San Luis Obispo Creek Stormwater Resource Plan

Final Draft

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EXECUTIVE SUMMARY

This report constitutes the San Luis Obispo Creek Watershed Stormwater Resource Plan (henceforth, the "SRP"), whose overarching purpose is to develop strategies to best manage the risks and opportunities presented by stormwater runoff from this coastal, mixed-land-use watershed along California's Central Coast. This Resource Plan follows the guidance of the State Water Board in analyzing the San Luis Obispo Creek watershed as a whole, integrating the current knowledge of the watershed and its receiving waters' condition to guide recommendations for the multi-benefit management of stormwater to improve overall watershed health.

The San Luis Obispo Creek watershed drains approximately 84 square miles, with the City of San Luis Obispo at its geographic center. The creek and its tributaries are used by south-central California steelhead (*Oncorhynchus mykiss*, listed as "threatened" under the federal Endangered Species Act), although only few areas remain with high-quality spawning and rearing habitat. Resource quality and stream health decline monotonically down the channel network, with the most abrupt decline associated with the urban center of the City of San Luis Obispo. Although a variety of direct channel impacts coincide with this zone, the well-documented decline in various in-stream conditions through this area, particularly water quality, is undoubtedly a primary result of urban stormwater runoff. Although potable water is supplied almost exclusively from out-of-basin reservoirs, groundwater is used extensively for agriculture and much of the watershed overlies a designated groundwater basin.

The protection or recovery of "watershed processes," encompassing the storage, movement, and delivery of water, chemical constituents, and/or sediment to receiving waters, should be the fundamental goal of stormwater management, and this principle guides the analyses and recommendations of this SRP. This approach leads to multi-benefit outcomes because the focus is on correcting the underlying *cause(s)* of resource degradation, not its variety of symptoms. Across areas displaying the greatest impacts to resources, their clearest commonality is a loss of infiltration from the contributing watershed area. Thus, the stormwater management strategies most responsive to this condition will be those that are most effective at recovering this watershed process to the greatest benefit of all water resources.

In summary, using the guidance provided by the characterization of the watershed (Section 1), the lens of impaired watershed processes (Section 3), and the identification of sites with the highest rating for addressing those impaired processes through stormwater management (Section 4), key areas plus a list of 3 planned projects sites have been identified that emphasize the types of structural stormwater projects (regional capital improvement projects, small- and large-scale low impact development projects, and green streets) that are particularly amenable to addressing the critical impairments to watershed processes. Through coordination with other entities and the public in both the development (Section 2) and implementation (Section 5) of the SRP, this document details the methodology for developing its findings and identifies multiple opportunities for multi-benefit watershed improvements.

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1.1 INTRODUCTION

1.1.1 Purpose and Scope

This report constitutes the San Luis Obispo Creek Watershed Stormwater Resource Plan (henceforth in this document, the "SRP"), whose overarching purpose is to develop strategies to best manage the potential risks and opportunities presented by stormwater runoff from this coastal, mixed-land-use watershed along California's Central Coast. In the spirit of the State Water Board Guidelines for Storm Water Resource Plans, the approach being used for this Resource Plan affirms that "The watershed approach is essential to integrate stormwater management with other basic aspects of aquatic resource protection and overall water management including flood control, water supply, and habitat conservation" (California State Water Board, 2015, p. 13). Thus, this SRP considers the San Luis Obispo Creek watershed as a whole, integrating the current knowledge of the watershed and its receiving waters' quality and overall health.

The form and content of this SRP are guided by the State Water Board Guidelines for Storm Water Resource Plans (California State Water Board 2015; henceforth, the "*Guidelines*"), which in turn were developed to implement Senate Bill 985 (SB-985) with respect to stormwater resource planning. These requirements went into effect January 1, 2015, and requires a city, County, or special district to develop a stormwater resource plan as a precondition of receiving voter-approved bond funds for stormwater and dry-weather runoff capture projects. This SRP is designed to meet those requirements on behalf of the public agencies and their partners within the San Luis Obispo Creek watershed, while also providing a concise body of information on the watershed and its water resources that should serve a variety of additional purposes in the years ahead. This SRP has been prepared in full coordination with the San Luis Obispo County Stormwater Resource Plan (henceforth, "the County SWRP"); the two plans share identical methodologies for the identification, scoring, and prioritization of stormwater resource projects and programs. The information contained in this SRP is also included in the County SWRP, but the present report offers a more in-depth characterization and consideration of the conditions and opportunities within the San Luis Obispo Creek watershed. With respect to project identification and scoring, however, the two plans are functionally identical.

1.1.2 Elements of the SRP

This SRP is organized to follow the sequence of presentation followed by prior such plans, and as reflected in the G*uidelines*:

Chapter 1. Existing Conditions in the San Luis Obispo Creek watershed (this chapter): introduces the purpose and scope of the SRP, and presents descriptions of the watershed, as defined by its surface-water drainage divides and its receiving waters.

Chapter 2. Coordination and Collaboration in Plan Development: describes the agency and other stakeholder involvement in the development of this plan.

Chapter 3. Types and Locations of Priority Projects: describes the foundation for how this plan identifies the stormwater management needs across the watershed and the types of Stormwater Control Measures available to address them.

Chapter 4. Screening, Scoring, and Prioritizing of Stormwater Control Measures: summarizes the development and application of quantitative and non-quantified metrics to evaluate specific proposed projects, and to identify areas where future, as-yet unidentified projects could prove both valuable and feasible.

Chapter 5. Plan Implementation: describes the process(es) by which the recommendations of this plan will be implemented, reevaluated, and updated as new information is developed and new opportunities are identified.

1.1.3 Previous Studies and Plans

Given a long history of prior study of the San Luis Obispo Creek watershed, prior sources have been widely utilized in the preparation of this SRP. Noteworthy among them are the Watershed Enhancement Plan (Land Conservancy of San Luis Obispo County, 2002), the Waterway Management Plan (City of San Luis Obispo, 2003), the Juvenile Steelhead Distribution and Population Estimate (Alley and Associates, 2008), the Program Effectiveness Assessment and Improvement Plan (City of San Luis Obispo, 2015), The San Luis Obispo County Instream Flow Assessment (Stillwater Sciences 2014), and the Percolation Zone Study (Stillwater Sciences, 2015). This prior published information has been supplemented with field visits in summer 2016; a variety of publicly available data on topography, hydrography, geology, and land cover; and previously compiled online data from 2nd Nature, Inc., the City of San Luis Obispo (henceforth, “the City”), the County of San Luis Obispo (henceforth, “the County”), and California Polytechnic State University, San Luis Obispo (henceforth, “Cal Poly”). Coincident with the preparation of this plan has been the development of the San Luis Obispo County Stormwater Resource Plan (the County SWRP); these two plans are entirely consistent with their approaches to the assessment and ranking of stormwater management needs and opportunities.

1.2 THE SAN LUIS OBISPO CREEK WATERSHED

1.2.1 Watershed Setting and Boundaries

The San Luis Obispo Creek watershed drains approximately 84 square miles, with the City of San Luis Obispo at its geographic center (Figure 1-1). Four tributaries (Stenner Creek, Brizzolara Creek, East Fork San Luis Obispo Creek, and mainstem San Luis Obispo Creek) flow south and west out of the Santa Lucia mountain range to converge within the City itself; they are joined by the valley-bottom tributaries of Prefumo Creek (flowing east out of the Los Osos Valley) and Davenport Creek (flowing west out of the Edna Valley). Mainstem San Luis Obispo Creek leaves the broad, alluvial valley in which the City is situated to the south through a narrow canyon that extends about six miles to the Pacific Ocean at the town of Avila Beach. The San Luis Obispo Creek watershed is wholly contained by “Watershed Group 3” of the County SWRP; and but for a few small, coastal drainages included in the latter the two areas are identical.

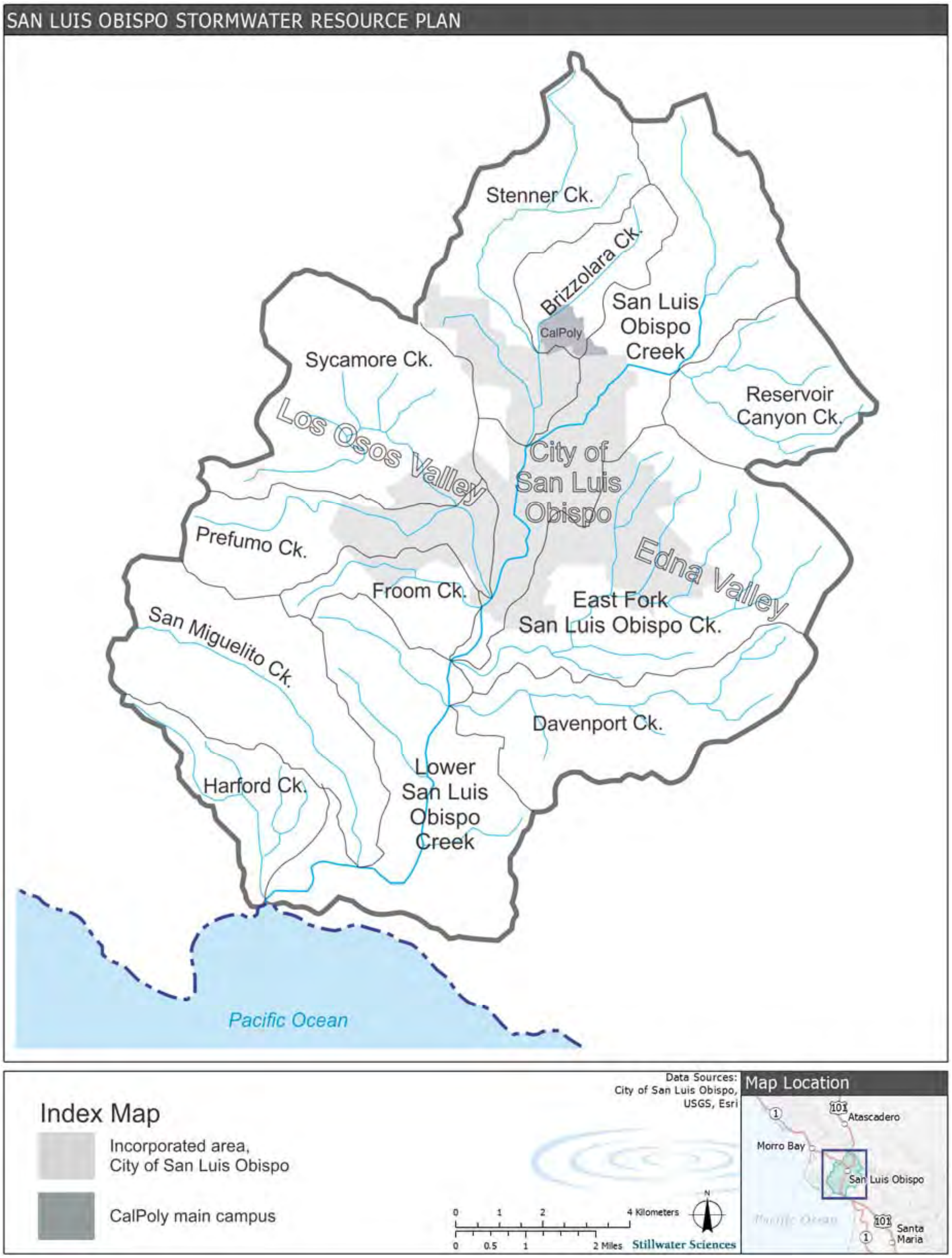


Figure 1-1. Index map of the San Luis Obispo Creek watershed.

1.2.2 Watershed Topography and Geology

The physiography of the watershed strongly expresses the underlying geological materials, and in turn influences most aspects of surface-water flow, groundwater, and thus (ultimately) the management of stormwater runoff. Broadly, the watershed comprises three sections: a central northwest-southeast trending valley (Los Osos and Edna valleys), flanked to the southwest and northeast by bedrock uplands (Irish Hills and Santa Lucia Range, respectively) (Figure 1-2). Based on nearly a half-century of prior geologic mapping (Dibblee 1974, 2004a-d, 2006a-c; Hall et al. 1979), the Santa Lucia Range to the northeast is underlain primarily by older, uplifted metamorphic rocks, over 70 million years old and now a sheared, jumbled collection of mixed rock types with common outcrops of serpentinite—a rock that originated from below the earth's crust and hydrothermally altered during its uplift towards the modern ground surface. In surface exposures, it displays a characteristic green hue, sufficiently distinctive and widespread to have been designated the official State Rock of California. It is typically unstable on steep slopes, in part because its unusual mineral composition inhibits the growth of all but the most specially adapted vegetation. As a result, landslides of all scales (from a few yards to many miles across) are common in this terrane.

To the southwest, much younger sandstones and siltstones of the Squire, Pismo, and Monterey Formations have been uplifted to altitudes locally above 1,000 feet since their marine deposition over the last 15 million years to form the Irish Hills. Although these rocks would otherwise have isolated the San Luis Obispo watershed from any direct access to the Pacific Ocean, ongoing erosion by the creek has cut a narrow canyon through the ridgeline through which both San Luis Obispo Creek and US Highway 101 now traverse to connect the City with the coastline. The present location of lower San Luis Obispo Creek likely predates uplift of these rocks, with stream erosion keeping pace with the rate of tectonic uplift to maintain this corridor up through the present day. Somewhat more resistant rocks just upstream of the coastline, or perhaps a more rapid rate of initial uplift there, apparently blocked a direct path of the channel to the Pacific Ocean; thus, the channel turns parallel to the coast for over a mile before finally discharging into the ocean at Avila Beach.

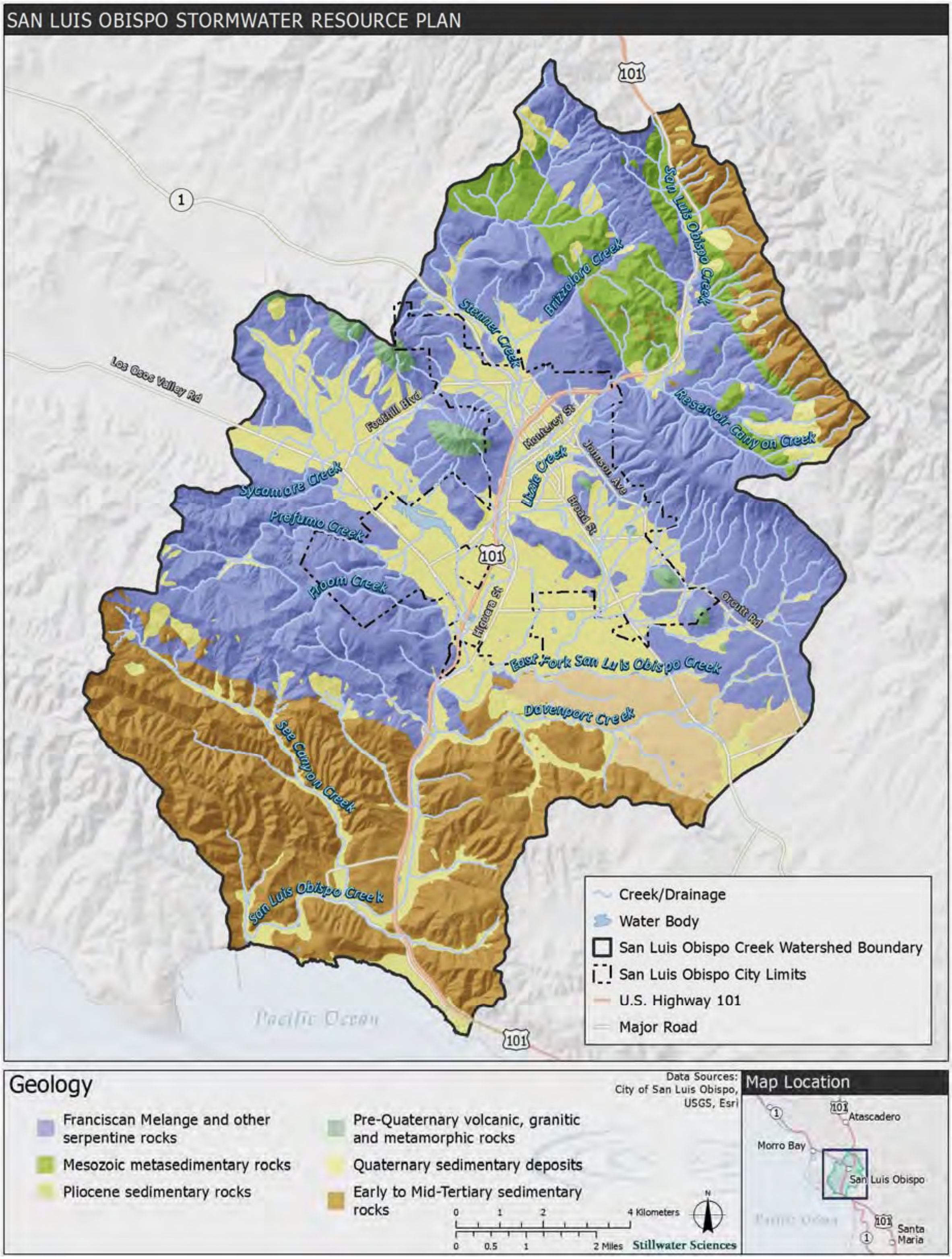


Figure 1-2. Generalized geology of the San Luis Obispo Creek watershed. The inset map highlights the three sections of the watershed described in the text. Geologic units and contacts compiled and generalized from Dibblee (2004a-d, 2006a-c).

From a hydrologic and stormwater perspective, the most important segment of the watershed is its middle one-third, comprising the lowland areas of Los Osos Valley, the land area of the City itself, and the southeast-trending Edna Valley. Although Franciscan rocks almost certainly underlie this part of the watershed at depth, it is presently an alluvial valley filled with many tens to over a hundred feet of sand, gravel, and silt deposited by the creeks flowing southwest off the Santa Lucia Range and northeast from the Irish Hills (Boyle 1991, as cited in CDWR 2004). Near-surface soils show substantial variability in their grain-size distribution and thus in their localized ability to infiltrate runoff or to transmit shallow groundwater (or "interflow"); but the overall properties of the basin-filling sediments suggest that opportunities to infiltrate surface runoff should be common, and the prospects for widespread groundwater storage and recovery should be good. To a much less degree these conditions may locally apply in the sedimentary rocks of the Irish Hills; and they are probably all-but absent altogether in the metamorphic rocks forming the mountains to the northeast.

1.2.3 Stream Channels and Surface-Water Hydrography

The stream channel network of the watershed has a dual personality. The drainage density across the mountainous areas is high, reflecting the limited ability of rainfall to infiltrate. Mapped channels are commonly separated by no more than a few hundred yards, and the deeply crenulated topography suggests that less permanent surface-water features are even more closely spaced. In the lowland Los Osos and Edna valleys, however, channels are much more widely separated, commonly by one-half mile or more, as subsurface flow supported by greater infiltration begins to dominate over surface conveyance. This overall pattern is complicated through the urbanized portions of the City where constructed stormwater channels, in the form of road ditches, gutters, and storm drainpipes, capture urban runoff and create a new, dense, and largely separate surface-water drainage system. The intrinsic properties of the watershed, however, remain well-expressed outside of developed areas, leaving a pattern of infiltration-dominated hydrologic processes that suggest a template for future stormwater management in keeping with the physical attributes of the watershed.

The pattern of seasonally and perennially flowing channels broadly reflects the geologic and physiographic framework of the watershed. As documented by Alley (2008) and Bennett (2015), and broadly affirmed by summer 2016 observations and local knowledge (Figure 1-3), headwater channels are typically dry through the summer as the shallow soil layers dry out and opportunities for discharge of deep groundwater are virtually nonexistent. As drainage areas increase down the channel network, sufficient flow collects to maintain perennial reaches of upper Stenner and San Luis Obispo Creeks. As these channels enter the lowlands, however, most tend to lose water into the subsurface and again go dry, expressing the hydrologic consequences of a deep unconfined aquifer supplied by insufficient surface flows to maintain a high water table and thus perennial flow. This pattern is also repeated in the eastern tributaries (Davenport Creek and East Fork San Luis Obispo Creek).

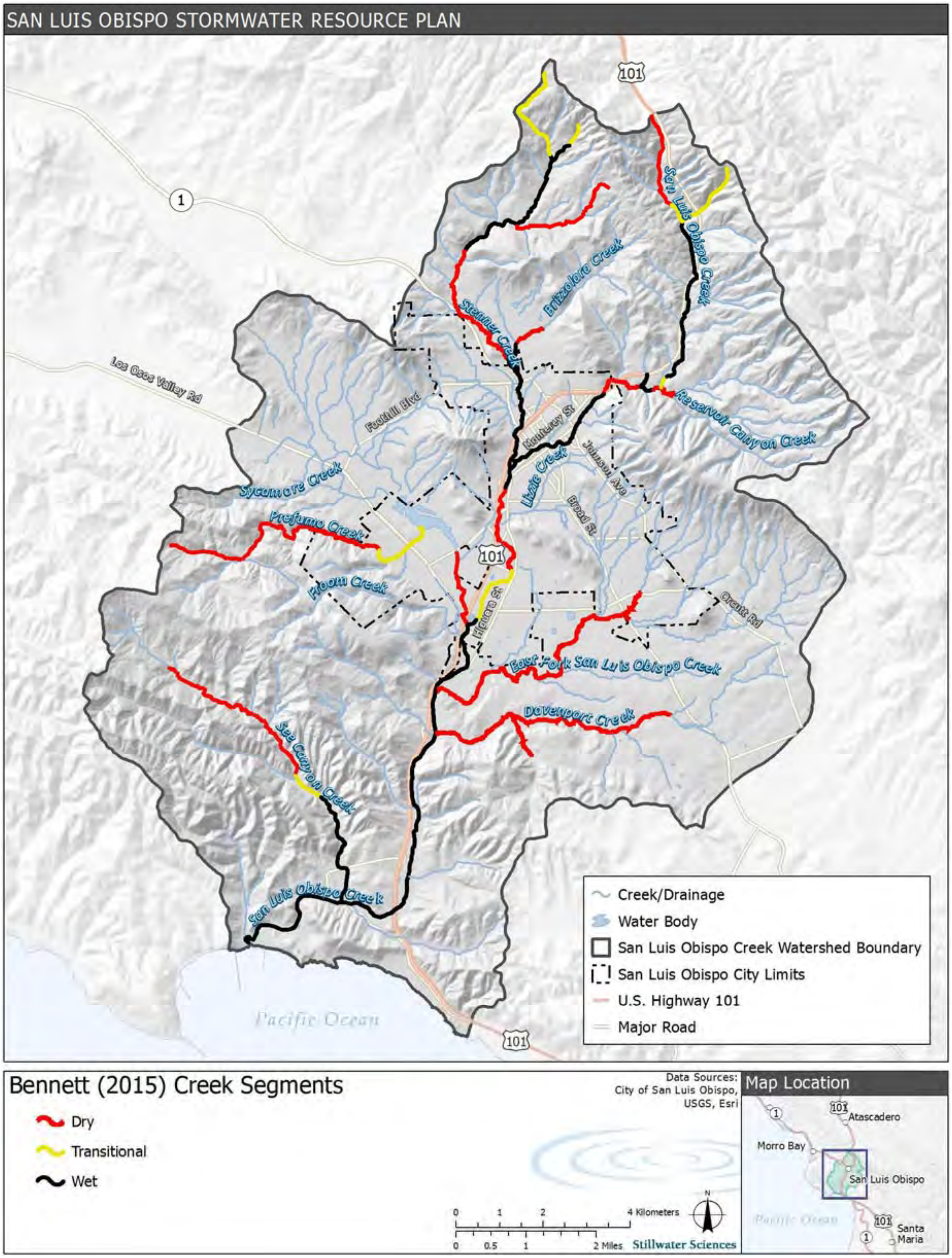


Figure 1-3. Pattern of summertime dry, transitional, and perennial (i.e., wet) channels (data transcribed from Bennett 2015).

