked through the IRWMP and will be discussed at the semi-annual meetings as needed.

8.5 VFWC Activities

VFWC is a regional partnership that shares expertise from nonprofit, government, and private organizations to help implement priority projects for watershed health. They help nonprofit, government, and private partners connect to pooled services and resources for project planning, funding, volunteers, integrating related projects, and outreach. In this capacity, VFWC can provide and promote SWRP projects and practices that assist disadvantaged and vulnerable communities and address environmental injustice issues.

8.6 2018 Regional Watershed/LID Conference

For over a decade, Dry Creek Conservancy has hosted regional LID conferences that address LID topics specific to Sacramento County and western Placer County, including the previous conference in 2015. The most recent conference, held March 1, 2018 at Cal EPA headquarters in Sacramento and co-hosted by VFWC, the State Water Board, and OWP at Sacramento State, expanded the program to encompass other watershed health topics, including development of this SWRP and its projects. Save-the-date announcements were distributed in December 2017 to previous conference participants as well as the collaborators that produced this SWRP. Approximately 110 stakeholders attended. The conference served as the public outreach meeting for development and initial implementation of the SWRP, and occurred on the first day of the SWRP's public review period (March 1 through March 31, 2018) to allow adequate time for feedback and other activities if needed.

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Appendices are available upon request