There are a few noteworthy exceptions to this overall pattern. Both Stenner Creek and San Luis Obispo Creek maintain perennial flow upstream of their confluence near Marsh Street and US 101 for more than 1.5 miles into the valley, despite flowing over the alluvial basin sediments. These perennial reaches pass through the City's downtown core, and their persistence suggests either a thin alluvial cover over shallow, impermeable Franciscan bedrock; a preponderance of artificially lined channels, isolating surface flow from the underlying sediments; and/or some contribution from urban baseflow. Regardless of the underlying causes for these perennial reaches, however, the channel is again dry shortly downstream of the Bianchi Lane overpass below the confluence, and it remains dry or nearly so until contributions from Prefumo Creek and the Water Resource Recovery Facility, and shallowing bedrock where the alluvial valley pinches out against the southwestern Irish Hills, again supports surface flows throughout the year (Figure 1-4).

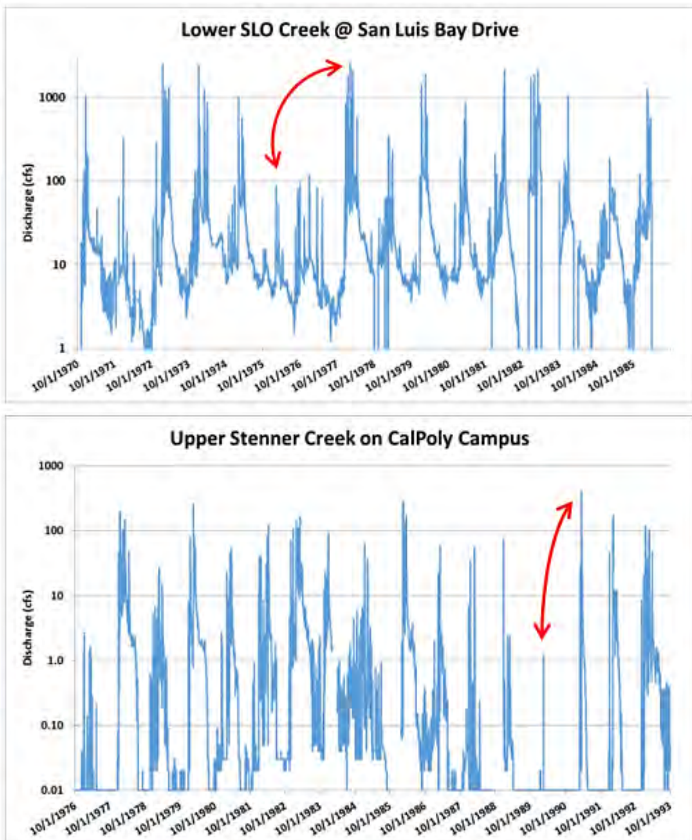


Figure 1-4. Two sample flow records from lower San Luis Obispo Creek and upper Stenner Creek (archival data provided by San Luis Obispo County). San Luis Obispo Creek (top) displays perennial flow, strongly seasonal variability, and a dramatic, 30-fold variation between annual maximum peaks in dry years (e.g., Water Year 1976) and wet years (e.g., Water Year 1978) (red arrow). The gage (since destroyed) was located about 4 miles downstream of the southern City limits and 3.4 miles upstream of the Pacific Ocean. Stenner Creek (bottom) shows similarly extreme variability in peak flows (compare the peak in Water Year 1990 [1.2 cfs] with that of the following year [416 cfs]), and also the seasonal drying that is present in all but the wettest period of the early 1980's.

Not surprisingly, fish use of the watershed, particularly by south-central California steelhead (*Oncorhynchus mykiss*, listed as “threatened” under the federal Endangered Species Act), is highly correlated with these patterns of surface water hydrology. Suitable steelhead spawning habitat occurs in Brizzolara Creek, Stenner Creek downstream of the confluence with Brizzolara, upper San Luis Obispo Creek in Cuesta Park, and middle San Luis Obispo Creek (Figure 1-5). All of these reaches are within portions of the creek that have suitable surface flows to support steelhead during winter and often into the spring. Unfortunately, fish passage obstacles that occur within the watershed under existing conditions reduce the ability of adult steelhead to access these areas. Despite these obstacles, spawning of anadromous adults is observed within these areas when surface flows during infrequent winter precipitation events are substantial enough to provide access.

Suitable steelhead juvenile rearing habitat occurs within lower Stenner Creek, upper San Luis Obispo Creek from Cuesta Park downstream to Ellsford Park, and from the Mission Plaza area downstream to the Marsh Street overpass. These are all areas adjacent to suitable spawning habitat. However, surface flows during spring and summer are presently nearly always insufficient to support suitable rearing, and are often completely dry. The portions of San Luis Obispo Creek with sufficient surface flows to support steelhead rearing occur downstream of the water treatment plant releases, where rearing habitat quality is less suitable. Despite the lower quality of habitat, the mere existence of perennial flow in this lower San Luis Obispo Creek reach supports a well-documented rearing population of steelhead juveniles, and anadromous smolts are regularly observed.

The patterns of surface water presence/absence and steelhead persistence in the San Luis Obispo Creek watershed suggest several management opportunities. Addressing key passage barriers, measures to protect the noted steelhead habitat in Stenner Creek and San Luis Obispo Creek from fine sediment, and actions to project or enhance surface flows in Stenner Creek and upper San Luis Obispo Creek would all provide direct benefits to the steelhead population.

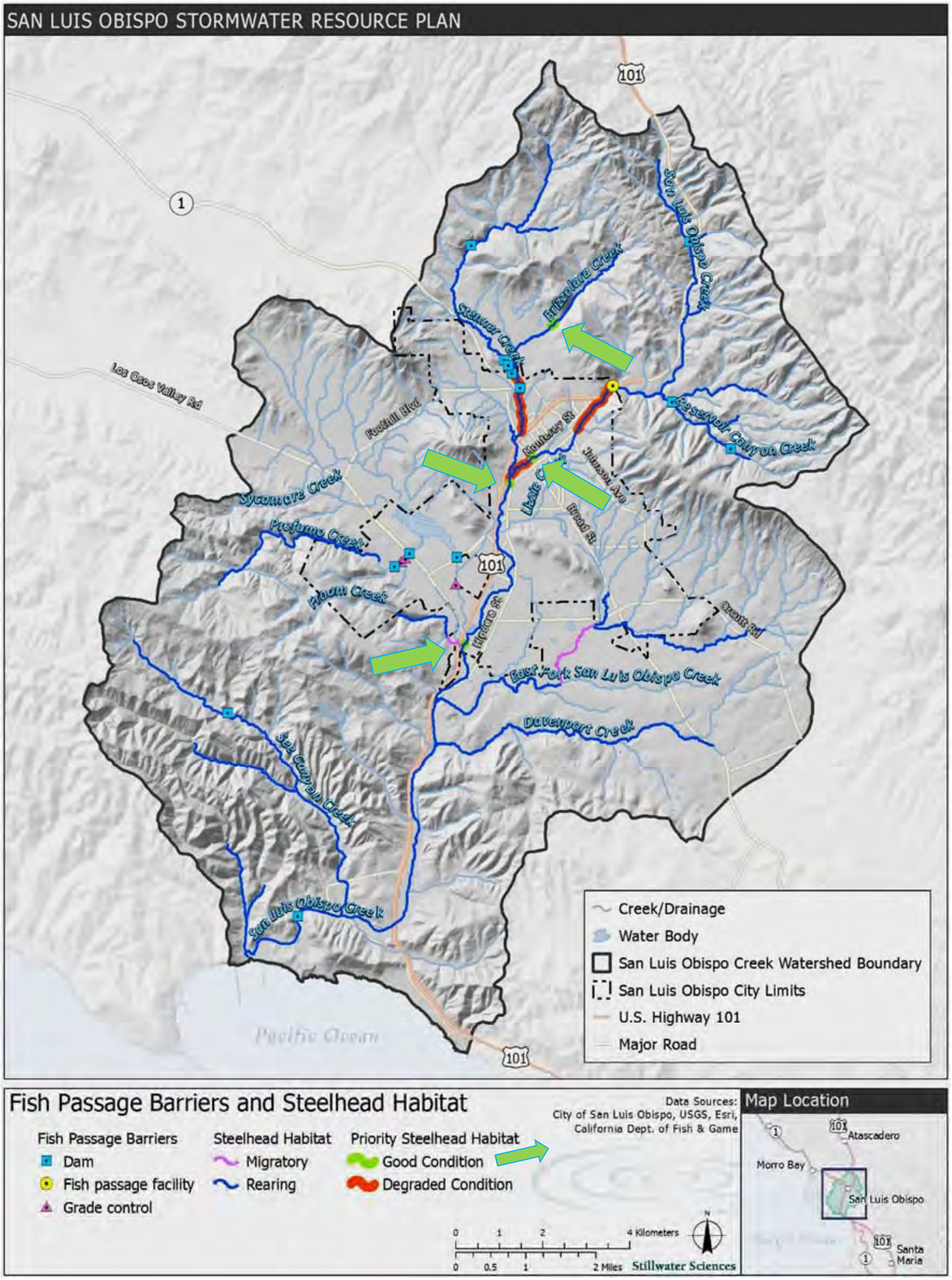


Figure 1-5. Suitable steelhead habitat (blue lines), fish barriers (colored polygons) and priority habitat reaches in good (green lines; the four locations, indistinct on the underlying drainage network, are highlighted by green arrows) and degraded (red lines) conditions throughout the San Luis Obispo Creek watershed. Source: California Department of Fish and Wildlife Passage Assessment Database (https://nrm.dfg.ca.gov/PAD/Default.aspx).

1.2.4 Water Supply

According to the recent San Luis Obispo County Integrated Regional Water Management Plan (SLO IRWMP 2014, pp. D-46—D-50), the two urban water providers (City of San Luis Obispo [5,218 AFY] and Cal Poly [1,040 AFY]) in the watershed depend primarily on surface water from the Nacimiento Project, Salinas Reservoir and Whale Rock Reservoir. Local groundwater supplies from the Avila Valley Subbasin and the San Luis Valley Subbasin provide the primary water supply for agriculture and rural users. Supplies are judged sufficient to meet projected future water demands.

The City is the sole water purveyor within the city limits, and presently all residential, commercial, and industrial water in the City and environs is provided from off-site reservoirs lying well outside the boundaries of the watershed (City of San Luis Obispo 2016). Thus, alternative approaches to stormwater management have the potential only to affect the demand for non-potable uses, notably outdoor irrigation, and only if the chosen management approaches can store runoff from the period when it occurs (namely, the winter rainy season, when irrigation demand is lowest) into the summer. The most feasible location for such storage is the underlying groundwater basin (see next section), a "reservoir" that would not support incidental landscape irrigation but which is already a locally important source of agricultural water needs.

Currently, the City obtains water from multiple sources: Salinas Reservoir (Santa Margarita Lake), Whale Rock Reservoir, Nacimiento Reservoir, and recycled water from the City's Water Resource Recovery Facility. Groundwater has also been utilized in the past, with the most recent reported use for municipal potable supply in 1990 (City of San Luis Obispo 2016). Current groundwater use includes one non-potable well, and two irrigation wells for the municipal golf course.

1.2.5 Groundwater

The San Luis Obispo Valley Groundwater Basin is a state-designated basin that chiefly underlies the lowland upper Los Osos and Edna valleys bisecting the watershed, which includes most of the City of San Luis Obispo (Figure 1-6). Its mapped boundaries coincide almost exactly with the edges of the alluvial sediment exposed at the ground surface (see Figure 1-2), and includes both the recent (Quaternary) alluvial deposits and the somewhat older (Pliocene) terrace deposits of the Paso Robles Formation, with similar sedimentary properties and origin as those of the Quaternary alluvium, that outcrop to the east. Groundwater in this basin is found in alluvium and in the sand, silt, gravel, and clays (CDWR 1979). Recharge of the basin is from precipitation on the valley floor, irrigation, and surface and underflow from San Luis Obispo Creek and its tributaries, as well as Pismo Creek and its tributaries (Boyle 1991).

The basin has recently been designated by the state as a medium priority basin that, as required by the Sustainable Groundwater Management Act (SGMA), has necessitated the formation of a Groundwater Sustainability Agency (GSA) for the sustainable management of the basin. The GSA for the San Luis Obispo Valley Groundwater Basin is presently developing a Groundwater Sustainability Plan (GSP) to be adopted by January 31, 2022 that will "include actions to ensure groundwater levels are stable over time, water quality is not degraded, and the groundwater basin is managed in a fair, cost-efficient, and sustainable manner for all of its years" (see http://www.slocountywater.org/site/Water%20Resources/SGMA/slovalley/pdf/SGMA101-Flyer-20160920.pdf.).

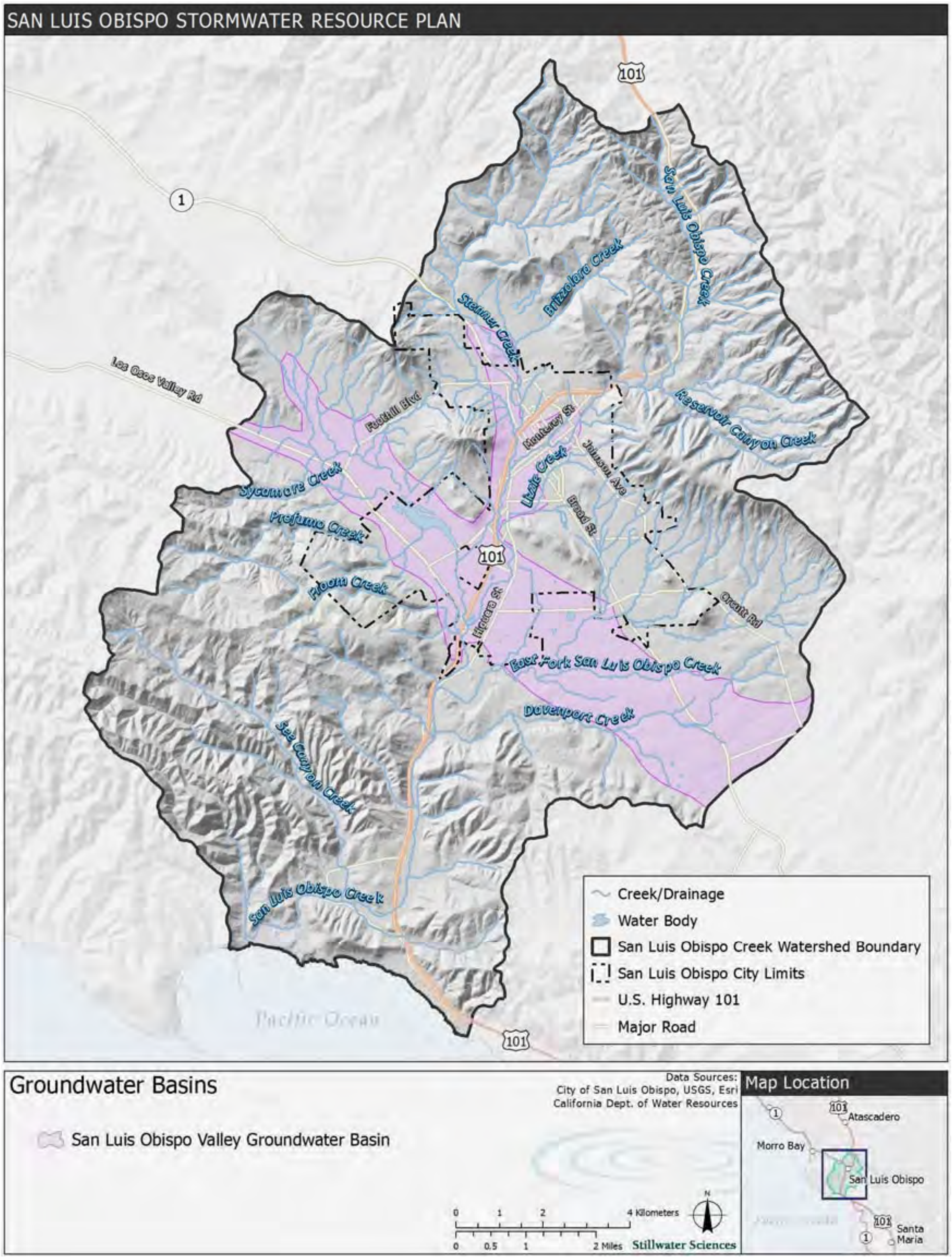


Figure 1-6. Boundaries of the San Luis Obispo Groundwater Basin, as designated by the California Department of Water Resources (CDWR 2004), within the boundaries of the San Luis Obispo Creek watershed.

Data from the San Luis Obispo Valley groundwater basin spanning the late 20th century were reported by the California Department of Water Resources (CDWR 2004) and were summarized in several recent studies (Stillwater Sciences 2014, 2015); the following background information is extracted directly from those reports. The groundwater basin and its contributing watershed receive between 19 and 23 inches of rainfall annually (CDWR 2004). Groundwater is relatively shallow in this 50- to 100-ft-thick unconfined aquifer (Boyle 1991, as cited in CDWR 2004). Groundwater levels reported from a well in Edna Valley near Pismo Creek have fluctuated between 5 and 80 feet below ground surface between 1958 and 1983 (Well: USGS 351258120364501 031S013E19H001M). Another well in Edna Valley has exhibited a decline from 19 to 46 feet below ground surface from October 2012 to April 2016 as a result of the recent drought conditions (Well: CDWR CASGEM 352001N1206071W001).

Groundwater in the basin is recharged primarily by infiltration of precipitation on the valley, applied irrigation water, and streamflow (Boyle 1991, as cited in CDWR 2004). Impervious surface cover across much of the groundwater basin likely inhibits percolation throughout the urban areas, and the basin is also considered to be in overdraft (CDWR 2003) due to over-pumping by agricultural, municipal, and industrial extractions relative to current recharge. Municipal water supply for San Luis Obispo is also provided by water imported from neighboring watersheds to the north and the Water Resource Recovery Facility (SLOCFCWCD 2012), and treated wastewater generated by the City of San Luis Obispo supplements these supplies through irrigation of parks, schools, sports fields, and commercial centers.

In addition to these summarized basin-wide data, contemporary records of water levels in three wells on the Cal Poly campus were made available for the present study and analyzed for both groundwater flow direction and general trends over time (Figure 1-7). Water levels fluctuate within years and between years by 10–15 feet in the two northern wells (MW-1 and MW-7), and by only a few feet in the southern well (MW-4). Flow directions are north-to-south, reflecting primary recharge from water draining off of the Santa Lucia Range together with points of discharge and extraction towards the center of the basin (see Figure 1-7A). There is a clear indication of systematically declining water levels in the two northern wells (MW-1 and MW-7) over their respective periods of record, but attributing a cause for this trend is complicated by a somewhat parallel reduction in rainfall volumes over this period, together with near-uniformity of water levels in the southern well over the same period (see Figure 1-7B). At minimum, these data suggest that the health of the groundwater basin, at least in this northern part, is not improving over time, an important context given ongoing and potentially increasing demands into the future.

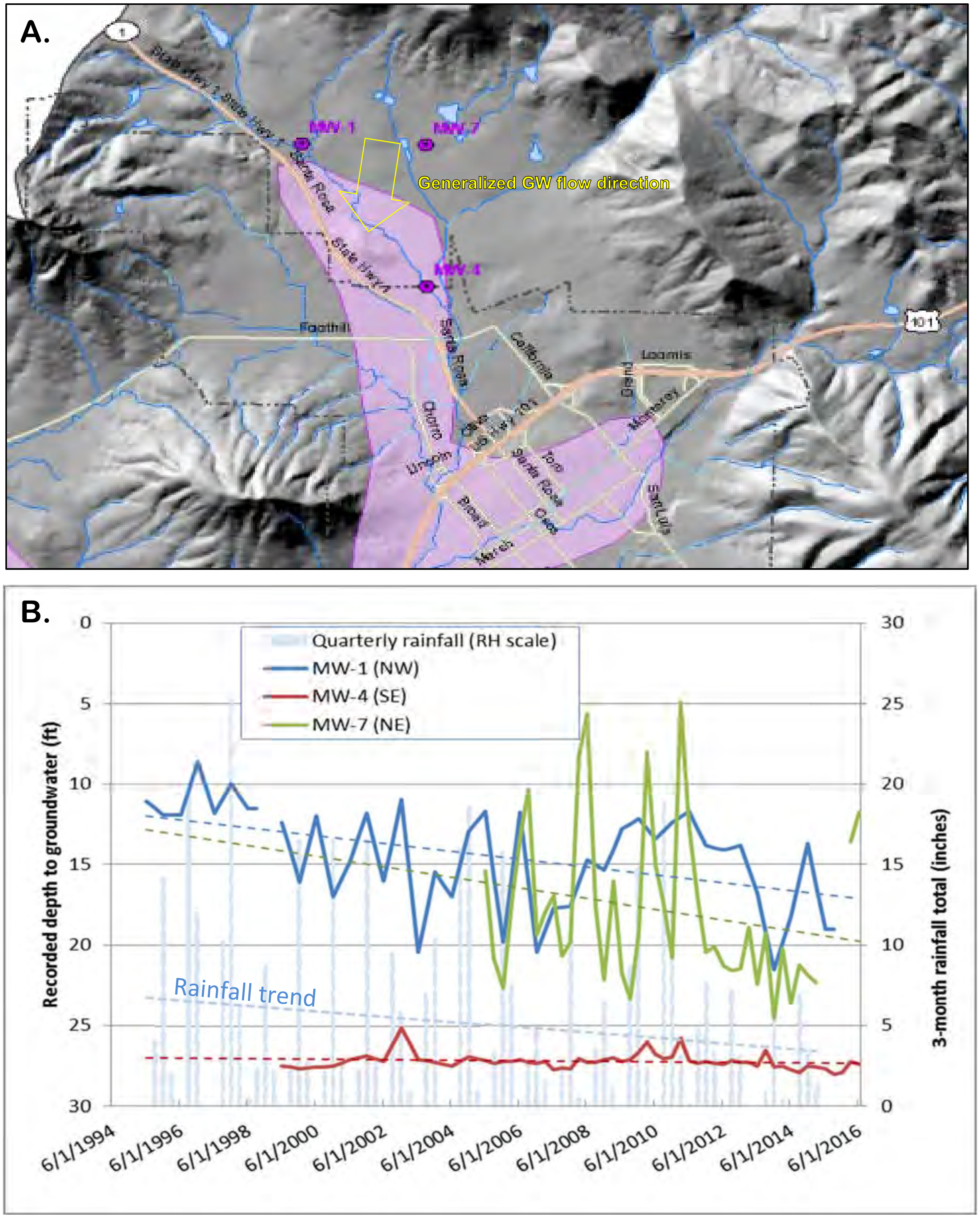


Figure 1-7. (A) View of the northern edge of the San Luis Obispo Valley Groundwater Basin and the three Cal Poly groundwater monitoring wells used to evaluate flow directions and long-term trends in water levels, and (B) plotted data from the three wells and 3-month (seasonal) rainfall totals (b). Long-term declines in the two northern wells (MW-1 and MW-7) are evident, following a trend (dashed lines, color-coded to match legend) similar to that of seasonal rainfall totals over the same period.

1.2.6 Land Cover and Land Use

Classification of land cover (Figure 1-8) made use of the National Land Cover Database of 2011 at 30-meter pixel resolution published by the Multi-Resolution Land Characteristics Consortium (Homer et al. 2012). To emphasize the broad categories most likely to influence stormwater behavior, and in particular to promote (e.g., forested cover) or inhibit (e.g., impervious urban surfaces) the infiltration of precipitation into the subsurface and overland flow, the mapped land cover types were grouped into six generalized categories:

- "Water" and "Wetlands" includes NLCD wetland categories 90 and 95;
- "Grassland/Herbaceous" includes NLCD categories 21 ("Developed, Open Space") and 71 ("Grassland/Herbaceous");
- "Urban" includes NLCD categories 22 ("Developed, Low Intensity"), 23 ("Developed, Medium Intensity"), and 24 ("Developed High Intensity");
- "Forested" includes NLCD categories 41 ("Deciduous Forest"), 42 ("Evergreen Forest"), and 43 ("Mixed Forest");
- "Agriculture" includes NLCD categories 81 ("Pasture/Hay") and 82 ("Cultivated Crops");
- "Other" includes all other categories, particularly Barren Land (31) and Shrub/Scrub (52).

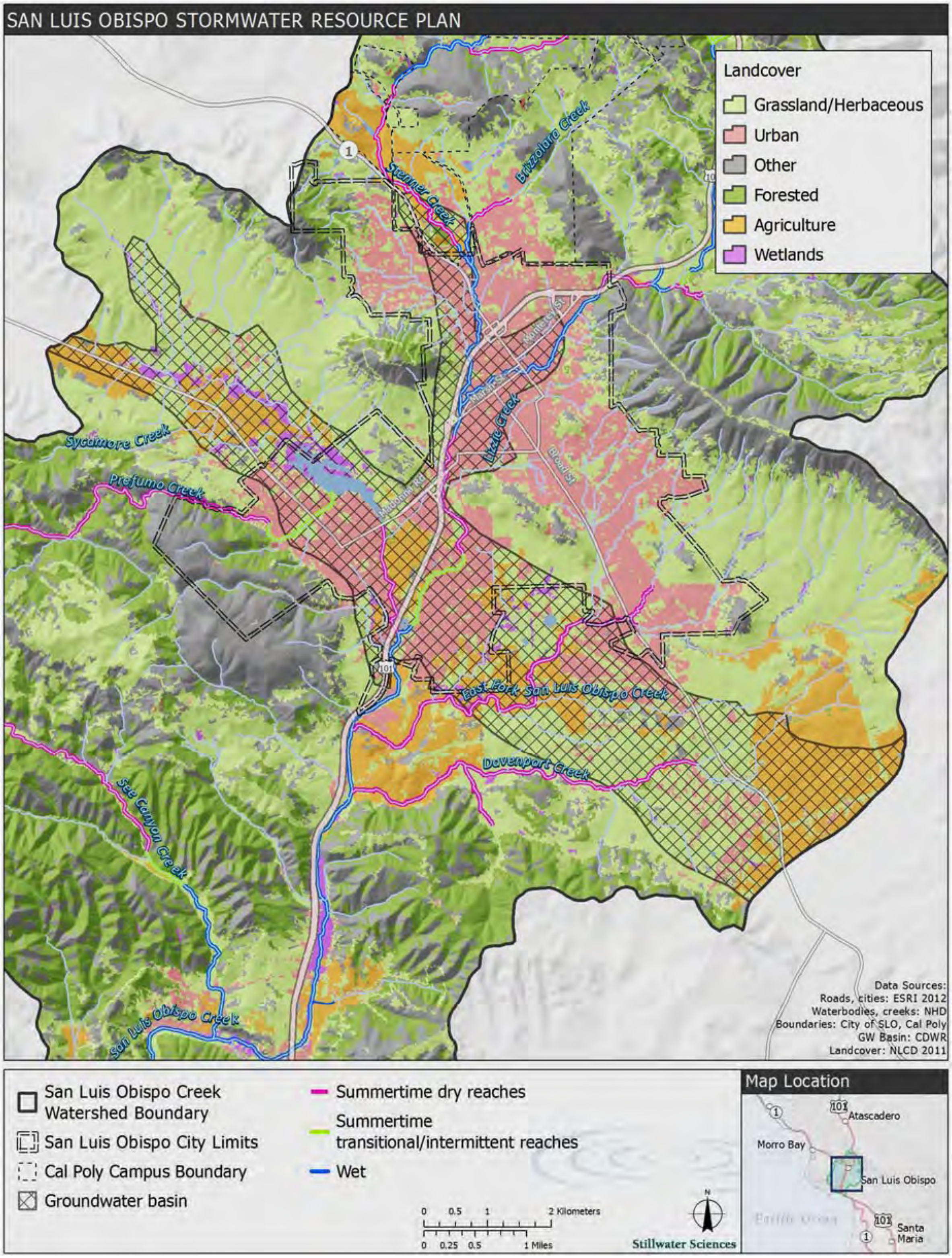


Figure 1-8. Generalized land-cover categories from the 2011 National Land Cover Database.

In the San Luis Obispo Creek watershed, the sole incorporated city is San Luis Obispo, which is also the responsible land-use agency.

1.2.7 Additional Map Information

Appendix 1, extracted from the San Luis Obispo County SWRP, includes additional maps of relevance to this SRP. They cover municipal boundaries and community service districts, aquatic habitat and fish barriers, and Watershed Management Zones.

1.3 RECEIVING WATER CONDITIONS

1.3.1 Approach

Characterizing the "condition" or "health" of a stream, lake, or wetland can take many forms. Virtually all studies have a particular impairment or endpoint in mind, be it an evaluation in the context of regulatory standards for water quality, the enhancement of one or more target species, or the identification of locations and types of prospective stream-improvement projects. Although these are all potential focus areas for stormwater resource planning, a more comprehensive organizing framework is useful to ensure that all of the key aspects of watershed health are at least acknowledged, recognizing that data may be more abundant for some aspects than for others.

This report embraces the conceptual framework offered by Karr and Yoder (2004), which uses the biological condition of organisms as the indicator of overall stream or watershed "health" (Figure 1-9). This framework explicitly links the human actions collectively termed "urbanization" with the resulting biological condition, typically the primary end-point of concern and almost always its most sensitive. Urbanization alters the landscape, inflicting stresses on stream biota through a set of water resource features (habitat structure, flow regime, water quality, energy sources, and biotic interactions) that can each be assessed. Meaningful analyses of a disturbed watershed, and ultimately successful rehabilitation of the impacted receiving waters of that watershed, require understanding the many stressors and their interactions that link human actions to biotic changes (e.g., Grimm et al., 2000).

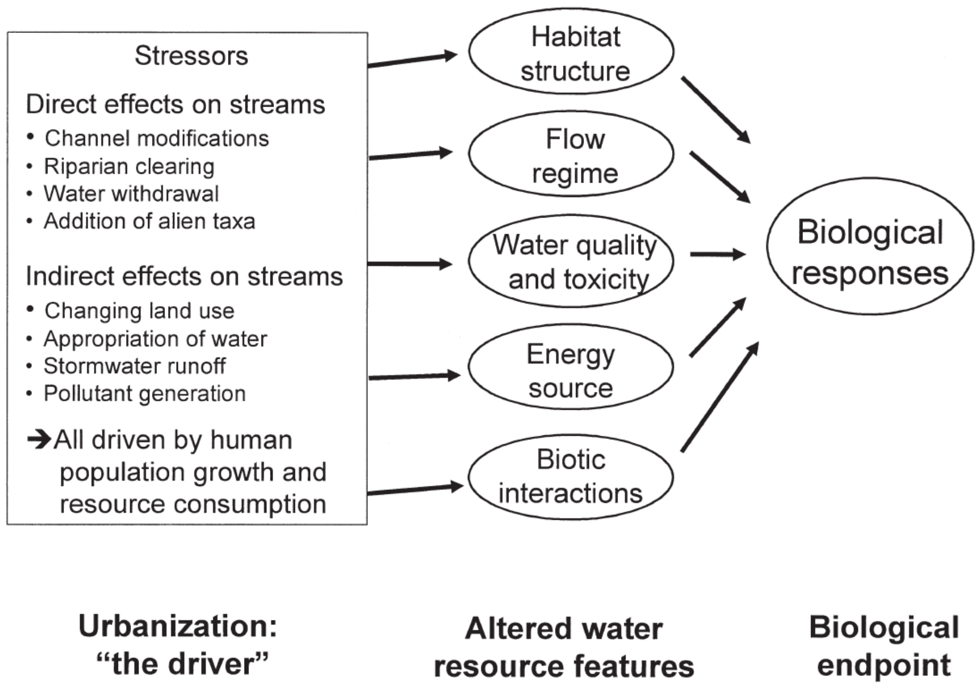


Figure 1-9. Conceptual model of the varied stressors resulting from human actions that alter stream biological condition (Figure 1 of Booth et al. 2004; modified from Karr and Yoder 2004).

1.3.2 Habitat Structure

Substantial prior work has documented habitat conditions, particularly with respect to the life-history needs of south-central California steelhead (*Oncorhynchus mykiss*), throughout the San Luis Obispo Creek watershed. Summaries in the 2002 Watershed Enhancement Plan include a shortage of deep pool habitat as the primary habitat deficiency (Cleveland 1995), particularly along the mainstem above and through the downtown area of the City, and beyond to the confluence with Prefumo Creek. These reaches also lacked riffles, complex instream shelter, and gravel substrate. Farther upstream into the Santa Lucia Range, habitat was severely lacking in instream shelter and pools. Overall, few of the habitat units (13%) had any instream shelter and as much as 70% of the stream had no overhead canopy cover. Also reported throughout the mainstem was a very high level of embeddedness, with 50–100% of the channel substrate covered with fine sediments (Land Conservancy of San Luis Obispo County 2002, p. 19).

A variety of migration barriers for adult steelhead have also been identified by Cleveland (1995), Levine-Fricke-Recon (1998), Payne (2004), California Department of Fish and Wildlife (CDFW), and City staff (see also Figure 1-5). Although not directly related to issues of stormwater management, the abundance of barriers poses a significant obstacle to recovering the full potential of the watershed and its instream resources.

1.3.3 Flow Regime

Given the dearth of long-term flow data on San Luis Obispo Creek, historic conditions and more recent alterations must largely be inferred by analogy to other, long-term flow monitoring sites around the central coast of California, and by the limited characterizations that are available here (e.g., Figure 1-4). A highly variable hydrograph, with dramatic differences in intra- and inter-annual peak discharges, is anticipated in this region regardless of the details of watershed land use or human alteration. The size of relatively frequent, annual-to-decadal peak flows are likely to be increased somewhat by watershed urbanization, but the magnitude of more extreme events will be much more strongly influenced by the vagaries of climate and local weather patterns (Hawley and Bledsoe 2011, Booth et al. 2016).

Of potentially greater consequence are conditions on the other extreme of the hydrograph, namely the period(s) of low or no flow in the channel. Given the strong association of perennial and ephemeral channels with the underlying geology, particularly in areas upgradient of intensive human activity, these conditions can be assumed to have an intrinsic, underlying cause that is independent of subsequent disturbance. However, a variety of activities—particularly groundwater pumping and impervious cover over once-infiltrative soils—are well-known to influence the duration and extent of seasonal drying of stream channels, and these factors are almost surely at play in this watershed as well.

Stillwater Sciences (2014) evaluated instream flow requirements for a number of Central Coast watersheds (including San Luis Obispo Creek) in an effort to determine: (1) what minimum level(s) of flow are needed in spring and summer to support critical life stages of federally listed south-central California steelhead (*Oncorhynchus mykiss*); and (2) which streams are meeting these levels. Sufficient data were available to generate a robust relationship between watershed area and necessary instream flows, a reasonable result insofar as the minimum flow for providing suitable aquatic habitat should vary with channel size (i.e., larger channels require more water to remain 'wet"), and channel size generally scales with watershed area:

For steelhead spring flow requirements,

$$Q = 0.049\ A_{dr} + 0.31;$$

and for steelhead summer flow requirements,

$$Q = 0.012\ A_{dr} + 0.20,$$

where A_{dr} is drainage area in square miles and Q is the estimated minimum flow requirement.

As examples, the minimum flows for the perennial reach of San Luis Obispo Creek where it enters the lower canyon (43.5 mi^2) is 2.4 and 0.7 cubic feet per second (cfs) in spring and summer, respectively; where the channel passes through downtown in the Creekwalk constructed channel (13.2 mi^2) the values are 1.0 cfs (spring) and 0.4 cfs (summer).

These minimum values are typically exceeded in many of the perennial reaches of the San Luis Obispo Creek channel network; conversely, they are obviously not met at all where and when the channel goes dry. Discriminating those reaches with an intrinsic propensity for drying from those where human disturbance has reduced flows below critical levels is a future task for a subsequent project. Even without full information, however, the most promising areas for such action can be inferred—they are likely to be (1) stream segments where the other water resource features (water quality, physical habitat, etc.) are good and so where correction of flow limitations could yield direct resource benefits; and (2) stream segments immediately adjacent to perennial reaches of the channel, and thus where relatively modest improvements could result in significant extension of the wetted channel network.

1.3.4 Water Quality

Two approaches have been taken to characterize water quality. Over the watershed as a whole, basic water-quality parameter values from the Central Coast Ambient Monitoring Project have been accessed, using the web-based interface at www.ccamp.org, to gain rapid site-by-site inspection of archived monitoring data. More comprehensively, baseline runoff and particulate pollutant loading were estimated within the City of San Luis Obispo and the San Luis Obispo Creek watershed using the Tool to Estimate Load Reductions (TELR). For this plan, TELR has been implemented at two scales: at a relatively detailed level (termed "swTELR") and a more coarse, regional level ("R-TELR"). Maps at both scales are included in this SRP (see Appendix 2 and Appendix 3).

TELR is a spatially distributed hydrologic model, with landscape characteristics and processes represented explicitly throughout a network of urban catchments or regional watersheds to provide average annual runoff and pollutant loading estimates (2NDNATURE 2017). The model has been developed as part of a web-based stormwater tools platform to provide spatially explicit outputs to satisfy MS4 permit reporting requirements and track stormwater mitigation progress over time to reduce reporting compliance effort on the part of permittees (see www.2nform.com). TELR employs the USDA Curve Number technique (USDA-SCS 1986); hydrologic computations combine a set of metrics that describe a 30-year rainfall distribution with spatial drainage characteristics, including impervious cover from the National Land Cover Dataset (NLCD), land use from local parcel assessor layers, soils from the Natural Resource Conservation Service (NRCS), and hydrography from the USGS National Hydrography Data Set (NHD) or local stormwater infrastructure and drainage mapping. Total Suspended Solids (TSS) estimates are used as proxy for other hydrophobic particulate pollutants with a tendency to adsorb to soil participles (e.g. total nitrogen, total phosphorus, bacteria, metals, pesticides/herbicides) via land-use based characteristic runoff concentrations (CRCs). Runoff is expressed in units of ft/yr (i.e., the annual volume of runoff normalized by the catchment area); particulate pollutant loads are expressed in units of tons per acre per year. Model results have been validated against high-resolution monitoring data and continuous simulation models (Beck et al. 2017).

In addition, water-quality data have been collected at several locations in the watershed for many years by a program coordinated by the Central Coast Regional Water Quality Control Board, with the data archived on internet-accessible databases. In particular, the Regional Board has issued two Total Maximum Daily Load (TMDL) designations for San Luis Obispo Creek: one for nutrients (specifically, nitrogen [see http://www.waterboards.ca.gov/centralcoast/water_issues/programs/tmdl/docs/san_luis_obsipo/nutrient/index.shtml]) and one for pathogens (see http://www.waterboards.ca.gov/centralcoast/water_issues/programs/tmdl/docs/san_luis_obsipo/path ogen/index.shtml). For nutrients, monitoring results throughout the watershed have demonstrated that the pollutant is originating from the water reclamation plant and agricultural sources entering the creek primarily downstream of the City. It also shows some improvements over the decade of monitoring, although further actions will still be needed to meet the TMDL target. For pathogens, the spatial pattern suggests a much stronger contribution from the urban parts of the watershed, and with a trend over time that does not yet suggest that corrective measures have been effective in the face of continued urbanization (Figure 1-10).

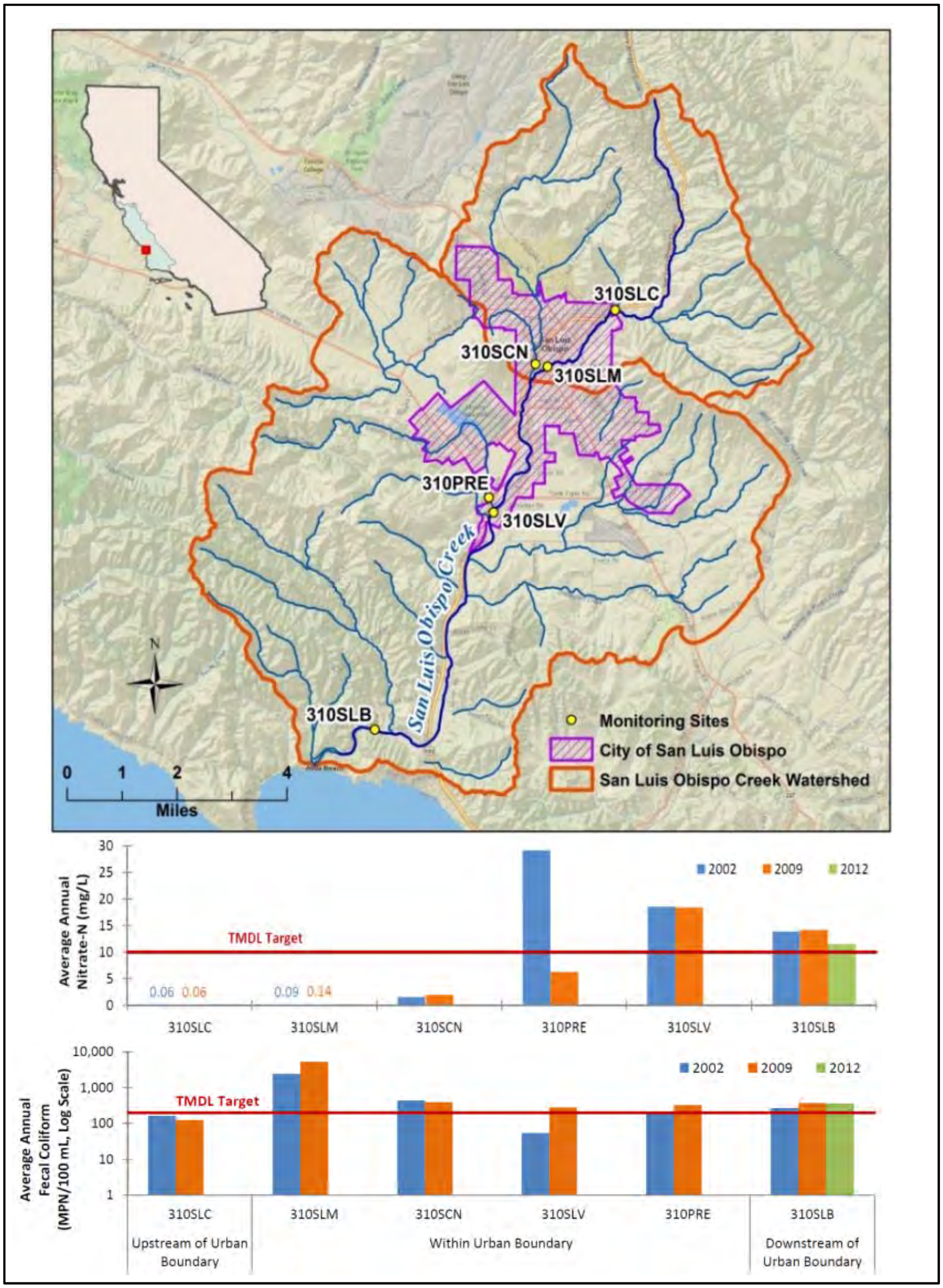


Figure 1-10. Water quality monitoring results for N-nitrogen (top graph) and pathogens (bottom graph) (reproduced from http://www.waterboards.ca.gov/centralcoast/water_issues/programs/tmdl/docs/san_luis_obsipo/nutrient/slo_nut_tmdl_prog_rpt2013.pdf and http://www.waterboards.ca.gov/centralcoast/water_issues/programs/tmdl/docs/san_luis_obsipo/pathogen/slo_path_prog_report_2013.pdf). Yellow circles on the map show the location of sampling sites.

Other data from the Central Coast Ambient Monitoring Program paint a consistent picture of the urban influence on water quality. A year's worth of monitoring data from 2015, summarized from two stations (310SCN [upstream of the downtown area of the City] and 310SLV [downstream of the City]; see Figure 1-10 for locations), show the clear signature of two common stormwater constituents of urban runoff: dissolved copper and dissolved zinc (Figure 1-11). Although the effects of copper specific to steelhead have not been well documented, a variety of studies of the effect of copper on other salmonid species (e.g., Hecht et al. 2007) indicate that biological effects are discernable at concentrations of no more than about 2 parts per billion (micrograms per liter [µg/L]). Prior reports cited in Hecht et al. (2007) have found that chronic concentrations of 12–15 µg/L, similar to those found in San Luis Obispo Creek, are associated with delays in migration, reduction in spawning, and death.

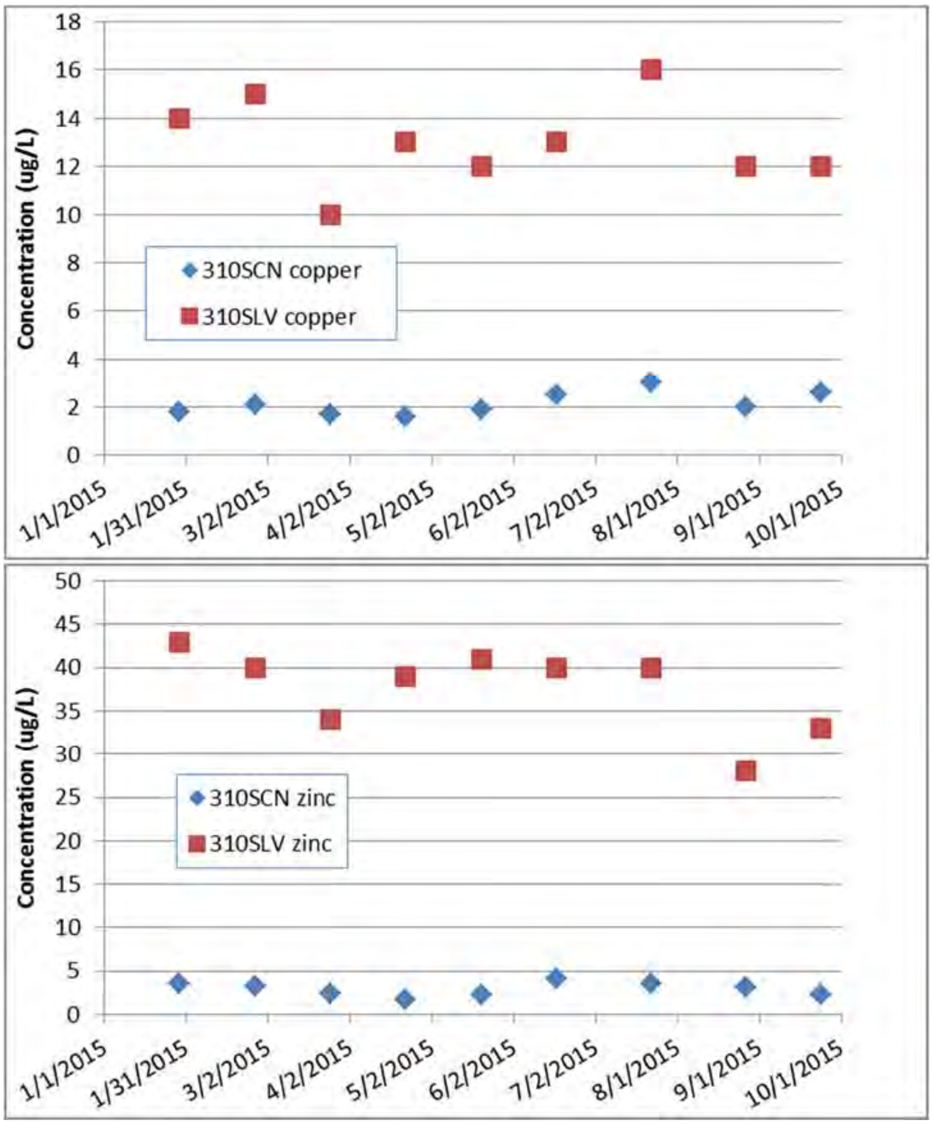


Figure 1-11. Monthly monitoring for copper and zinc, from locations shown in Figure 1-10: 310SCN is just upstream of the City center, 310SLV is downstream. Note the change in y-axis scales between the two graphs.

The City has also conducted its own water quality studies over time, one of which evaluated the correlation between dissolved oxygen (DO) and nitrogen (N) during a period of intensive monitoring in the summer of 2010. This study found no statistically significant correlation between these two parameters, although both DO and the concentration of nitrate-nitrogen (NO_3-N) increased in the downstream direction: DO somewhat modestly, NO_3-N rather substantially (City of San Luis Obispo 2010). A planning-level evaluation of the City's stormwater program (City of San Luis Obispo 2015) further anticipated that pathogens, sediment, and trash would be the highest priority "pollutants of concern" for the program, given the existing TMDL for the former and relatively common incidence of the latter two in urban drainage systems.

1.3.5 Energy Sources and Biotic Interactions

Although "energy sources" (i.e., the tropic structure of the food web that supports instream organisms) and "biotic interactions" (including predation, invasive species, and population dynamics) are two of the water resource features that are key components of stream and watershed health, there is little direct information on either of them in the San Luis Obispo Creek watershed. Although they are clearly influenced in a variety of ways by the interaction of human populations and urbanization with the stream and its riparian zone, they are acknowledged here primarily in the interest of completeness but without the expectation that such considerations will be a significant driver of stormwater management for resource enhancement.

1.3.6 Integrative Measures of Watershed Health

Biota, an integrative measure of aquatic-system "health," has been collected by a variety of studies. The most comprehensive collection of biological data in the Central Coast Region is compiled and maintained by staff of the Regional Water Quality Control Board. It includes data collected as part of the state's Surface Water Ambient Monitoring Program (SWAMP) and other data developed by the Regional Board as part of the Central Coast Ambient Monitoring Program (http://www.ccamp.org/).

In the San Luis Obispo Creek watershed, two mainstem stations and the tributaries of Stenner, Prefumo, and Davenport creeks have been monitored for BMI data sporadically over the past decade, with two years (2002 and 2003) particularly well-represented in all data sets. The farthest upstream station (Figure 1-12), 310SLC in Cuesta Park (see Figure 1-10 for location), lies above most development zones; ranching does persist upstream of the station, and so this may serve as an indicator of conditions in response to predominantly agricultural (but not residential) land uses. EPT taxa (Ephemeroptera = mayfly, Plecoptera = stonefly, Trichoptera = caddisfly) were 10–13 in those two years of monitoring, with 7% intolerant taxa (i.e., taxa that do not thrive in polluted or otherwise impacted waters) and 19–22% tolerant taxa. During a field visit in 2012, aquatic worms (highly tolerant) but no EPT taxa were seen in a cursory examination. In the center of the city on Stenner Creek (310SCN), the channel has been severely stabilized but some habitat features have been constructed; EPT taxa were 2–6 in the same two years, with 0–1% intolerant taxa and 33–41% tolerant taxa. 2012 field observations showed very few individuals, but with less algae than the upstream site and a single mayfly/stonefly. Below most of the urban development (310SLV), the results were 0–1 EPT taxa, 0% intolerant taxa and 36–50% tolerant taxa; in the field, the bed was predominantly sand with heavy algae growth and no EPT taxa observed.

Conditions recover marginally at the BMI station near the mouth of the creek at the Pacific Ocean (310SLB). It has shown relatively few EPT taxa (1–6), low intolerant taxa (one sample at 22%, the others at 0%), and up to 35% tolerant taxa.

Figure 1-12. San Luis Obispo Creek, from its headwaters (ridgeline at extreme right in the GoogleEarth image) downstream through the town of San Luis Obispo (the large urban area at left-center). BMI stations shown with red pins, photo locations are red pins with black dot. Top two photos taken at the

upstream-most site (310SLC), with no upstream urbanization but significant grazing. The lower left photo was taken in the center of town at site 310SCN; the lower right photo was taken below most urbanization at site 310SLV. The distance from the upstream-most site (310SLC) to the downstream-most site shown here (310SLV) is about 4 miles, the Pacific Ocean is an additional ~6 miles downstream.

These instream data have been integrated into the "California Stream Condition Index," a single-valued score for a given monitoring event at a specific location. As described in Rehm et al. (2015, p. 3), "The California Stream Condition Index (CSCI) is a new statewide biological scoring tool that translates complex data about benthic macroinvertebrates (BMIs) found living in a stream into an overall measure of stream health...The CSCI combines two separate types of indices, each of which provides unique information about the biological condition at a stream: a multi-metric index (MMI) that measures ecological structure and function, and an observed-to-expected (O/E) index that measures taxonomic completeness."

Using the CSCI, multiple locations within the San Luis Obispo Creek watershed paint a consistent picture of overall aquatic health. Sampling in 2003 shows a progressive downstream degradation in conditions (Figure 1-13), with the intervals showing the greatest change coinciding with the urban areas of the City of San Luis Obispo.

Figure 1-13. Results from 2003 benthic macroinvertebrate sampling by the Central Coast Ambient Monitoring Program (data plotted and downloaded from www.ccamp.org). From upstream (upper right corner of

the map) to downstream (lower left of map), the station identifiers and their California Steam Conditions Index (CSCI) scores are as follows:

- 310CAW192 (SLO Creek above Reservoir Canyon Creek), 1.031 (“Excellent”)
- 310SLC (San Luis Obispo Creek at Cuesta Park), 0.829 (“Fair”)
- 310CE0276 (Stenner Creek), 0.796 (“Fair”)
- 310CE0724 (SLO Creek above Marsh Street), 0.763 (“Poor”)
- 310CE0308 (SLO Creek below Marsh Street), 0.695 (“Poor”)

Two additional stations farther downstream on the mainstem San Luis Obispo Creek were monitored in 2002–2006 for calculating the Southern California IBI, a prior integrative measure of invertebrate health (Ode et al. 2005); these results are consistent with those of the CSCI in showing a marked loss of stream quality through the downtown area of the City, a condition that does not recover before reaching the Pacific Ocean.

1.4 IMPLICATIONS FOR STORMWATER MANAGEMENT

1.4.1 Watershed Conditions and Pollution-Generating Activities

The existing conditions of the San Luis Obispo Creek watershed summarized in this report highlight several key issues that have guided the subsequent development of the SRP. The fundamental finding is that resource quality and stream health decline monotonically down the channel network, with the most abrupt decline associated with the urban center of the City of San Luis Obispo. Although a variety of direct channel impacts coincide with this zone, the well-documented decline in various in-stream conditions through this area, particularly water quality, is undoubtedly a primary result of urban stormwater runoff.

Although only two Total Daily Maximum Loads (TMDLs) have been identified within the boundaries of the watershed, these few identified impaired waters do not imply an equivalent absence of any pollution-generating activities—only that the intensity of those activities has not been so great as to impose more broad impacts. This stands in contrast to more urban areas of the state, for which their associated stormwater resource plans enumerate a far more extensive (and urban-focused) list of activities and impairments. Many of these activities associated with urban land uses also take place in the San Luis Obispo creek watershed—deposition and wash-off of automobile-sourced pollutants, runoff from commercial areas, home and municipal (over) application of fertilizers and pesticides, and increased runoff (and so increased erosion) originating from impervious surfaces. Their severity is less, however, where the population density, and the sheer area of urbanized land, is less. Thus, the opportunities for restoration and the likelihood of improvements are correspondingly greater here.

The major land uses of the watershed—agriculture, grazing, and urbanization—each impose potentially significant impacts on water resources. Urban areas are a major component of this watershed, and their influence on downstream water quality can be substantial. They also impose a locally significant demand on water supplies, contributing to groundwater depletion and necessitating the construction of habitat-blocking dams to satisfy that need. However, these urban areas also provide many feasible opportunities for active stormwater management—not only to improve the supply/demand balance for water supplies, but also to alleviate downstream impacts from excessive surface flows and/or pollutant loads. Not entirely coincidentally, the urbanized areas of this watershed are located in part or entirely on relatively flat, relatively infiltrative alluvial valley-bottom sediments. Thus, the major elements of most modern stormwater management strategies (retention and infiltration) will prove to be feasible here.

Agriculture and grazing are more challenging to address as sediment- and pollutant-generating activities in the context of a stormwater resource plan. However, some projects that focus on resource enhancement through treatment facilities or floodplain reconnection are credible considerations in an SRP; and other conservation programs and actions outside the scope of this plan are nonetheless ongoing and have significant benefits to downstream resources.

1.4.2 Habitat Conditions

Limited rearing habitat in San Luis Obispo Creek and its tributaries severely constrains available locations for instream summertime occupation by an aquatic species of high concern, namely south-central California steelhead, particularly given the extent of the channel network that does not maintain year-round flow. In the mainstem channels, these seasonally dry reaches largely coincide with geologic conditions conducive to infiltration and thus to water-losing stream segments. Thus, intrinsic watershed properties are likely a primary determinant on the spatial extent and seasonal duration of dry channels, but these attributes are almost certainly influenced by local groundwater conditions as well.

1.4.3 Groundwater

The San Luis Obispo Valley Groundwater Basin was identified in the early 2000's as being in overdraft, a condition that has worsened over the past decade. Impervious cover throughout the central part of the basin associated with development in and around the City has reduced the rate of once-natural recharge into the underlying aquifer, even as it has contributed to increases in the magnitude and flashiness of peak flows in the stream channel itself.

1.5 APPLICABLE PERMITS

The City of San Luis Obispo is subject to three permits under the Clean Water Act: the National Pollutant Discharge Elimination System (NPDES) Phase 2 municipal separate storm sewer system (MS4) permit, and two TMDLs (one each for pathogens and for nutrients). Cal Poly is subject to Section F ("Non–Traditional Small MS4 Permittee Provisions") of the same NPDES MS4 permit. This SRP is most directly responsive to, and guided by, requirements of the MS4 permit. It has somewhat less relevance to the TMDLs, for the reasons described below.

1.5.1 NPDES Phase 2 stormwater (MS4) permit

The city is covered under the Phase II Small MS4 General Permit (2013-0001-DWQ), with an issue date of February 5, 2013. This SRP is most directly relevant to Section E.12 of the NPDES permit, the Post-Construction Storm Water Management Program, and in particular section E.12.k, which requires permittees to meet post-construction stormwater management requirements through understanding and application of a watershed-process approach. As described more fully in Section 3 of this SRP, the importance of key watershed processes is inferred from physical attributes of the landscape, and their protection is achieved through measures that are tailored to those physical attributes (and grouped into "Watershed Management Zones" [WMZs]). This SRP uses the prior mapping of WMZs as the foundation of its analyses and recommendations.

1.5.2 Pathogen TMDL

San Luis Obispo Creek was originally placed on the 303(d) list in 1996 when it was found that pathogen levels exceeded levels for protection of the Water Contact Recreation (REC-1) beneficial use. In May 2016, after collecting water quality data for 10 years without finding sufficient improvement, additional efforts have been implemented to achieve better outcomes. They are based on the results of DNA analyses, which strongly suggest that avian sources (particularly roosting pigeons in the tunnels through which the creek passes) are dominant, with less significant contributions from cows, domestic pets, and human sources. Efforts to reduce these inputs include greater engagement with Cal Poly and the County of San Luis Obispo for source reduction in the upper watershed, conducting land owner outreach and assistance to initiate a riparian fencing program to limit livestock from getting into the creek system. The City has focused on a suite of investigations in the downtown core, downstream of the tunnels where the pathogen levels skyrocket. These include a variety of pigeon-abatement projects, drain inlet filter installations, and sewer line inspections and upgrades, none of which are affected by or influence this SRP.

Of more direct relevance to meeting the goals of the TMDL is the management of surface runoff from the urban surfaces of the City, particularly roadways, which are undoubtedly contributory to some degree to the pathogen loadings in the creek. This SRP emphasizes those stormwater control measures (herein termed "SCMs", following NRC 2009), particularly those emphasizing infiltration, that should be well-suited to the soils and topography of the City proper and that are highly effective at reducing pathogen loads. Although not a major source, the treatment of stormwater from these areas using the approaches identified in the SRP should contribute to the attainment of TMDL objectives.

See LINK; *TMDL approved December 3, 2004*

1.5.3 Nutrient TMDL

In contrast to the Pathogen TMDL, the nutrient TMDL for San Luis Obispo Creek is focused almost entirely on discharges from the Water Resource Recovery Facility, which discharges to the creek at the downstream limits of the city. As such, this SRP is not anticipated to make a significant contribution to the attainment of TMDL objectives; however, a significant upgrade to the facility will be completed in the next few years to correct this water-quality problem.

See LINK; *TMDL approved September 9, 2005*

2 COORDINATION AND COLLABORATION IN PLAN DEVELOPMENT

2.1 PUBLIC ENGAGEMENT

In a small city such as San Luis Obispo, public engagement is often most effective in combination with the presentation and discussion of proposals and plans before elected officials. This External Review Draft of the SRP is scheduled to be presented to the City Council on July 5, 2017 for a study session, with the expectation that it may be adopted at that time, in conjunction with the City's effort to re-envision the currently named "Stormwater Program" to be more inclusive of a multiple-benefit watershed approach. As part of this process, this external review draft is being made available for prior public and agency review, following the normal schedule for Council Agenda Reports.

2.2 AGENCY AND COMMUNITY CONSULTATION

Multiple agencies and non-governmental organizations (NGOs) have been consulted in the preparation of this plan. These include:

- Central Coast Salmon Enhancement, Inc., a local NGO
- Coastal San Luis Resource Conservation District
- County of San Luis Obispo
- San Luis CoastKeeper, a local NGO
- The Central Coast Regional Water Board
- The Low Impact Development Initiative (LIDI)
- Two AmeriCorps fellows, engaged through the Local Government Commission

In addition, a variety of City of San Luis Obispo units were consulted, particularly those with an important future role in plan implementation. These include the Water Division (which is involved in many water master planning activities like the Sustainable Groundwater Management Act effort, recycled water expansion, the Water Resource Recovery Facility upgrade to investigate direct potable injection) and the Public Works Department, which is the lead department for the Capital Improvement Plan (CIP) Program at the City. All the projects identified in the plan have been provided to them for review and comment, and for future incorporation of LID features. Cal Poly coordination with the departments of Facilities and Campus Planning were also ongoing throughout plan development.

3 TYPES AND LOCATIONS OF PRIORITY PROJECTS

For projects to be appropriate for meeting the stated goals of the Stormwater Management Plan, identifying what needs to be addressed must be grounded in an understanding of the watershed processes (and their impairment) that are key to maintaining the condition and health of receiving waters. Different project "types" have differing abilities to address those impaired watershed processes, and they also have different criteria for their siting and their evaluation. This chapter introduces the process-based approach that forms the basis of the analysis, and also presents the subdivision of project types that will be applied in the subsequent identification and prioritization of future actions.

3.1 PROCESS-BASED WATERSHED MANAGEMENT

3.1.1 Watershed Processes

"Watershed processes" is the term adopted by the Central Coast Regional Water Quality Control Board to encompass the storage, movement, and delivery of water, chemical constituents, and/or sediment to receiving waters. Their protection or recovery across the urban and urbanizing landscape of the region is the fundamental goal of stormwater management, and this principle guides the analyses and recommendations of this SRP. The association of watershed processes with particular attributes of the landscape—specifically, the site geology, its hillslope gradient, and the type of receiving water (e.g., a stream or a lake) to which they drain—provide the definition of ten unique "Watershed Management Zones" (WMZs) that identify both the critical attributes of the landscape from a watershed-process perspective and the types of stormwater management that is necessary to protect those processes (CCRWQCB 2013).

Wherever impervious surfaces replace grasslands and forest, the watershed processes that control the movement of water across the landscape is radically altered. Nearly all of the impairments described in urban streams, except those that physically alter the channel itself, result from one underlying cause: loss of the water-retaining function of the soil and vegetation in the urban landscape. In an undeveloped, vegetated landscape, soil structure and hydrologic behavior are strongly influenced by biological activities that increase soil porosity (the ratio of void space to total soil volume) and the number and size of macropores, and thus the infiltration, storage, and movement of water into and through the soil. Leaf litter on the soil surface dissipates raindrop energy; the soil's organic content reduces detachment of small soil particles and maintains high surface infiltration rates. As a consequence, rainfall commonly infiltrates into the ground surface or is transpired by vegetation.

In an urban landscape, these processes are severely compromised or lost altogether, simply because the upper soil layers and vegetation have been stripped, compacted, or covered with rooftops or pavement. This transformation of the hydrologic regime, from one where subsurface flow once dominated to one where overland flow now dominates, alters the processes of runoff generation throughout the built-up landscape. It can affect not only the in-channel hydrology directly but also its water chemistry and temperature, the rate of sediment transport and erosion of channel banks and bed, and mobilization of once-static channel elements (e.g., large logs). Each of these elements contributes to the support of aquatic biological communities, and their alteration results in a subsequent reduction in biotic health (Karr and Yoder 2004). Other human actions associated with urbanization do not affect stormwater directly but can further amplify the negative consequences on biota. These actions include clearing of riparian vegetation around streams and wetlands, atmospheric pollutants that are subsequently deposited, release of exotic or toxic chemicals into the environment, and channel crossings by roads and utilities.

As a consequence of these transformations resulting from high levels of imperviousness, the watershed processes of infiltration and interflow are commonly converted to surface runoff, increasing runoff volumes and reducing aquifer recharge. In addition, development commonly covers natural surfaces and often introduces non-native vegetation, preventing the natural supply of sediment from reaching receiving waters and reducing the opportunities for chemical and biological transformations of pollutants in runoff into more benign compounds.

3.1.2 Watershed Management Zones of the San Luis Obispo Creek Watershed

The San Luis Obispo Creek watershed is physiographically and geologically diverse; every WMZ except #'s 7 and 8 (which cover the steepest terrain draining to wetlands, large rivers, or the marine nearshore) is represented here. Inside of the City limits, WMZs 1, 3, 4, 6, 9, and 10 are present; outside of the City but within the watershed boundaries, most of these are present as well, together with WMZs 2 and 5. The descriptions of the WMZs, as summarized from CCRWQCB (2013) with specific applicability to the San Luis Obispo watershed, are as follows:

WMZ 1. Drains to stream or to wetland; underlain by Quaternary and Late Tertiary deposits 0-40%, and Early to Mid-Tertiary sed. 0-10%

Attributes and Management Approach: This single WMZ includes almost two-thirds of the urban area of the Region; it is defined by low-gradient deposits (Quaternary and Tertiary in age) together with the moderately sloped areas of these younger deposits that drain to a stream or wetland. The dominant watershed processes in this setting are infiltration into shallow and deeper soil layers; conversely, overland flow is localized and rare. Management strategies should minimize overland flow and promote infiltration, particularly into deeper aquifers if overlying a groundwater basin in its recharge area, as is the case for much of the San Luis Obispo Creek watershed.

WMZ 2. Drains to stream or to wetland; underlain by Early to Mid-Tertiary sed. 10-40%

Attributes and Management Approach: This WMZ is similar to #1 in both materials and watershed processes, but groundwater recharge is anticipated to be less critical in these areas; thus, whereas management strategies need to minimize overland flow as with WMZ #1, they need not emphasize groundwater recharge as the chosen approach to the same degree.

WMZ 3. Drains to stream or to wetland; underlain by Franciscan mélange and Pre-Quaternary crystalline 0-10%

Attributes and Management Approach: This WMZ includes those flat areas of the Region underlain by old, generally impervious rocks with minimal deep infiltration and so not overlying mapped groundwater basins. Although relatively uncommon Region-wide, this WMZ is quite prevalent throughout the eastern part of the City of San Luis Obispo. Overland flow is still uncommon over the surface soil; chemical and biological remediation of runoff, reflecting the slow movement of infiltrated water within the upper soil layer, is the dominant watershed process. Management strategies should promote treatment of runoff through infiltration and/or filtration, and in general by minimizing overland flow.

WMZ 4. Drains to lake, large river, or marine nearshore; underlain by all types 0–10%, and Quaternary and Late Tertiary deposits 10-40%

Attributes and Management Approach: This WMZ covers those areas geologically equivalent to WMZs 1 and 3 but draining to one of the receiving-water types that are not sensitive to changes in flow rates (in this watershed, Laguna Lake). The dominant watershed processes in this low-gradient terrain are those providing chemical and biological remediation of runoff. Virtually all of this area in the watershed also overlies the San Luis Obispo groundwater basin and so also requires a specific focus on infiltrative management to support deep recharge into the underlying aquifer.

WMZ 5. Drains to stream; underlain by Quaternary deposits, Late Tertiary deposits, and Early to Mid-Tertiary sed. >40%
Attributes and Management Approach: These steep, geologically young, and generally infiltrative deposits are critical to the natural delivery of sediment into the drainage system; management strategies should also maintain the high degree of shallow infiltration that reflects the relatively permeable nature of these deposits, although nowhere do they overlie a recognized groundwater basin.

WMZ 6. Drains to stream; underlain by Franciscan mélange and Pre-Quaternary crystalline rocks >40%
Attributes and Management Approach: In the San Luis Obispo Creek watershed, these steeply sloping geologic deposits typically abut WMZ 9, differing only in their increased gradient. They are important to the natural delivery of sediment into the drainage system but have little opportunity for deep infiltration, owing to the physical properties of the underlying rock. Management strategies should maintain natural rates of sediment delivery into natural watercourses but avoid any increase in overland flow beyond natural rates, which are low where undisturbed even in this steep terrain.

WMZ 9. Drains to stream or wetland; underlain by Franciscan mélange and Pre-Quaternary crystalline rocks 10–40%
Attributes and Management Approach: These moderately sloping, older rocks that drain to either a stream or wetland are neither extremely sensitive to changes in infiltrative processes (because the underlying rock types are typically impervious) nor key sources of sediment delivery (because slopes are only moderate in gradient). None include an underlying groundwater basin, emphasizing the relative unimportance of supporting deep infiltration. Overland flow is still uncommon over the surface soil, and so management strategies should apply reasonable care to avoid gross changes in the distribution of runoff between surface and subsurface flow paths.

WMZ 10. Drains to lake and underlain by Pre-Quaternary crystalline rocks 10-40%
Attributes and Management Approach: In the San Lis Obispo Creek watershed, the one area of this WMZ is equivalent to WMZ 9 but drains into a receiving water, Laguna Lake, that is insensitive to changes in runoff rates. It comprises moderately sloped areas that are not anticipated to be key sediment-delivery sources (by virtue of hillslope gradient), draining into a lake that generally does not require natural rates of sediment delivery for its continued health. The area itself of WMZ 10 does not overlie the groundwater basin, suggesting that a broad management focus on deep infiltration is unwarranted.

These conditions and management approaches have been summarized by CCRWQCB (2013) as follows:

1	Overland flow avoidance, groundwater recharge / interflow, evapotranspiration
2	Overland flow avoidance / groundwater recharge, interflow, evapotranspiration
3	Chemical & bio transformations / overland flow avoidance, evapotranspiration
4	Chemical & bio transformations (*)/
5	Delivery of sediment / groundwater recharge, interflow, evapotranspiration
6	Delivery of sediment / avoidance of overland flow, evapotranspiration
7	Delivery of sediment / (*) *[not present in San Luis Obispo Creek watershed]*
8	/ groundwater recharge, interflow, evapotranspiration *[not present in San Luis Obispo Creek watershed]*
9	/ overland flow avoidance, evapotranspiration
10	/ (*) *[not present in San Luis Obispo Creek watershed]*

- Processes listed before the "/" = key watershed processes; of primary concern for protection; should be subject to most stringent numerical criteria.
- Processes listed after the "/" = watershed processes of less critical importance; could be subject to less stringent numerical criteria.
- (*) denotes areas that do not require protection of the process of groundwater recharge *unless* underlain by a groundwater basin (may apply in WMZs 4, 7, and 10).

3.2 CALCULATION OF RUNOFF AND POLLUTANT LOADING

The purpose of modeling drainages across the watershed is to help identify those catchment areas with the greatest potential for mitigating stormwater impacts relative to one or more of the five multiple water-resource benefit categories (water quality, water supply, environment, flooding, community) specified in the *Guidelines*. Outputs from this spatial-opportunities analysis are intended to support the quantitative comparison of stormwater projects to identify those that achieve the greatest benefits for runoff control or pollutant reduction. The modeling approach described aligns with State Water Board guidelines to use quantitative metrics for project evaluation via planning-level estimates of runoff pollutant loading across the planning area.

Management objectives of this modeling approach are to:

1. Characterize spatial patterns of stormwater runoff and pollutant loading throughout the watershed;
2. Identify areas where opportunities to mitigate stormwater impacts are greatest; and
3. Provide a basis for quantifying potential reductions that can be integrated with MS4 compliance-based load reduction estimates.

This SRP makes use of the Tool to Estimate Load Reductions (TELR), as noted in Chapter 1. TELR has been implemented at two scales: within the jurisdiction of the City of San Luis Obispo, swTELR ("stormwater TELR") was used to estimate baseline runoff and particulate pollutant loading. Mapping of urban catchment drainages and integration of local spatial datasets was previously completed by City staff with assistance from 2NDNATURE, with individually modeled subcatchments ranging from one to several hundred acres in area. Outputs are available to each permit holder online (www.swterl.com); the maps for the City of San Luis Obispo are also included in this SRP (see Appendix 2).

Outside of these municipal areas, a coarser scale of analysis was applied to develop equivalent results within a tractable analytical framework, given the larger area to be covered. R-TELR ("Regional TELR") was modified from the original TELR framework to provide full coverage across the watershed (and all of San Luis Obispo County), making use of the CalWater Planning Watersheds (http://egis.fire.ca.gov/watershed_mapper/PDF/calw221_with_Fish_ESU_County.htm) as the analysis unit. Ranging from about 7,200 to nearly 20,000 acres each in this watershed, these Planning Watersheds are typically one to two orders of magnitude larger than those used for swTELR, and so the discriminations are correspondingly less precise. However, in combination these applications provide coherent and consistent characterization of runoff and pollutant loadings across the watershed for use in the subsequent stages of this SRP. Particularly at this regional scale, the spatial distribution of high-runoff and high-particulate areas emphasize the importance of increased imperviousness in the generation of runoff and pollutants.

A more complete description of R-TELR is provided in Appendix 3-B of the County SWRP; the regional-scale maps are included in this SRP as Appendix 3.

3.3 APPROACH TO ADDRESSING WATER-QUALITY NEEDS

The approach taken in this SRP to address water-quality needs comprises (1) methods to characterize, and as possible quantify, the spatially explicit generation of pollutant loads throughout the watershed; (2) a compilation of the available structural and non-structural "stormwater control measures (SCMs) to address polluted runoff; and (3) a decision-support framework to evaluate currently proposed capital projects and non-structural programs, and to identify promising new sites based on their potential suitability and value for hosting effective multi-benefit SCMs. The first two items are addressed in this section; the third is the topic of the next chapter in this SRP.

3.3.1 Pollution-Generating Activities

This SRP recognizes two primary *activities* that generate or contribute to polluted runoff or that impair beneficial use of stormwater and dry-weather runoff. The first is urbanization, echoing the findings from the last decade across the United States about the importance of this land use. In acknowledgment of this source's importance, the quantitative analysis of this land use's contribution to pollutant loads has been a primary focus of the Central Coast Region's NPDES MS4 stormwater permit, and its implementation (using swTELR) at a fine spatial scale (10's to 100's of acres) has been recently completed throughout the urban communities and incorporated cities of San Luis Obispo County (including the City of San Luis Obispo).

Unlike many of the other SRPs that have already been completed, this watershed has a second activity that can be a significant pollutant generator, namely cultivated agriculture. Although "stormwater runoff" is not normally associated as closely with this activity as with urbanization, the broadly rural nature of the study area argues for its inclusion in this plan. To support this inclusion, the analytical framework already developed and applied to urban areas has been modified to be applied consistently and comprehensively over all of the non-urban areas (using R-TELR).

3.3.2 Strategies to Address Polluted Runoff

The *strategies* evaluated in this SRP to address the polluted runoff and its sources also fall into two broad categories, mirroring our recognition of the two groups of pollutant-generating land-use categories.

In **urban areas**, we define three types of constructed "projects" and an additional set of programmatic actions that are most likely to achieve the goals of implementing applicable regulatory permits, contributing to the achievement of Total Maximum Daily Loads (TMDL), and satisfying other relevant water quality requirements:

1. Regional- and neighborhood-scale Capital Improvement Projects (CIPs)
2. Parcel-Scale LID for New (Public-Agency) Construction
3. Green Streets

Appendix 3-C of the San Luis Obispo County SWRP provides brief descriptions of the first two project categories, organized by the scale of their intended treatment.

The third category, "Green Streets," embraces a range of municipal street treatments that incorporate Low Impact Development (LID) strategies to capture, store, treat and infiltrate stormwater to provide environmental and urban greening benefits. Pervious pavements, bioswales, bioretention and biofiltration are the most commonly used LID green street design Stormwater Control Measures (SCMs). "Complete streets" is another street design term and defined by the California Department of Transportation as "a transportation facility that is planned, designed, operated, and maintained to provide safe mobility for all users, including bicyclists, pedestrians, transit vehicles, truckers, and motorists, appropriate to the function and context of the facility."

A city and regional identification of candidate green streets includes elimination of areas that generally are not favorable for green street design and inclusion of those streets and areas most likely to meet feasibility requirements. For example, residential streets are generally not ideal for green streets given the number of driveways and parking usage along the street that significantly limit where SCMs can be located. Also, streets without curb/gutter (e.g., soft shoulder) make it difficult to efficiently route stormwater into SCMs and furthermore, the sediment associated with the road shoulder often causes a clogging issue within the SCM. For details of alternative designs, this SRP incorporates by reference the guidance contained in, for example, https://www.centralcoastlidi.org/projects.php.

In **agricultural areas** (and in contrast to urban areas), the focus of pollutant reduction is on programmatic actions, for which the Resource Conservation Districts (RCDs) are uniquely positioned to evaluate and implement. RCDs work with ranchers, farmers, and landowners in the County through technical assistance, financial assistance, and educational workshops on strategies to reduce sediment, nutrient and pesticide loading to surface and groundwaters, and improve irrigation efficiency. Programs such as the Mobile Irrigation Lab are used to complete irrigation efficiency evaluations and make recommendations for irrigation scheduling and system improvements.

3.3.3 Consistency with NPDES Permits

The approach being used in this SRP to evaluate the effectiveness of proposed projects, and to identify optimal locations for new projects to best manage stormwater and dry-weather runoff, is entirely consistent with the current Phase II Small MS4 General Permit (2013-0001-DWQ, issue date February 5, 2013) that covers the City of San Luis Obispo. In particular, Section E.12 of the NPDES permit requires permittees to meet post-construction stormwater management requirements through understanding and application of a watershed-process approach. These requirements include the restoration of watershed processes through site design and runoff reduction, water quality treatment, runoff retention, and peak flow management. Requirements emphasize Low Impact Development treatments; for larger projects, the permit also demand the identification of the Watershed Management Zone(s) for the project and treatments that address the process impairments identified for that zone.

Specific design criteria and best management practices, as specified in Resolution No. R3-2013-0032, include the following:

For site design and runoff reduction: Limit disturbance of creeks and natural drainage features; minimize compaction of highly permeable soils; limit clearing and grading of native vegetation at the site to the minimum area needed to build the project, allow access, and provide fire protection; minimize impervious surfaces by concentrating improvements on the least-sensitive portions of the site, while leaving the remaining land in a natural undisturbed state; and minimize stormwater runoff.

For water quality treatment: In order of declining preference, implement LID treatment systems, implement biofiltration treatment systems, implement non-retention-based treatment systems.

For runoff retention in identified WMZs: Retain the 85^{th} or 95^{th} percentile 24-hour rainfall event using suitable site design, LID-type SCMs, other structural control measures, and/or off-site mitigation if on-site mitigation is demonstrably infeasible.

As described above in Section 3.1, the importance of key watershed processes is inferred from physical attributes of the landscape, and their protection is achieved through measures that are tailored to those physical attributes (and grouped into Watershed Management Zones [WMZs]). This SRP makes full use of the WMZ mapping as the foundation of its analyses and recommendations, and so the actions undertaken with its guidance are fully supportive of the NPDES requirements.

3.3.4 Consistency with TMDLs

Within the watershed, the Central Coast Regional Water Quality Control Board has issued 2 TMDLs, both for San Luis Obispo Creek:

- Nutrient TMDL, approved September 9, 2005
- Pathogen TMDL, approved December 3, 2004

One of the TMDLs is clearly associated with urban land use (San Luis Obispo Creek pathogens); the other is associated with wastewater treatment and falls outside the purview of actions included in this SRP.

3.4 CONCEPTUAL PROJECT TYPES

A variety of sources listing the categories of stormwater control measures (SCMs) have been published or are under active development throughout California and nationwide. Some of the major categories (and some recent local reference sources for their characterization and design) are:

- Regional stormwater capture (San Mateo County 2016)
- Green streets (http://centralcoastlidi.org/, San Mateo County 2016, Ventura County 2016)
- LID retrofits (San Mateo County 2016)
- Bioretention (http://centralcoastlidi.org/, Ventura County 2016)
- LID parking lots (http://centralcoastlidi.org/)

These and other SCMs have been compiled in a near-comprehensive fashion by the California Stormwater Quality Association (CASQA) (Table 3-1; see also Appendix 3-C of the San Luis Obispo County SWRP).

Table 3-1. Compilation of common SCM categories, emphasizing the suitability of particular measures in the various WMZs found in the San Luis Obispo Creek watershed. Modified from Table 14 of CASQA (2010, p. 57).

Stormwater Control Measure (SCM)	Capture and Reuse Suitable for any/all WMZs	Infiltration Optimize for WMZs 1, 2, 4, 5	Filtration[1] Optimize for WMZs 3, 4
Bioretention (infiltration design)		x	x
Bioretention (filtration design)			x
Porous Pavement (infiltration design)		x	x
Porous Pavement (filtration design)			x
Capture/Reuse (cisterns, rain barrels)	x		*x
Vegetated Roofs			x
Soil Amendments		x	x
Downspout Disconnection		x	x
Filter Strips			x
Vegetated Swales			x
Infiltration (Retention) Basins		x	x
Infiltration Trenches		x	x
Dry Wells		x	x
Dry Ponds (Extended Detention Basins)			x
Constructed Wetlands			x
Wet Ponds			x
Media Filters / Filter Basins			x
Proprietary Devices			x
Site planning and design (see Table 3-2)		X	X
* depends on design			
[1]Many filtration SCMs can also result in substantial runoff reduction via infiltration or evapotranspiration.			

The last entry on Table 3-1, "Site planning and design," also provides opportunities for the implementation of nonstructural SCMs (termed "BMPs" in the original table, reproduced below as Table 3-2).

Table 3-2. Elements of site planning and design in the context of Low Impact Development stormwater management. Table reproduced from CASQA (2010, p. 41, Table 6).

Phase	LID Principles (minimization)	LID Principles/ BMPs (mitigation)
Planning	• Preserve natural infiltration capacity • Preserve existing drainage patterns • Protect existing vegetation and sensitive areas	N/A
Design	• Minimize impervious area • Disconnect impervious areas	• Infiltration BMPs • Capture/Reuse BMPs • Filtration BMPs
Construction	• Minimize construction footprint • Minimize unnecessary compaction • Minimize removal of native vegetation and trees	• Revegetate disturbed areas
Occupation	• Implement source control BMPs	• Maintain BMPs appropriately

4 SCREENING, SCORING, AND PRIORITIZING OF SCMs

4.1 METHODOLOGY

The approach taken in this section to identify high-priority, multi-benefit stormwater control measures (SCMs) in the watershed comprises three steps (Figure 4-1):

(1) A decision-support framework to evaluate currently proposed capital projects, and to identify promising sites for new capital and/or programmatic projects, for their suitability and effectiveness at achieving multiple benefits from stormwater and dry-weather runoff. This is the "Screening" step diagrammed in Figure 4-1.
(2) A template for quantifying the anticipated benefits of capital projects to support their prioritization, and a separate template for identifying and summarizing the non-quantifiable attributes of identified capital projects and non-structural programs ("Scoring" of Figure 4-1).
(3) A summary presentation format to allow stakeholders to make a final prioritization and implementation decisions from amongst identified SCMs, and to identify localities where future actions with the greatest potential benefits might be explored ("Prioritization" of Figure 4-1).

As noted in Step 1 above, this approach recognizes two related, yet somewhat independent, applications. In most previously submitted SWRPs, the first (and commonly only) evaluation is of previously identified capital projects. However, a framework solely designed to evaluate identified projects and programs is most useful only for those regions with a large existing portfolio of such actions. This is not the case for this watershed, and so Step 1 also seeks to highlight areas that merit *future* consideration, based on promising combinations of opportunity and need for multi-benefit stormwater management. These are termed "Focus Areas" in the present plan.

Figure 4-1 summarizes the approach taken in this SRP. Of note are the three different "types" of evaluations being made in this plan: proposed projects, proposed (non-capital) programs, and what are termed here "Focus Areas." The first type, proposed projects, is the most common subject of other stormwater resource plans—its location is known, the existing stormwater-related problems can be identified, and the project's benefits can be inferred in part or calculated (depending on its stage of design). Proposed programs can also be evaluated, but typically their location is more general and their benefits much harder to define—and so they are evaluated in part separately. The third type, Focus Areas, constitute an essential element of planning for an area without a large backlog of identified projects, but for which current and future problems may demand consideration. These are *not* identified projects and so their evaluation cannot be identical to those of the proposed projects, but evaluating the Planning Watersheds can highlight those areas where future projects or programs might be considered to best effect.

Additional details and background information can be found in the San Luis Obispo County SWRP, on which this method is based.

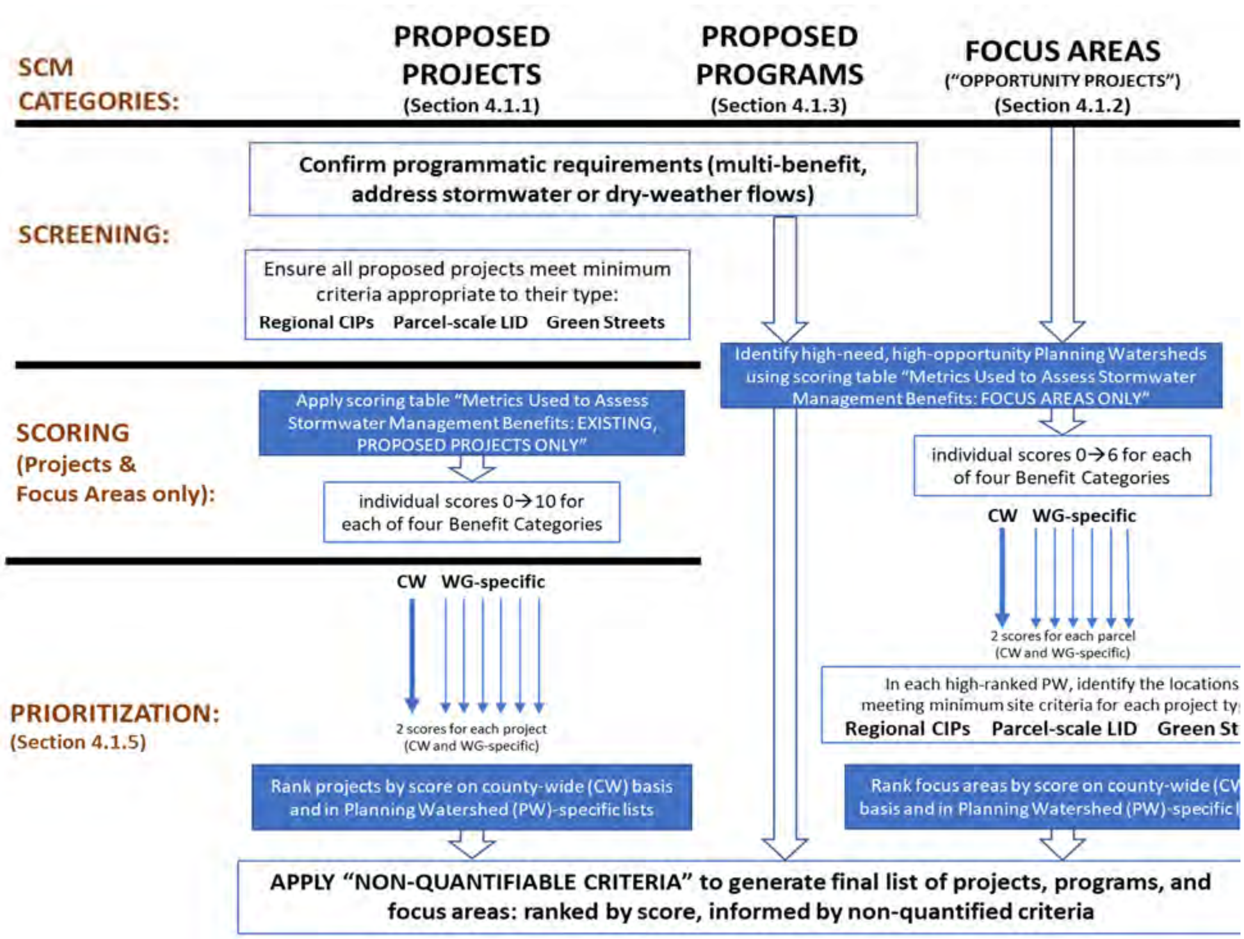


Figure 4-1. Diagram of the main steps leading to the prioritization of projects, programs, and Focus Areas as described in the following sections of this plan.

4.1.1 Screening (Step 1) and Scoring (Step 2) of Identified Projects

The ***screening*** of identified projects begins with the basic criteria articulated in the *Guidelines*:

- Must address hazards, opportunities, and/or resources affected by stormwater or dry weather runoff (p. 21);
- Must provide at least two "Main Benefits" (second column of Table 4 of the *Guidelines*, pp. 30–31, reproduced below as Figure 4-2).

TABLE 4. STORM WATER MANAGEMENT BENEFITS		
Benefit Category	**Main Benefit**	**Additional Benefit**
Water Quality *while contributing to compliance with applicable permit and/or TMDL requirements*	Increased filtration and/or treatment of runoff	Nonpoint source pollution control Reestablished natural water drainage and treatment
Water Supply *through groundwater management and/or runoff capture and use*	Water supply reliability	Water conservation
	Conjunctive use	
Flood Management	Decreased flood risk by reducing runoff rate and/or volume	Reduced sanitary sewer overflows
Environmental	Environmental and habitat protection and improvement, including; - wetland enhancement/creation; - riparian enhancement; and/or - instream flow improvement	Reduced energy use, greenhouse gas emissions, or provides a carbon sink Reestablishment of the natural hydrograph
	Increased urban green space	Water temperature improvements
Community	Employment opportunities provided	Community involvement
	Public education	Enhance and/or create recreational and public use areas

Figure 4-2. Table 4 of the *Guidelines*, providing a list of the "Main Benefits" of which two (or more) must be satisfied by every proposed project in an SWRP. These are distributed amongst the five "Benefit Categories" of Water Quality, Water Supply, Flood Management, Environment, and Community that are each evaluated in subsequent stages of the scoring and prioritization process, described in detail below.

The ***scoring*** of identified projects follows the overarching guidance of the *Guidelines* (p. 21): "Plans shall include a metrics-based and integrated evaluation and analysis of multiple benefits to maximize water supply, water quality, flood management, environmental, and other community benefits within the watershed. (Wat. Code, § 10562, subd.(b)(2)." Table 3 of the *Guidelines* lists some examples of how these benefits might be quantified: these are reproduced with modifications (Table 4-1) to focus on those metrics of potentially greatest feasibility for San Luis Obispo County.

Table 4-1. Examples of how benefits from various SCMs might be quantified (modified from the *Guidelines*, 2015).

Benefit	Example Actions	Example Metric Units
Water Quality (for overall improvement in urban water quality, and to support achievement of TMDLs for pathogens and nitrogen)	Filtration SCMs Protection or reestablishment of natural buffers around receiving waters	**Treatment Design Storm** 85% 24-hr storm volume, 95% 24-hr storm volume **Pollutant Load Reduction** lbs/day, kg/day
Water Supply (through stormwater infiltration, and/or runoff capture and use	Infiltration SCMs Runoff capture SCMs	**Volume Infiltrated or Captured** acre-feet per year (afy)
Flood Management (through peak flow reduction)	Reducing runoff rates and/or volumes through infiltration, capture, and/or detention	**Volume Infiltrated or Captured** million gallons per day (mgd) **Flow Reduction** reduction in cfs
Environmental (habitat improvement, low-flow augmentation)	Riparian buffer protection or enhancement Infiltration/groundwater recharge SCMs	**Buffer Expansion** acres, linear feet **Infiltration Design Storm** 85% 24-hr storm volume **Biological Improvements** California Stream Condition Index
Community	Enhanced and/or created recreational and public use areas Community involvement through workshops Public education	**Size** number of residents served, acres of open space created/protected

For this watershed, quantification is feasible for some but not all of the benefits suggested by Table 4-1. Unlike many other plans, covering more broadly urban areas with greater resources and a longer history of intensive stormwater management, quantification of all prospective benefits would require development of a hydrologic model of the watershed, a task that is beyond the resources of a small city and unnecessary as well. Progress on the two TMDLs in the watershed would not be advanced by water-quality monitoring; the nutrient TMDL is associated with wastewater treatment-plant discharges, and pathogens are notoriously difficult to model with any credible accuracy (e.g., Blaustein et al. 2015).

This plan also considers quantification of “Community benefits” an imposition of false precision onto what are largely qualitative judgments. Although a few select program types may be amenable to comparison via quantitative metrics (e.g., number of students served by educational outreach), the majority of this benefit category is best characterized by more qualitative evaluations. They are included in the application of non-quantified criteria as part of the final prioritization of projects. This exclusion of quantified community benefits is not intended to downplay their importance, only the methodology used to evaluate the contribution made to them by a project or program. Such benefits can include public education about the importance of source control, maintaining pervious landscaping, and stormwater management in general; community involvement through participation in workshops, neighborhood plantings, and trash clean-ups; environmental justice, by targeting disadvantaged communities for pollution remediation where the impacts are commonly greatest; recreation and aesthetic enjoyment, because an LID bioswale or green street is a far more enjoyable site than a fenced-in detention pond; and employment opportunities, because all of these facilities will need to be built. These types of considerations are included in the non-quantitative evaluation where they are more appropriately evaluated.

4.1.1.1 Screening criteria by project type

Beyond the two fundamental programmatic requirements (address stormwater or dry weather runoff and provide at least two “Main Benefits”), a more focused project-type-specific evaluation of minimum criteria is also necessary. It is anticipated that proposed projects will, in general, have already been determined to meet these criteria, but their explicit articulation here can also provide a useful framework for the initial screening of future project sites. The following criteria are anticipated to reflect the conditions needed for successful and cost-effective implementation of multi-benefit projects, as discriminated by their three main types:

<u>Regional- and Neighborhood-Scale CIPs</u>

1. Public parcel ownership
2. Minimum parcel size 0.25 acres
3. Undeveloped or only lightly developed land use (e.g. parkland)
4. Parcel slope <10%

<u>Parcel-Scale LID</u>

1. Public parcel ownership
2. Small parcel size (<0.25 acres, to discriminate from “regional” projects)

<u>Green Streets</u>

For candidate green streets, their preliminary screening is more nuanced, reflecting much prior work already accomplished by jurisdictions and nonprofit groups throughout the Central Coast region. The following factors generally indicate a higher likelihood of feasibility:

- *Moderate traffic streets* - this street type often has a relatively wide right-of-way that may provide space for integration of green street SCMs and tends to not have limitations associated with residential streets (e.g., parking demand, driveways). High-traffic streets such as freeways were excluded as candidate green streets, although stormwater designs can be integrated into these areas as part of a regional or centralized design approach (e.g., long linear water quality swales, large detention/retention basins).

- *Commercial land use areas* - These areas are more likely to include a curb/gutter system that helps to design routing of stormwater in/out of the SCMs and street widths can be favorable for SCM siting. Commercial land use areas often have is existing stormwater infrastructure that may be needed to connect SCM undrains when native soil infiltration rates are not adequate. Furthermore, streets within the commercial land use areas are often the focus of economic viability, urban greening and community aesthetics goals.

- *Street grade* - a longitudinal street slope of 2%-5% is ideal for routing stormwater in/out of SCMs as runoff moves along the street length. Streets that are too "flat" make routing stormwater in/out of SCMs difficult while steep slopes present their own engineering challenges in the design of SCMs, which may include weirs or berms to address moderate slopes but generally, the design and associated SCM performance and stability decreases at slopes greater than 6%.

For all three project "types," these criteria emphasize the *Guideline's* requirement to evaluated "opportunities to use existing publicly owned lands and easements" for stormwater treatment facilities. This plan restricts the consideration of such opportunities to public parcels, as identified by county data in GIS, in recognition of the greater ease in implementing such projects on publicly owned or managed land. In the case of identified projects (this section), matters of access or ownership have presumably already been resolved. In the case of prospective future projects ("Focus Areas"), an initial screening of public parcels in accord with the above criteria renders the prospect of identifying future projects a more tractable, feasible task.

4.1.1.2 Quantifiable scoring criteria

For those identified projects that meet the above screening criteria, their anticipated performance across the quantifiable benefit categories of Water Quality, Water Supply, Flood Management, and Environment are evaluated based on available project information to the extent possible, using the criteria summarized below and in Table 4-2.

The quantitative metrics used to score identified stormwater projects have been selected to measure the needs and opportunities presented by the Planning Watershed under consideration, and (for projects) the ability to achieve benefits within the four categories identified by the 2015 *Guidelines* (Water Quality, Water Supply, Flood Management, and Environment). The fifth benefit category, Community, is rated only with nonquantifiable metrics, given the qualitative nature of its criteria.

To receive a non-zero score in any of the categories, projects must first meet the basic criterion for that category before being considered under the subsidiary criteria. For each category, the basic criterion is as follows:

- Water Quality: must remove pollutants from stormwater or dry weather runoff via chemical, physical, and/or biological processes.
- Water Supply: must reduce net municipal or agricultural consumption through direct reuse or aquifer recharge of stormwater runoff.
- Flood Management: must reduce runoff rates or volumes of stormwater runoff.
- Environment: must restore/protect watershed and/or ecological processes impacted by stormwater or dry weather runoff.

These articulate the underlying intent of a stormwater resource plan—to identify projects and programs that preserve, restore, or enhance watershed processes to yield a broad suite of water quality benefits and support beneficial uses.

All proposed projects are assumed to meet the fundamental requirements of all stormwater resource plans (namely, address stormwater or dry-weather flows and achieve more than one main benefit). The projects are also assumed to be feasible given site requirements for the identified project type. Following this screening, project benefits are quantified for each of the benefit categories through the evaluation and scoring of four to six metrics (Table 4-2), whose maximum values sum to 10 for each category. These metrics were selected to be measurable for projects at a relatively early stage of siting and design, and which collectively address the importance of the problem(s) being addressed and the potential effectiveness of the project to address them. Scores are either assigned on a "yes/no" basis (i.e., full value or 0 value, denoted in the list below as 1/0, 2/0, etc.) or as a proportional variable that can range continuously from 0 to its maximum value (denoted by 0→1, 0→2, etc.).

The total score for each benefit category (0 to 10 for each) is multiplied by a weighting factor that has been assigned by the Technical Advisory Group, reflecting the locally determined relative importance of each category. These weightings total 100%, and so the sum of the weighted benefit-category scores is a final value for project, based on its quantified metrics, that can range from 0 to 10.

- Quantified metrics for **Water Quality Benefits** include evaluation of the treatment design storm, nature and condition of the downstream receiving water, and predicted loadings from the catchment (the latter expressed in tons per acre per year of Total Suspended Solids). Pollution reduction from the project are also quantified from information on the project's design (if possible), using a spreadsheet-based model of runoff volumes and literature-based event mean concentrations for a selected group of pollutants. To maintain consistency of evaluating projects with both quantified and unquantified pollutant load reductions, these results do not influence project scoring but do inform the overall prioritization framework (see Section 4.1.4) and are available for subsequent stages of project definition and development (including preparation of proposals for grant funding).
- Quantified metrics for **Water-Supply Augmentation** make use of the predicted magnitude of infiltration or water reuse, if available, together with measures of infiltration feasibility and the current and future adequacy of groundwater supplies.

- Quantified metrics for **Flood Management** make use of the predicted magnitude of infiltrated or otherwise detained water, the presence of existing downstream flooding problems, and the predicted magnitude of runoff (modeled by TELR in units of ft/yr).
- Quantified metrics for **Environment** emphasize the size of protected or restored habitat, and the magnitude of flow restoration provided through infiltration.

More complete descriptions and rationale for each of the metrics can be found in Appendix 4-A of the San Luis Obispo County SWRP.

Table 4-2. Summary of quantified metrics for existing projects. Each category combines two types of metrics: the first set of metrics (shaded), totaling a maximum of 4 points, depends on the specific project design; the second set of metrics, totaling a maximum of 6 points, depends on the designated project location. Data to support this second set of metrics is provided in Chapter 1. "Yes/No" criteria are denoted as "2/0"; scaled criteria, with a range of values, are denoted as "0→2" (or other values as indicated).

BENEFIT CATEGORY and associated metrics	METRIC VALUES (sum for total)
WATER QUALITY: to receive a non-zero project score, project must remove pollutants from stormwater or dry weather runoff via chemical, physical, and/or biological processes	
Designed for treatment of the 85% 24-hr storm volume (Y/N)	2/0
Designed for treatment of the 95% 24-hr storm volume (Y/N)	1/0
Treats dry-weather flows	1/0
Sensitive downstream receiving water (WMZs 1, 2, 3, 5, 6, 8, or 9) (Y/N)	2/0
Specific TMDL or 303(d)-listed pollutants in downstream receiving water (including groundwater used for water supply) (Y/N)	2/0
TELR TSS loading in catchment (scaled, minimum to maximum loading county-wide)	0→2
SUM	**(0→10)**
WATER SUPPLY: to receive a non-zero project score, project must reduce net municipal or agricultural consumption through direct reuse or aquifer recharge of stormwater runoff	
Designed to infiltrate or otherwise reuse water (Y/N)	1/0
Projected quantity of water infiltrated or otherwise reused (scaled volume, minimum to maximum value of all proposed projects) (annual volume)	0→3
Overlies infiltration-favorable WMZ (WMZs 1, 2, 4, 5, 8) (Y/N)	2/0
In current supply-limited area (scaled, ground subsidence from 0 to maximum value, county-wide) (identified "critical groundwater areas" = maximum value)	0→3
In projected future supply-limited area (scaled, groundwater dependence index from 0 to maximum value, county-wide) (identified "critical groundwater areas" = maximum value)	0→1
SUM	**(0→10)**
FLOOD MANAGEMENT: to receive a non-zero project score, project must reduce runoff rates or volumes of stormwater runoff	
Designed to infiltrate or otherwise detain water (Y/N)	1/0
Quantity of water infiltrated or otherwise detained (scaled volume, minimum to maximum value of all proposed projects) (maximum facility volume per storm event)	0→3
Existing downstream flooding and/or sedimentation risks to public property and/or human health and safety (Y/N)	4/0
TELR runoff volume in catchment (scaled, minimum to max runoff, county-wide)	0→2
SUM	**(0→10)**

ENVIRONMENT: to receive a non-zero project score, project must restore/protect watershed and/or ecological processes impacted by stormwater or dry weather runoff	
Designed for infiltration of the 85% 24-hr storm volume (Y/N)	2/0
Creates/restores/protects wetland, in-stream, or riparian habitat (scaled by area [0.1 to max score ≥10 acres] or length [1 to max score ≥100 ft])	0→2
Number of at-risk aquatic animal species (from EnviroAtlas) (scaled, 0 to maximum value, county-wide) (https://www.epa.gov/enviroatlas)	0→2
Length of identified critical steelhead habitat within catchment (scaled, 0 to maximum value, county-wide)	0→3
TELR runoff volume in catchment (scaled, minimum to max runoff, county-wide)	0→1
SUM	**(0→10)**

A total score for each project is obtained by multiplying each benefit category sum (which can range from 0 to 10) by a weighting factor. These factors were determined in consultation with the Technical Advisory Committee (TAC) and are specific to the San Luis Obispo Creek watershed (Table 4-3), although these values are similar to others being applied in other watersheds of San Luis Obispo County as part of the County SWRP. A final project score, which can range from 0 to 10, is determined by summing the four weighted benefit category totals.

Table 4-3. Assigned weightings for the benefit category scores. All values in percent and sum to 100%.

BENEFIT CATEGORY	WEIGHTING (%)
Water Quality	25
Water Supply	35
Flood Management	20
Environment	20

4.1.2 Screening (Step 1) and Scoring (Step 2) of Prospective Focus Areas

This SRP has identified "Focus Areas" as those individual Urban Catchments or Planning Watersheds that are likely suitable for hosting one or more multi-benefit SCMs, whether or not any have yet been identified within them. The procedure to identify them makes use of a subset of the quantitative metrics used to score identified stormwater or dry-weather projects (see previous section). As for identified projects, the metrics for scoring potential Focus Areas have been selected to measure the opportunities and needs present in each of the catchments to benefit from actions to improve the four quantified benefit categories identified by the *Guidelines* (Water Quality, Water Supply, Flood Management, and Environment).

An underlying assumption is that all subsequently proposed projects within these Focus Areas will meet the fundamental requirements of all stormwater resource plan projects (namely, address stormwater or dry-weather flows and provide multiple benefits). Thus, the purpose of the Focus Area evaluation is not to specify the type or detail of any specific SCM, but rather to identify (1) the Urban Catchments or Planning Watersheds with the highest needs and opportunities for locating beneficial stormwater or dry-weather treatment projects; and (2) within those catchments with the greatest need and opportunity, the parcels that meet the minimum criteria for project feasibility for Regional- and Neighborhood-scale CIPs, Parcel-scale LID, and Green Streets.

The scoring process for Focus Areas is analogous to that for identified projects. Needs and opportunities, at an Urban Catchment or Planning Watershed scale, are quantified for each of the benefit categories through the evaluation and scoring of up to three metrics, all of which overlap with the Identified Projects metrics (previous section) and whose maximum values sum to 6 within each category. These metrics were selected to be project-independent, evaluating the existing risks to resources and the opportunity for successful implementation, using available data and accessible through GIS. Scores are either assigned on a "yes/no" basis (i.e., full value or 0 value, denoted in the list below as 1/0, 2/0, etc.) or as a proportional variable that can range continuously from 0 to its maximum value (denoted by 0→1, 0→2, etc.). They are summarized in Table 4-4, with more complete descriptions and the range of observed values across San Luis Obispo County included in the County's SWRP.

The total score for each benefit category (0 to 6 for each) is multiplied by the same weighting factor (Table 4-3), reflecting the locally determined relative importance of each category. These weightings total 100%, and so the sum of the weighted benefit-category scores provides a final value for each Planning Watershed, based on its quantified metrics, that can range from 0 to 6.

Table 4-4. Summary of the quantified criteria and scores applied to Planning Watersheds to identify Focus Areas for potential future SCM design and implementation.

BENEFIT CATEGORY and associated metrics	METRIC VALUES (sum for total)
WATER QUALITY	
Sensitive downstream receiving water (WMZs 1, 2, 3, 5, 6, 8, or 9) (Y/N)	2/0
Specific TMDL or 303(d)-listed pollutants in downstream receiving water (including groundwater used for water supply) (Y/N)	2/0
TELR TSS loading in catchment (scaled, minimum to maximum loading county-wide)	0→2
SUM	**(0→6)**

WATER SUPPLY	
Overlies infiltration-favorable WMZ (WMZs 1, 2, 4, 5, 8) (Y/N)	2/0
In current supply-limited area (scaled, ground subsidence from 0 to maximum value, county-wide) (identified "critical groundwater areas" = maximum value)	0→3
In projected future supply-limited area (scaled, groundwater dependence index from 0 to maximum value, county-wide) ("critical groundwater areas" = maximum)	0→1
SUM	**(0→6)**
FLOOD MANAGEMENT	
Existing downstream flooding and/or sedimentation risks to public property and/or human health and safety (Y/N)	4/0
TELR runoff volume in catchment (scaled, minimum to max runoff, county-wide)	0→2
SUM	**(0→6)**
ENVIRONMENT	
Number of at-risk aquatic animal species (from EnviroAtlas) (scaled, 0 to maximum value, county-wide) (https://www.epa.gov/enviroatlas)	0→2
Length of identified critical steelhead habitat within catchment (scaled, 0 to maximum value, county-wide)	0→3
TELR runoff volume in catchment (scaled, minimum to max runoff, county-wide)	0→1
SUM	**(0→6)**

Within the watershed, all publicly owned parcels were identified in GIS on the basis of Assessor's records and evaluated for potential suitability of regional-, neighborhood-, or parcel-scale projects using the criteria of Section 4.1.1.1. Suitability for green streets was evaluated throughout the City of San Luis Obispo, based on the likelihood that only these roadways would be high priorities for active stormwater management for many years to come.

4.1.3 Evaluation of Programs (non-capital projects)

Following the lead of other SWRPs, programs and other non-structural projects are evaluated using non-quantified criteria only (next section). An additional screening, that of the priority Urban Catchments or Planning Watersheds from the procedure outlined in Section 4.1.2 (above), can inform the prioritization of these types of actions.

The evaluation of programs highlights both the utility and the limitations of this screening process, for the following reasons:

- Programs often provide multiple benefits but ultimate outcomes are very difficult to quantify.
- Programs don't necessarily have defined locations within a city or county.
- Benefits are varied and often fall outside of pure stormwater management objectives.

- Community benefits may be more defined with programs than other actions, and so the results are not always comparable with capital projects.

These factors do not preclude the evaluation of program benefits, but the emphasis in the *Guidelines* on quantitative metrics raises the likelihood that capital projects are likely to be prioritized more highly through the stormwater resource planning process. Only through careful attention to the non-quantified criteria evaluation (next section) can this bias be adequately addressed.

4.1.4 Non-Quantified Criteria (Step 3)

A variety of other considerations besides those covered by the quantified metrics (above) typically guide the identification, selection, and implementation of SCMs. For this SRP, these were identified by first compiling a wide range of non-quantified criteria used in several other SWRPs reviewed during the preparation of this work (specifically those for Ventura County, San Mateo County, San Diego County, and Russian River). This list of prospective criteria was presented to the county-wide TAC, who each identified those categories that they considered most important. Those identified in this SRP as "primary" were so identified by 4 or more TAC members; those designated "secondary" were identified by at least two TAC members. A few additional criteria were subsequently added, based on considerations expressed in the *Guidelines* or otherwise offered by State Water Board and local staff. These led to a final compiled list of “yes/no” elements, grouped into five major evaluation categories with 5 elements each, and of which two are “primary” (Table 4-5). Although comprehensive, this approach is also rather cumbersome to present and its results difficult to digest; thus, a rubric was established to summarize the results for each of the five categories:

- “Full credit”: more than 3 identified attributes, or all "primary" criteria, within the evaluation category are met (marked by ● on the summary reporting sheet for identified projects/programs)
- “Partial credit”: two or three identified attributes (marked by ⦿)
- “No credit”: 0 or 1 identified attribute (marked by ○)

Table 4-5. Non-quantified criteria to be evaluated for every identified project and non-structural program, grouped into five "evaluation categories" (Community, Project Readiness, Project Value and Performance, Non-Water-Resource Environmental, and Coordination and Collaboration). Bold-faced criteria were identified as "primary" by the county-wide TAC.

- COMMUNITY
  - **Provides habitat, urban greening, open space to DACs**
  - **Enhances/creates recreational and public use areas**
  - Provides public education
  - Provides urban greening (aesthetic, shading, air quality, livability)
  - Provides community involvement
- PROJECT READINESS
  - **O&M funding secured**
  - **Funding is committed**
  - Project site secured
  - Benefits quantified
  - Near-construction-ready design complete
- PROJECT VALUE AND PERFORMANCE
  - **Projects located on public land (State Board Priority)**
  - **Cost <$50k or otherwise feasible w/o external funding**
  - Supports regulatory compliance
  - Quantified reductions in pollutants or volume are significant
  - Efficient O&M (< 1 action/year required)
- ENVIRONMENTAL (non-water resource)
  - **Offers climate change resiliency**
  - **Protects / increases native vegetation**
  - Greenhouse gas emission reduction
  - Provides a carbon sink
  - Reduces heat island effect
- COORDINATION & COLLABORATION
  - **Meets multiple agency objectives**
  - **Funding is leveraged**
  - Public/stakeholder engagement
  - Supports broader effort (e.g., link in contiguous wildlife corridor)
  - Identified in prior plan or planning process

4.1.5 Prioritization of Identified Projects and Programs (Step 3, cont.)

The process described in the prior sections give rise to three key summary elements, which are displayed in a list that includes every identified project and program:

(1) The quantified metric score for each project (i.e., the weighted sum of the four benefit-category scores) (from Tables 4-2 and 4-3);

(2) The summary rating for the five non-quantified evaluation categories (Table 4-5) for both projects and programs; and

(3) The estimated cost of implementation (if available), to a level of precision appropriate for the stage of design.

4.2 APPLICATION OF THE SCREENING, SCORING, AND PRIORITIZATION CRITERIA

As of the preparation of this initial version of the San Luis Obispo Creek SRP, three projects within the watershed (Table 4-6) have been identified, scored, and prioritized in accordance with the approach described in Section 4.1. In addition, four County-wide programs (which would have applicability within this watershed) have been identified in the San Luis Obispo County SWRP; they are included in the following tabulation as well.

Table 4-6. List of projects and programs included in this SRP. Project descriptions are provided in Appendix 4; descriptions of the programs, all of which are County-wide, are included in the County SWRP.

Project/Program Name
PROJECTS
Meadow Park Stormwater Capture and Use
Mitchell Park Bioretention
Higuera Widening Project
PROGRAMS (County-wide)
Stormwater Rewards Rebate Program
Region-wide Key Percolation Zone Study
Earth Genius - Educational Programming
Agricultural Water Management

4.2.1 Identified Capital Project SCMs—screening and scoring

Following the approach outlined in Section 4.1.1, the 3 identified projects have summary scores as listed in Table 4-7 and mapped in Figure 4-3. The complete scoring results are provided as Appendix 5.

Table 4-7. List of identified projects and their final scores. See Appendix 5 for the components of these summary scores.

Project Name	Score
Meadow Park Capture and Use	3.3
Mitchell Park Bioretention	7.2
Higuera Widening Project	1.4

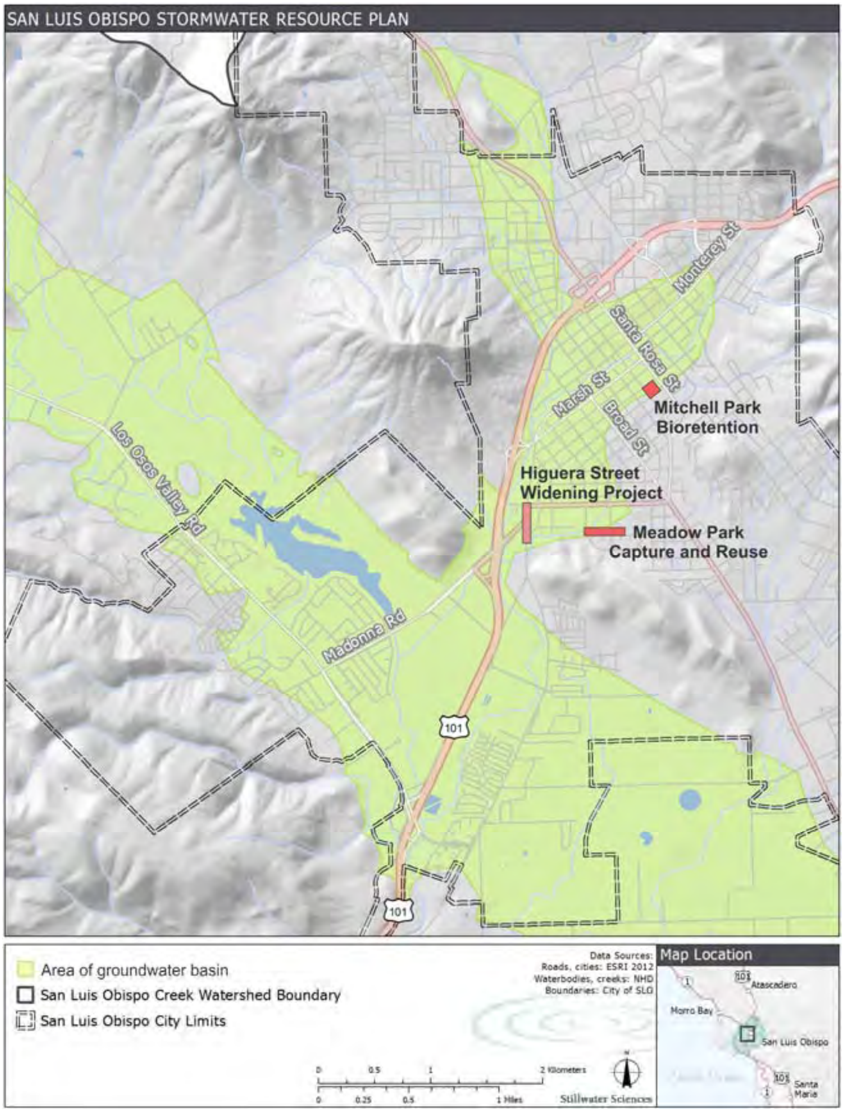


Figure 4-3. Map of identified project locations within the City of San Luis Obispo.

4.2.2 Focus Areas for Prospective SCMs—screening and scoring

4.2.2.1 Scoring of Planning Watersheds

Following the approach outlined in Section 4.1.2, each of the five CalWater Planning Watersheds that constitute the San Luis Obispo Creek watershed were scored and stratified (Table 4-8). The complete scoring results are tabulated in Appendix 6.

Table 4-8. Focus-area scoring for the five Planning Watersheds the constitute the watershed (see Appendix 6 for full results).

CALWATER ID NUMBER	NAME	ACRES	TOTAL SCORE
6162	Stenner Lake	7,259	**4.36**
6172	Reservoir Canyon	7,999	**4.24**
6196	Laguna Lake	18,172	**4.39**
6219	Prefumo Canyon	9,531	**3.60**
6231	Sea Canyon	10,131	**3.57**

4.2.2.2 Identification of prospective capital project sites on public parcels

Within the City of San Luis Obispo, screening of potential Regional-, Neighborhood-, and Parcel-scale capital projects began with the evaluation of public parcels, as described above. They are displayed in Figure 4-4 and listed in Appendix 7.

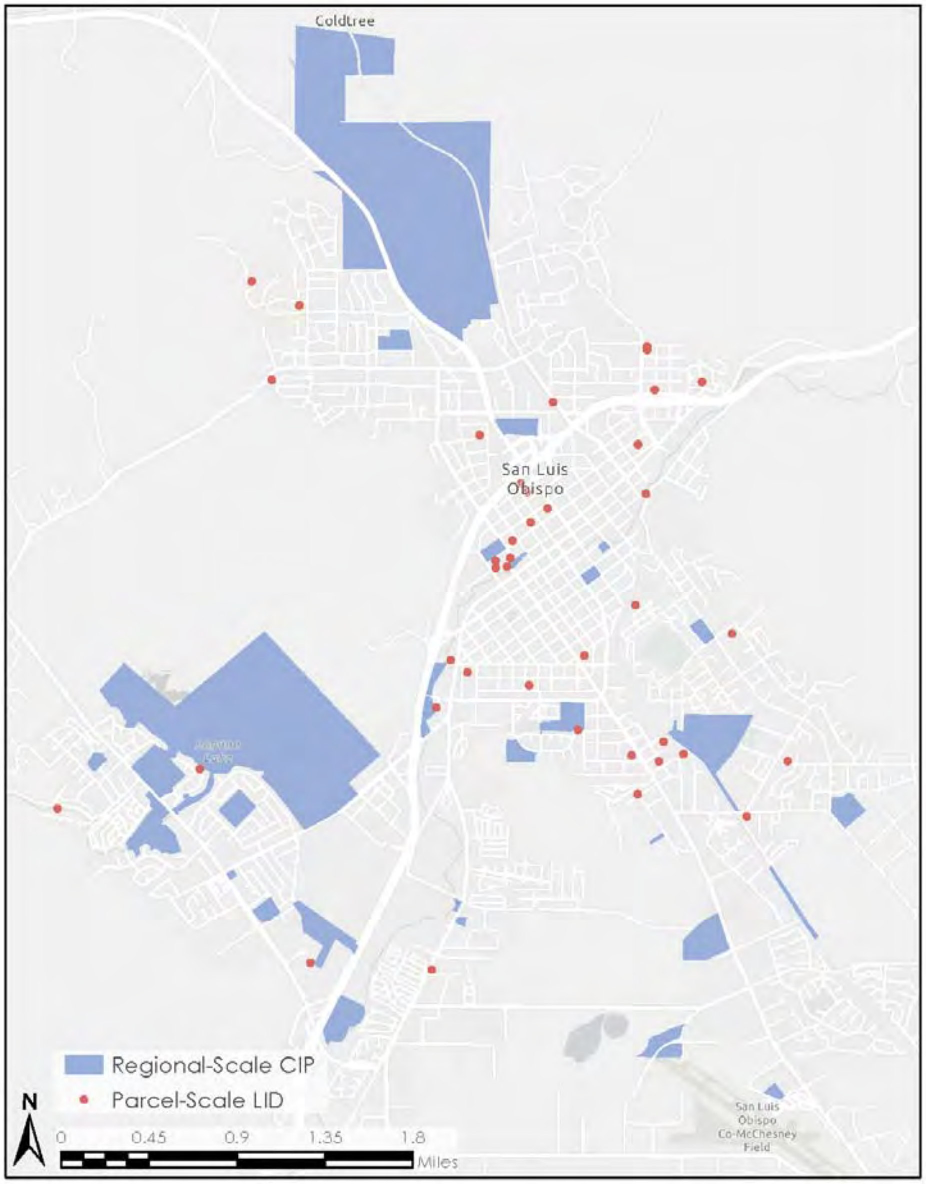


Figure 4-4. Blue polygons identify the public parcels that meet the criteria for Regional- and Neighborhood-scale CIPs (i.e., public land; any NLCD category except 22, 23, 24; within WMZ 1, 2, 4, 5, 8; slope <10%; acres > 0.25). The red dots identify the public parcels that meet the criteria for parcel-scale LID treatments (public land, acres <0.25; too small to outline at map scale). Parcels are listed in Appendix 7.

4.2.2.3 Identification of prospective green streets

Using the criteria for identifying potentially high-feasibility green streets, and in consultation with the potential host municipality, a one potential high-priority green street retrofit location was identified:

City of San Luis Obispo:

1. Slack Street (bound by Longview Lane and 1 block east of Henderson at street end) (2,242 ft)

This road segment, and other that meet the basic criteria for feasibility, are mapped on Figure 4-5.

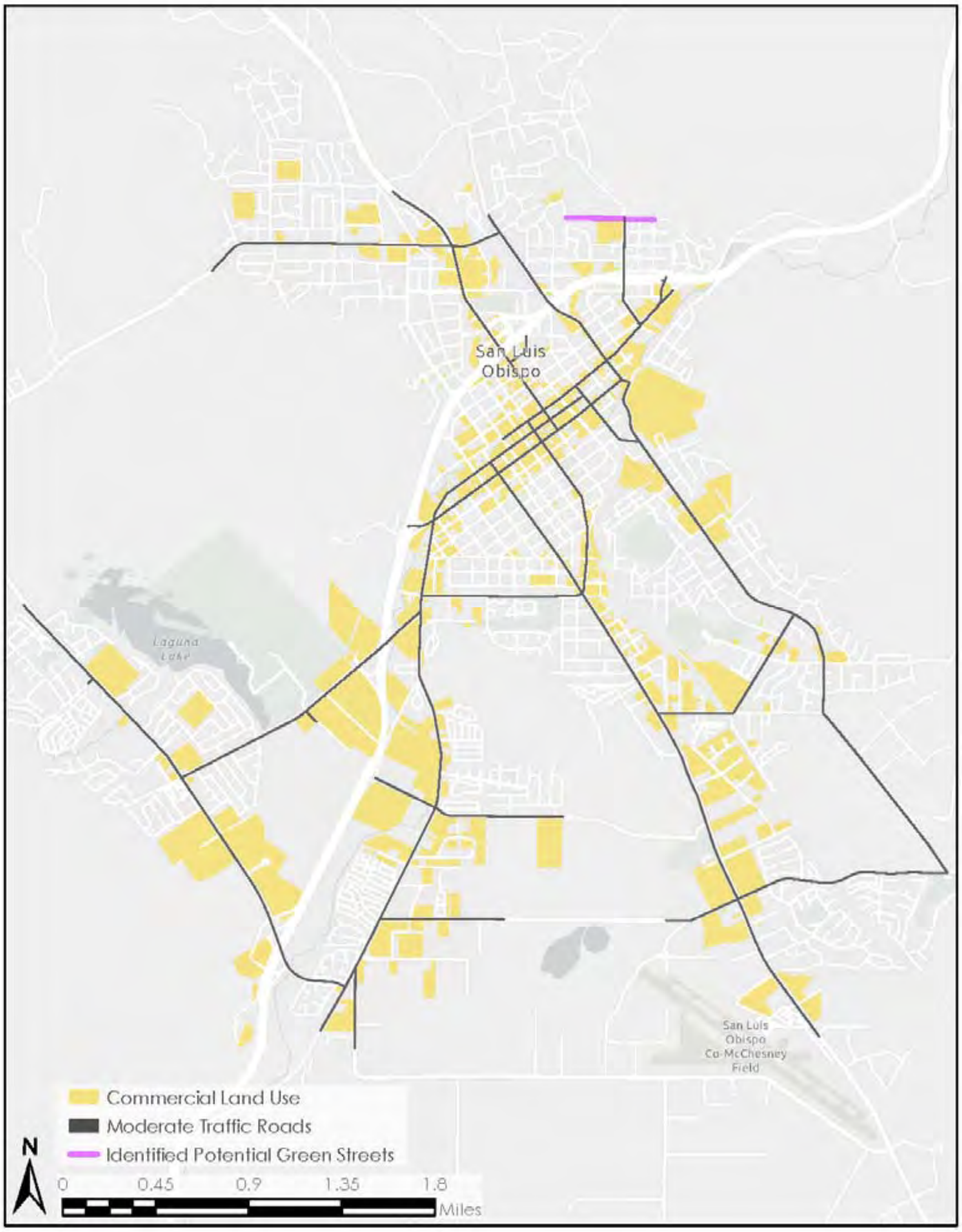


Figure 4-5. Potential green street segments in the watershed. A list of all such street segments is provided in Appendix 8.

4.2.3 Prioritization of Projects and Programs

Prioritization of SCMs in this plan is a two-step process. The first is the assignment and summarizing of non-quantified benefits (Section 4.1.4), and the second is the presentation of quantified benefits, non-quantified benefits, and cost in a set of ranked lists. These results are presented in Table 4-9. This summary, with the associated detailed breakdowns of scores and ratings provided in the appendices, is intended to provide stakeholders with the information necessary to advance projects and programs forward towards implementation.

Table 4-9. Summary table of project and County-wide program scores, non-quantified metrics, and cost, listed in quantitative metric-score order.

	METRIC SCORE	COMMUNITY	PROJECT READINESS	PROJECT VALUE AND PERFORMANCE	ENVIRONMENT (non-water resource)	COORDINATION & COLLABORATION	ESTIMATED COST
PROJECTS:							
Mitchell Park Bioretention	3.3	●	⦿	●	●	○	$50,000
Meadow Park Capture and Use	7.2	⦿	⦿	⦿	○	○	$595,000
Higuera Widening Project	1.4	●	○	○	○	○	unknown
PROGRAMS (County-wide, identified from the County SWRP):							
Stormwater Rewards Rebate Program		●	○	○	●	⦿	$264,000
Region wide Key Percolation Zone Study		⦿	○	○	⦿	○	$56,000
Earth Genius - Educational Programming		●	⦿	●	●	●	$5,000 - $15,000 per school, per year
Agricultural Water Management		(information not presently available)					

● = "Full credit": more than 3 identified attributes, or all "primary" criteria, within the evaluation category are met

⦿ = "Partial credit": 2 or 3 identified attributes

○ = "No credit": 0 or 1 identified attribute

4.3 SUMMARY OF PRIORITY NEEDS AND STORMWATER CONTROL MEASURES

In the areas of greatest integrated impacts to resources, the common thread is a loss of infiltration from the contributing watershed area. Thus, the stormwater management strategies most responsive to this condition will be those that are most effective at recovering this watershed process in developed area. From Table 3-1, structural SCMs that best address this need would include:

- Bioretention (infiltration design)
- Porous pavement (infiltration design)
- Soil amendments
- Downspout disconnection
- Infiltration basins
- Dry wells

Several of these can be implemented in more broadly characterized “Green Streets” projects; others are amenable to both site-scale and regional-scale implementation; and still others (including the incorporation of non-structural LID site design considerations) can be implemented more broadly at relatively low cost, particularly in residential areas. This emphasis on infiltrative SCMs, however, does not imply that focused water-quality-improvement measures (such as the drop-inlet filters to capture first-flush pollutants being installed in the downtown area) are not *also* beneficial in addressing water-resource concerns—only that the watershed-scale impacts of urbanization are most broadly and pervasively being expressed through the impairment of infiltration.

Presently unavailable is information on any direct linkages between consumptive water use from the San Luis Obispo groundwater basin and any declines in the level of a near-surface water table that might affect streamflow. The only relevant data made available for this study, for the upper watershed area and presented in Section 1, are equivocal as to whether any systematic trends in changing water-table elevations exist. They do suggest, however, that an unsaturated zone of some tens of feet thick lies between the ground surface and the water table, which would render fluctuations in the water-table level largely or totally irrelevant to changes in stream discharge. This condition, if widespread, would also limit the direct relevance of groundwater recharge to instream flow by (for example) stormwater infiltration, except for near-stream localities where shallow groundwater (i.e., “interflow”) might reach the channel directly before the water infiltrates more deeply.

Regardless of direct improvement to potable water supply, infiltrative SCMs are best suited to improve the overall health of the groundwater basin. Given the general suitability of the central, urban parts of the watershed to infiltration, recovering or protecting this watershed process should be the primary focus of stormwater management in these high-priority areas. Such measures would also contribute to the recovery of a more natural hydrograph during storm periods and improve water quality, both of which likely contribute to the substantial monotonic decline in stream health (as measured by the California Stream Quality Index and reported in Section 1) that currently exists.

In “near-stream” areas (likely measured in 10s or 100s of feet, but with no direct data to define more precisely), some improvements to instream flows might also be expected from these measures. Elsewhere, however, only the replacement of direct offtake of surface water (if any exists) by capture-and-reuse is likely to directly benefit instream flows.

Outside of the highest priority areas, which can be recognized where a lack of instream flows, modeled stormwater-related problems, and infiltration opportunities coincide, the lens of watershed processes still offers clear guidance for stormwater management. Particularly in the unincorporated areas of the watershed, the groundwater basin underlies primarily grassland/herbaceous and agricultural land uses.

These areas are presumably functioning well at present for supporting infiltration, but any future urban development in them should emphasize infiltration as both necessary and likely feasible (the entire area is underlain by WMZs 1 or 4) (Figure 4-6).

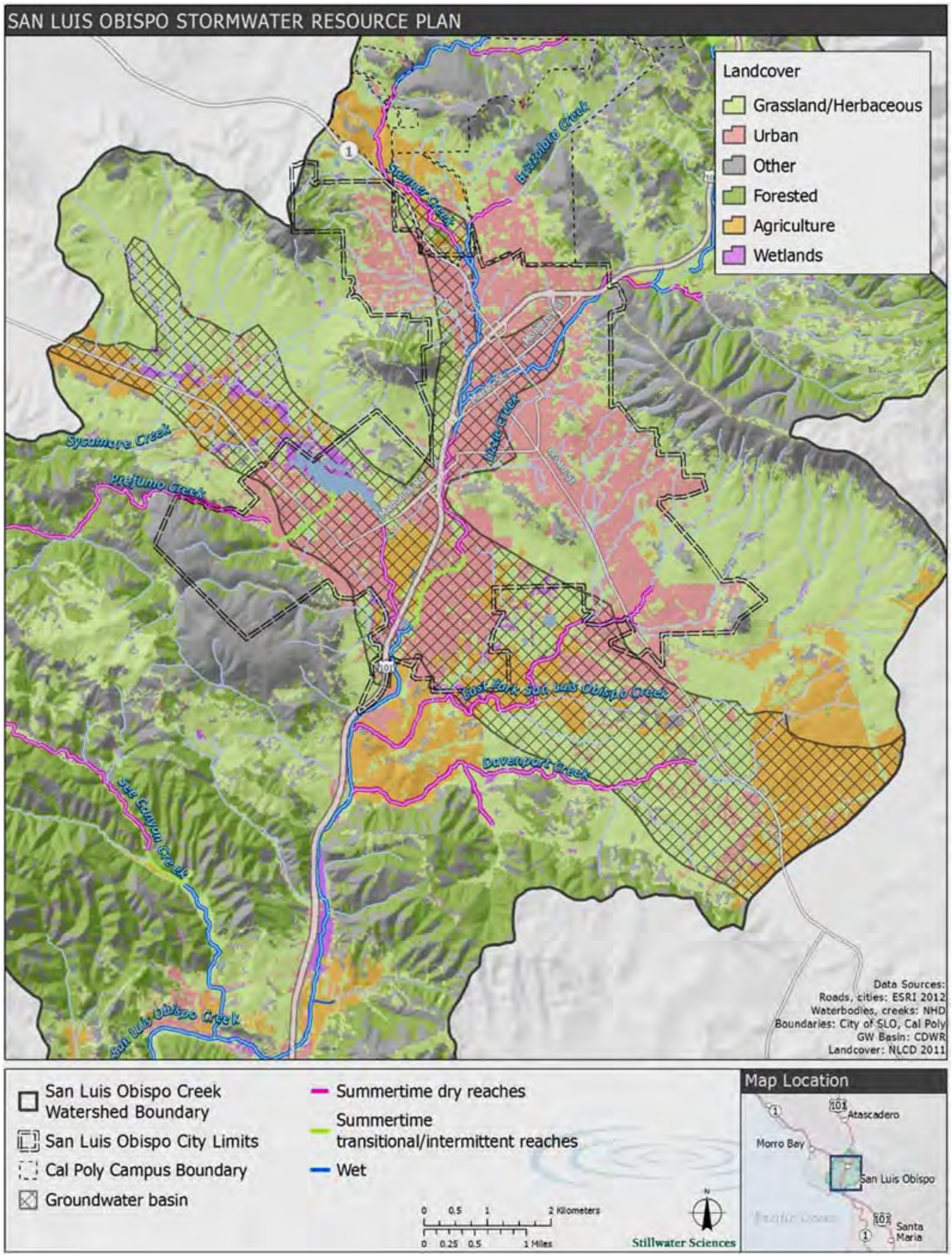


Figure 4-6. The San Luis Obispo Creek watershed where underlain by the mapped groundwater basin (cross-hatched area), highlighting the predominately grassland and agricultural land uses outside of the urban core.

Significant runoff- and pollutant-generating areas as identified by 2NDNATURE (2017) are also present outside of the groundwater basin, particularly along the Broad Street corridor to the southeast of the city center. This area is mapped as a patchwork mosaic of WMZs 1 and 3; recent subsurface exploration suggests that most of the area is probably underlain by impermeable rock and is more appropriately managed throughout as WMZ 3, with strategies chosen that "promote treatment of runoff through infiltration and/or filtration, and in general by minimizing overland flow" (CCRWQCB 2013). Virtually all of the LID project types listed in Table 3-1 can accomplish these tasks, although those that emphasize deeper infiltration (dry wells, infiltration basins) will likely be less effective in this area than filtration-oriented bioswales, infiltration trenches, and constructed wetlands/wet ponds.

4.4 MULTI-CRITERIA BENEFITS AND OTHER OPPORTUNITIES

The *Guidelines* seek to encourage multiple benefits from every recommended action. To that end, they state that "Each project and program implemented in accordance with the Plan should at minimum, address: (1) at least two or more Main Benefits listed in Table 4 (e.g., see Tables 4-1 and 4-2 of this document) within the watershed or sub-watershed, and (2) as many as feasible Additional Benefits for the same project/program." The referenced categories of "main benefits" that are most likely to apply to prospective stormwater management SCMs in the San Luis Obispo Creek watershed are as follows:

- Increased filtration and/or treatment of runoff
- Decreased flood risk by reducing runoff rate and/or volume
- Environmental and habitat protection and improvement
- Increased urban green space
- Public education

Other main benefits listed by the *Guidelines* but less likely to apply are water supply reliability, conjunctive use, and employment opportunities.

A number of "additional benefits" from the *Guidelines* are also likely to be achieved from prospective actions in the watershed, and their consideration will be incorporated into the final identification and ranking of projects and programs (see next section of this report):

- Nonpoint source pollution control
- Reestablished natural water drainage and treatment
- Reestablishment of the natural hydrograph
- Water temperature improvements
- Enhance and/or create recreational and public use areas

These multi-criteria benefits are implicit in the approach used to identify high-priority projects, because the highest ranked projects are only those where multiple benefits are already identified. This outcome highlights an additional benefit of using a watershed-process approach: rather than targeting specific *symptoms* (e.g., high pollutant concentration) this SRP targets underlying *causes*. In so doing, the desire to address the varied manifestations of those impaired processes, which are collectively termed "benefits," is fully incorporated.

Cal Poly also has a formal master planning process for capital projects that may provide opportunities for more extensive incorporation of LID-based stormwater management approaches than would be required under the campus's current NPDES permit. The final administrative draft of the Master Plan has yet to be released, and so the details of specific projects and locations are not yet available. However, preliminary discussions suggest that the following projects (and their associated elements for green infrastructure or environmental outreach) are likely to be considered or included in preliminary and final designs:

Slack Street and Grand Avenue Residential Neighborhood (420 units)

- Riparian Enhancement
- Bioswales
- Rain Garden
- Education

Brizzolara Creek Enhancement

- Seasonal Creek (re-establish the natural hydrograph) and Wetland Enhancement (wetland creation)
- Bank Repair (habitat protection and improvement)
- Recreation – Pedestrian/Bike Path
- Outdoor Teaching and Learning Amphitheater
- Bioswales
- Education/Signage

Fermentation Sciences Building

- Bioswales
- Rain Garden
- Rainwater Harvesting (pilot project)
- Education

5 PLAN IMPLEMENTATION

5.1 INTRODUCTION

The SRP is a living document and will be updated, evaluated, and revised periodically dependent upon input from the public, stakeholders, resource agencies, and local government as well as in response to changes in funding opportunities in which a review and update of the SRP may be necessary to align potential projects. The SRP is also designed to be accessible and used by the public to identify valuable, multi-benefit projects that enhance stormwater resource management. Therefore, the development of this SRP is intended to be a tool to guide development, implementation, and monitoring of stormwater projects at both the watershed and regional scale. The SRP will rank projects using the metrics provided in the prioritization methods (Chapter 4), although the final determination of priorities will be determined by local and regional policies and directives. The SRP, and consequently the Implementation Strategy described in this chapter, will outline the ways to ensure valuable, high-priority projects with multiple benefits are identified, and that there is an adaptive management process in place to monitor projects.

The technical memo below discusses the plan for implementation of the SRP. For the SRP to be effective, an adaptive management and funding strategy is needed to transition from planning to implementation. As the SRP draws in part from existing regional and watershed plans to provide a functionally equivalent SRP, the implementation strategy efforts for this plan build upon those existing efforts, which include the IRWM Plan and other relevant plans referenced in this document. This strategy will also discuss data compilation, management, and storage protocols including mechanisms to make all project data and outputs available to stakeholders, assess monitoring programs and data quality control, update data, and identify data gaps. The plan will also be periodically reviewed and revised to reflect changes in SRP management strategies, completion of data gaps informing key areas for stormwater management, and implementation of SRP projects and programs which will guide the effectiveness of future projects and programs.

5.2 RESOURCES FOR PLAN IMPLEMENTATION

According to the Water Code, the SRP should identify the resources that the participating entities are committing for implementation of the Plan Water Code §10562(d)(8).

5.2.1 Decision Support Tools and Data Management

The County of San Luis Obispo will host a spatial data viewer to provide access to data sets used in the spatial project prioritization. These will include inputs and outputs from the regional modeling approach (R-TELR) along with data sets created by other organizations that were used in the spatial prioritization. The metadata for each of these layers will provide a data description and links to the source data sets or data generating organizations. It is not anticipated that these data layers will need to be updated on timeframes shorter than 5 years. These spatial data layers primarily provide a baseline indication of the relative impacts and opportunities throughout the County, summarized at the Planning Watershed

Scale. As such, the Planning Watersheds scoring output will not need to change with the addition of new projects.

The County will also maintain the project scoring spreadsheet that provides a semi-automated multi-benefit scores for projects based on region-weighted scoring of spatial and project benefit metrics. The primary need for regular updates by County GIS staff will be the addition of new projects to both the spatial data layers and the scoring spreadsheet as this information becomes available. Because a component of the scoring requires locating projects within a Planning Watershed and/or a TELR catchment, addition of projects to the spreadsheet will require either joining of project locations to these hydrographic boundary datasets in a GIS or manual identification of Planning Watershed/TELR catchment using Google Earth and the associated KML files (provided by 2NDNATURE). Once this is complete, the spatial portion of the project scoring is automated. County staff will need to update the benefits portion of the project scoring spreadsheet for each new project added to obtain a project score based on project descriptions or design specifications.

The San Luis Obispo County Watersheds Management Plan, Phase I identified several key data gaps to watershed health and function. Development and management of stormwater resources through this SRP fills a key data gap covering the 25 watersheds in San Luis Obispo County. Development of Phase II of the San Luis Obispo County Watersheds Management Plan will address data gaps that are complimentary to stormwater resources such as water quality, water quantity, flood management, and environmental benefits. Likewise, as the RCDs of the county continue to fill in data gaps for Phase II of the San Luis Obispo County Watersheds Management Plan, the information will be incorporated into the IRWMP.

5.3 IMPLEMENTATION STRATEGY

5.3.1 Adoption of SRP into Integrated Regional Water Management Plan

Once concurrence from SWRCB is achieved, the Plan will be incorporated by the Regional Water Management Group (RWMG). The RWMG will discuss how the SRP will fit into the broader management objectives of the San Luis Obispo County IRWM Plan. Upon incorporation of the Final SRP to the IRWMP, updates to the projects list prioritized for funding, or other information on the watershed's priorities will be conducted by the RWMG. The SRP project list will be merged with the existing IRWM Full Project List. The group presently meets regularly on a monthly basis and the SRP will continue to be a regular agenda item to discuss as needed. Additional meetings will occur as needed based on grant funding announcements. Updates to the SRP will be posted on the county's SWRP website.

The RWMG will be responsible for making the announcement(s) and setting the schedule for project solicitation. Future calls for projects will be solicited by the RWMG to the existing stakeholder list. The stakeholder list will be updated as needed. Projects will be submitted using an online form, along with supporting information, to run the project through the prioritization process. New projects submitted through this online form will then be scored and prioritized (see Chapter 4) by the Review Committee (RC) annually and then on an as needed basis throughout the year. The RC will be initially comprised of the current Project Management Team and may be modified based on input from RWMG. The RC will then recommend the new projects with their associated prioritized score to the RWMG for inclusion in the SRP. When the solicitation for Round 2 of the Prop 1 Storm Water Grant Program is announced, anticipated Winter 2019, project proponents may update information previously submitted during the first solicitation of projects for inclusion on the SRP Project List.

5.3.2 Entities Responsible for Project Implementation

Project implementation will vary depending on project proponent participation and as funding sources become available. Project entities are responsible for implementing their projects; however, the Plan encourages collaboration between project leads to reach more multi-benefits. Project proponents will ensure agreements are in place with landowners, ensure the availability of match funding, apply for grant funding, and enter into an agreement with the State and/or other grantor. Project proponents will be responsible for obtaining any permits, providing project management staff to complete the designs, implementation, maintenance and reporting.

5.3.3 Community Participation

The SRP has developed a Stakeholder Outreach Plan to engage and solicit input from various stakeholders throughout San Luis Obispo County. Please see Chapter 2 for the Stakeholder Outreach Plan for a detailed description.

5.3.4 Strategy for Obtaining Necessary Permits

Permitting will be the responsibility of project proponents and must comply with Federal, state, and local requirements, including relevant permits and CEQA. Potential permits may include: County Grading and/or minor use construction permit, USFS Special Use Permits, Clean Water Act Section 404 and 401 permits, CDFW Streambed and Lake Alteration Agreement, Coastal Commission's Coastal Development permit, and/or Caltrans encroachment permits.

5.3.5 Potential Funding Sources

Potential funding sources for multi-benefit stormwater and dry weather runoff projects:

- California Coastal Conservancy Proposition 1 Grants
- California Department of Fish and Wildlife Proposition 1 and Fisheries Restoration Grants
- California Water Resources Control Board SWRP Proposition 1 Implementation Grants
- California Water Resources Control Board 319(h) Program Grants
- California Wildlife Conservation Board Habitat Enhancement and Restoration Program Grants
- Integrated Regional Water Management Plan Implementation Grants
- Bureau of Reclamation WaterSMART Drought
- Response Program Grants

- National Oceanic and Atmospheric Administration Bay Watershed
- Education and Training and National Marine Fisheries Service Fisheries Research Grants
- Various Federal Fish & Wildlife Service Grants
- Various United States Department of Agriculture's Natural Resources Conservation Service Environmental Quality Incentives Program and Conservation Stewardship Program Grants
- Various Federal Department of Energy Grants
- California Department of Conservation's Sustainable Agricultural Lands Conservation Program's Agricultural Easement Grants
- Sponsored by proponent

5.4 ADAPTIVE MANAGEMENT

The SWRP Guidelines state that any SWRP should be a living document, implemented as an adaptive Plan with ongoing monitoring and check-ins to ensure regulatory objectives and multiple benefit goals are being met. The SRP should "identify the development of appropriate decision support tools and the data necessary to use the decision support tools" Water Code §10562(d)(8) to support the adaptive management process. As discussed in 2.1, the SRP will be adapted at least annually when the RC meets and more frequently as decided by the RWMG as needed.

5.4.1 Purpose of Adaptive Management

Adaptive management is a structured, iterative process which allows for changes to be made with the goal of improving future management. In order to decrease uncertainty over time and improve management in the long term, data and information will be needed to inform the Plan. Taking an adaptive management approach to the SRP allows for an evolving Project List and scoring metrics that will become more robust as more information, be it best available science, funding opportunities, or design phase, becomes available. Ensuring that the SRP takes an adaptive approach will ensure its usefulness into the future.

5.4.2 Adaptive Management Procedure

The Plan will be updated by the RWMG based on best available science, new data sets (e.g. new USGS shapefiles as available), TELR algorithms, and will need to seek future funding in order to update models on a regular basis. After new information becomes available, adjustments by the RWMG can be made and those adjustments can then be implemented. Adjustments to the weighting of the metrics may be needed over time as implemented projects may alter the desired weighting of the multiple benefits. For example, if TMDLs objectives are met by implementation of a project or program currently on the list, "water quality" might be determined to no longer need as high a weighting as at present, potentially resulting in an adjustment to the weighting of benefits to reflect the changed parameter.

5.5 TRACKING IMPLEMENTATION PERFORMANCE MEASURES

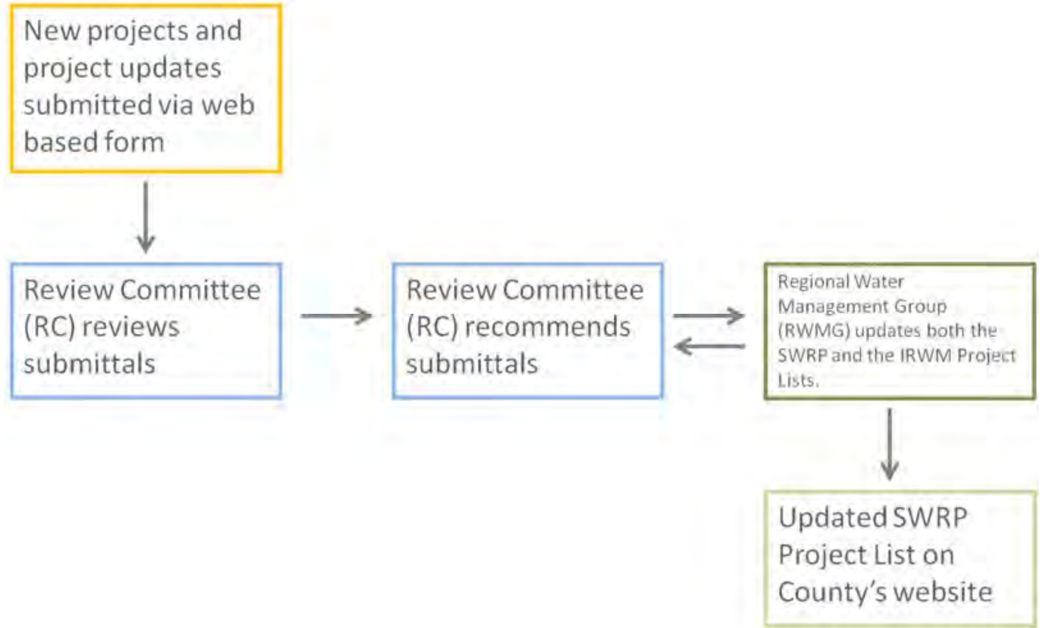
Tracking performance measures allows for communication between project proponents and the RWMG. Tracking measures is needed to ensure regulatory requirements and multi-benefit goals are being met. The IRWM framework for tracking performance measures will also be used for SRP projects. The performance measures and metrics provide a basis for further developing a detailed project performance database which will identify:

- Project goals
- Desired outcomes
- Output indicators – measures to effectively track output
- Outcome indicators – measures to evaluate change that is a direct result of the work
- Measurement tools and methods
- Measurable targets that are feasible to meet during the life of the proposal
- Monitoring measurements and interpretation of change in output indicators over time

As projects are implemented, quantification of benefits per the metrics and weighting established in the Approach may become available as grant reporting requirements mandate. For example, a project implemented that achieves water quality goals to meet TMDL and MS4 permit objectives may be documented and used to measure performance of the project or program. Project proponents will provide monitoring data to the state of California, in forms and formats needed to be included in the state's databases, where this is a condition of any grant funding. Additionally, required final and annual reporting of projects can be used to provide information to stakeholders and other interested parties on lessons learned and the quantified and non-quantified outcomes of the project.

Projects at a conceptual stage on the Project List at this time may not have had adequate data to have gone through the metrics scoring approach. As these projects increase in their development to design phases, quantitative measurements of anticipated benefits can then be used in the metrics scoring approach. Project proponents will be able to score their projects using the approach at any time in the development and inclusion of a project to the Project List.

Figure 5-1. Flow chart summarizing the Project List update process, which will occur annually and then as needed during the year.



5.6 IMPLEMENTATION PLANS, PROGRAMS, AND PROJECTS

5.6.1 City Processes

In general, proposals for Capital Improvement Projects (CIPs) within the City pass through a well-established process, which begins with a community-led goal-setting process prior to detailed budgeting. Requests from the community combined with those of various City agencies lead to staff development of specific projects related to those requests. Prospective CIPs are reviewed within an established internal process, and the Budget Review Team (BRT) then determines how much can be afforded and assigns priorities to the CIP list. Once the CIP list is approved and prioritized by the BRT, it returns to the staff for implementation.

For the stormwater-related projects in this SRP, a somewhat wider variety of processes are available for implementation. CIPs on the 2017 list for implementation have already been screened to identify potential incorporation of LID features for little or no substantive cost change. Standalone stormwater projects will continue to be identified, designed, and run through the CIP/BRT process for consideration. However, many of these requests will likely be supported by grant funding, rendering their prioritization through this process on financial grounds moot.

The update of the 2002 Watershed Enhancement Plan for San Luis Obispo Creek (Land Conservancy of San Luis Obispo County, 2002), currently in progress by the City, provides a further opportunity to integrate the multiple benefit approach. Instead of solely focusing on fish habitat, barriers, and enhancement (as in the original 2002 version), the updated plan will take a holistic approach to watershed characterization, consolidating all of the existing creek-related projects and programs under one organizational umbrella within the City. Stormwater runoff, pollution, flood control, transients and public safety will be the major new elements of this approach, since every one of these concerns have a significant impact on watershed health.

5.6.2 IRWMP

The San Luis Obispo County Integrated Regional Water Management Plan (IRWMP), led by the San Luis Obispo County Flood Control and Water Resources Division, is active in this region (home page at https://www.slocountywater.org/site/Frequent Downloads/Integrated Regional Water Management Plan/index.htm). San Luis Obispo County is taking the lead on their portion of the SRP for their unincorporated areas, and the City (in conjunction with Cal Poly) has responsibility for completing this SRP for the San Luis Obispo Creek watershed. When completed, the San Luis Obispo Creek watershed SRP will be integrated into the IRWMP planning process. The IRWMP is expected to be a venue for implementing many of the projects identified in this SRP, given its position as a regional entity for planning and funding.

5.6.3 Decision Support Tools

Two efforts are underway to improve decision-making processes and outcomes. The Program Effectiveness, Assessment and Improvement Plan (PEAIP) is an ongoing, comprehensive assessment of the stormwater management program: how it has been implemented, what has been learned, what has been changed, and what has been updated. This is intended to allow the City to focus on successes and dedicate more time and resources to what has not worked, or to secure more resources to support a higher level of service in these areas.

In conjunction with the PEAIP, the Regional Water Quality Control Board has required all Central Coast MS4s to complete the “Spatially-based Stormwater Volume and Pollutant Loading” mapping exercise (locally referenced as “The 13267 Letter”). Under this approach, the City is broken up into 100-200 acre catchment areas. In each catchment area, particulate loading volumes and runoff volumes are calculated based on land-use, geology, hydrology, topography, etc. This is a useful planning tool to see where new developments might be proposed to go and see what changes to the loading and runoff would be. This also allows a view into where re-development might undo some of the impervious surfaces across the City’s landscape. This SRP is making use of that analysis (2NDNATURE 2017; see Figure 4-4 above) to identify the highest priority areas for achieving such improvements through CIP implementation.

5.7 COMMUNITY PARTICIPATION

Implementation of the recommendations contained in the SRP will engage the community at various stages. This SRP will be approved by the City Council in an open meeting, and so the community will have an opportunity to comment on the plan during a review period prior to the Council meeting. The City’s primary vehicle for authorizing new capital projects, the annual CIP list, engages the community through the budget process and community goal-setting process that the City offers to the community for input. The upcoming revision to the 2002 Watershed Enhancement Plan will also be submitted to the City Council for approval. After this, plan development will transition into implementation of projects. The completed SRP and the updated Watershed Enhancement Plan will provide a list of prospective projects that can be moved into the CIP prioritization process (see Section 6.1.1, above) or developed into proposals for external grant funding.

Although direct consultation with the community does not normally occur in the pursuit of external grant opportunities, such efforts are typically done in collaboration with other community-based and supported groups (particularly Central Coast Salmon Enhancement and the California Conservation Corps) which help the City to develop these projects and to gain grant funding.

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APPENDIX 1

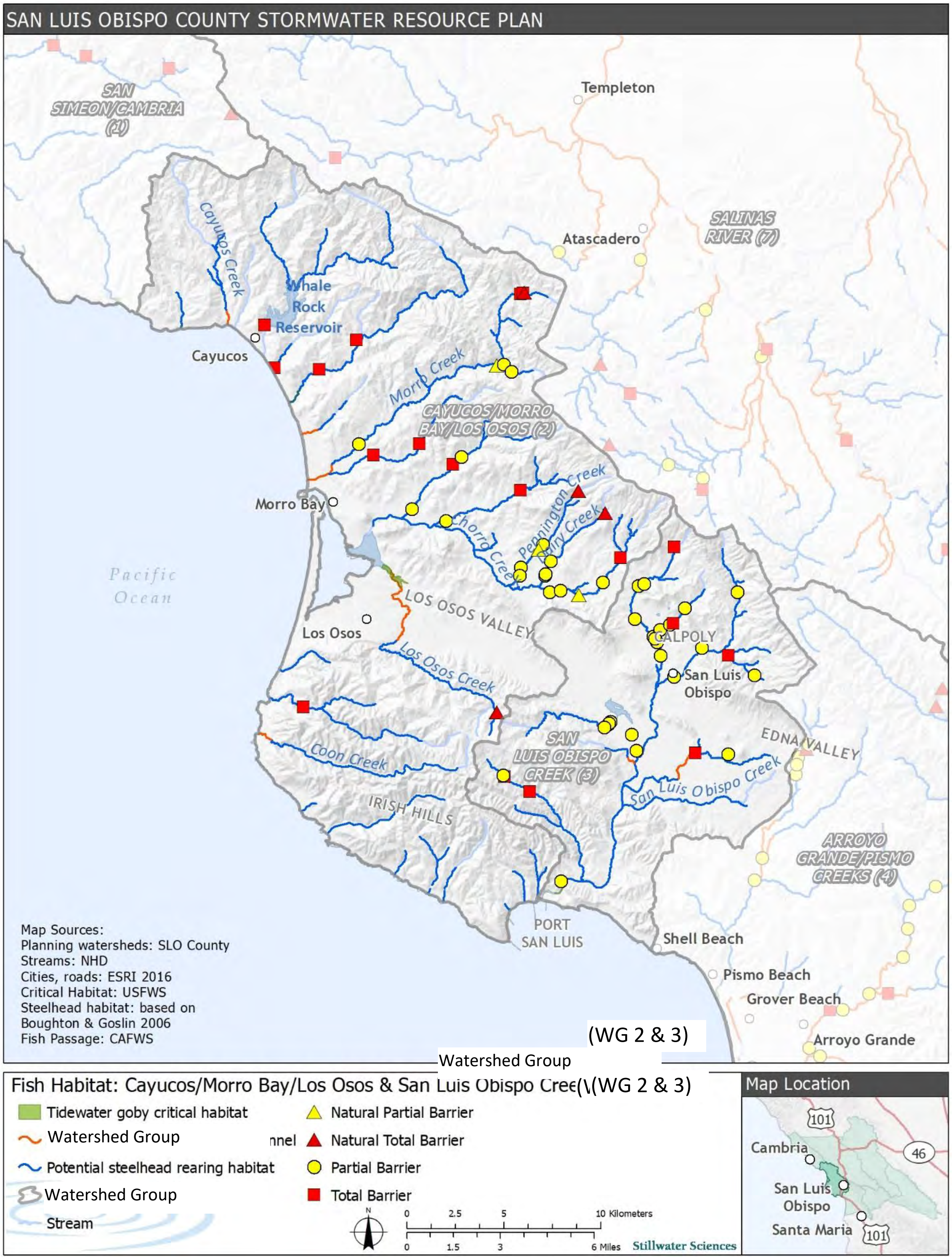
Additional maps for the San Luis Obispo Creek watershed

The following maps are included:

1. Municipal boundaries and community service districts
2. Aquatic habitat
3. Watershed Management Zones

These maps are reproduced from the San Luis Obispo County SWRP, on which the San Luis Obispo Creek watershed is designated “Watershed Group #3.”


SAN LUIS OBISPO COUNTY STORMWATER RESOURCE PLAN
SAN SIMEON/CAMBRIA (1)
Templeton
Atascadero
SALINAS RIVER (7)
Cayucos Creek
Whale Rock Reservoir
Cayucos
Morro Creek
CAYUCOS/MORRO BAY/LOS OSOS (2)
Pennington Creek
Dairy Creek
Chorro Creek
Morro Bay
Pacific Ocean
Los Osos CSD
Los Osos
LOS OSOS VALLEY
Los Osos Creek
CALPOLY
San Luis Obispo
EDNA VALLEY
SAN LUIS OBISPO CREEK (3)
Coon Creek
San Luis Obispo Creek
IRISH HILLS
Avlia Beach CSD
Squire Canyon CSD
ARROYO GRANDE/PISMO CREEKS (4)
PORT SAN LUIS
Shell Beach
Pismo Beach
Grover Beach
Arroyo Grande
Map Sources:
Planning watersheds, City limits, CSDs: SLO County
Streams: NHD
Cities, roads: ESRI 2016
Municipal Services: Cayucos/Morro Bay/Los Osos & San Luis Obispo Creek (WG 2 & 3)
City Limits
Community Service District
Watershed Group
Stream
N
0 2.5 5 10 Kilometers
0 1.5 3 6 Miles
Stillwater Sciences
Map Location
101
Cambria
46
San Luis Obispo
Santa Maria
101


SAN LUIS OBISPO COUNTY STORMWATER RESOURCE PLAN
SAN SIMEON/GAMBRIA (1)
Templeton
Atascadero
SALINAS RIVER (7)
Cayucos Creek
Whale Rock Reservoir
Cayucos
Morro Creek
CAYUCOS/MORRO BAY/LOS OSOS (2)
Morro Bay
Pennington Creek
Chorro Creek
Pacific Ocean
LOS OSOS VALLEY
Los Osos
Los Osos Creek
CALPOLY
San Luis Obispo
Coon Creek
SAN LUIS OBISPO CREEK (3)
EDNA VALLEY
San Luis Obispo Creek
IRISH HILLS
ARROYO GRANDE/PISMO CREEKS (4)
PORT SAN LUIS
Shell Beach
Pismo Beach
Grover Beach
Arroyo Grande
Map Sources:
Planning watersheds: SLO County
Streams: NHD
Cities, roads: ESRI 2016
Critical Habitat: USFWS
Steelhead habitat: based on Boughton & Goslin 2006
Fish Passage: CAFWS
(WG 2 & 3)
Watershed Group
Fish Habitat: Cayucos/Morro Bay/Los Osos & San Luis Obispo Cree(\(WG 2 & 3)
Tidewater goby critical habitat
Watershed Group
Potential steelhead rearing habitat
Watershed Group
Stream
nnel
Natural Partial Barrier
Natural Total Barrier
Partial Barrier
Total Barrier
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0 1.5 3 6 Miles
Stillwater Sciences
Map Location
101
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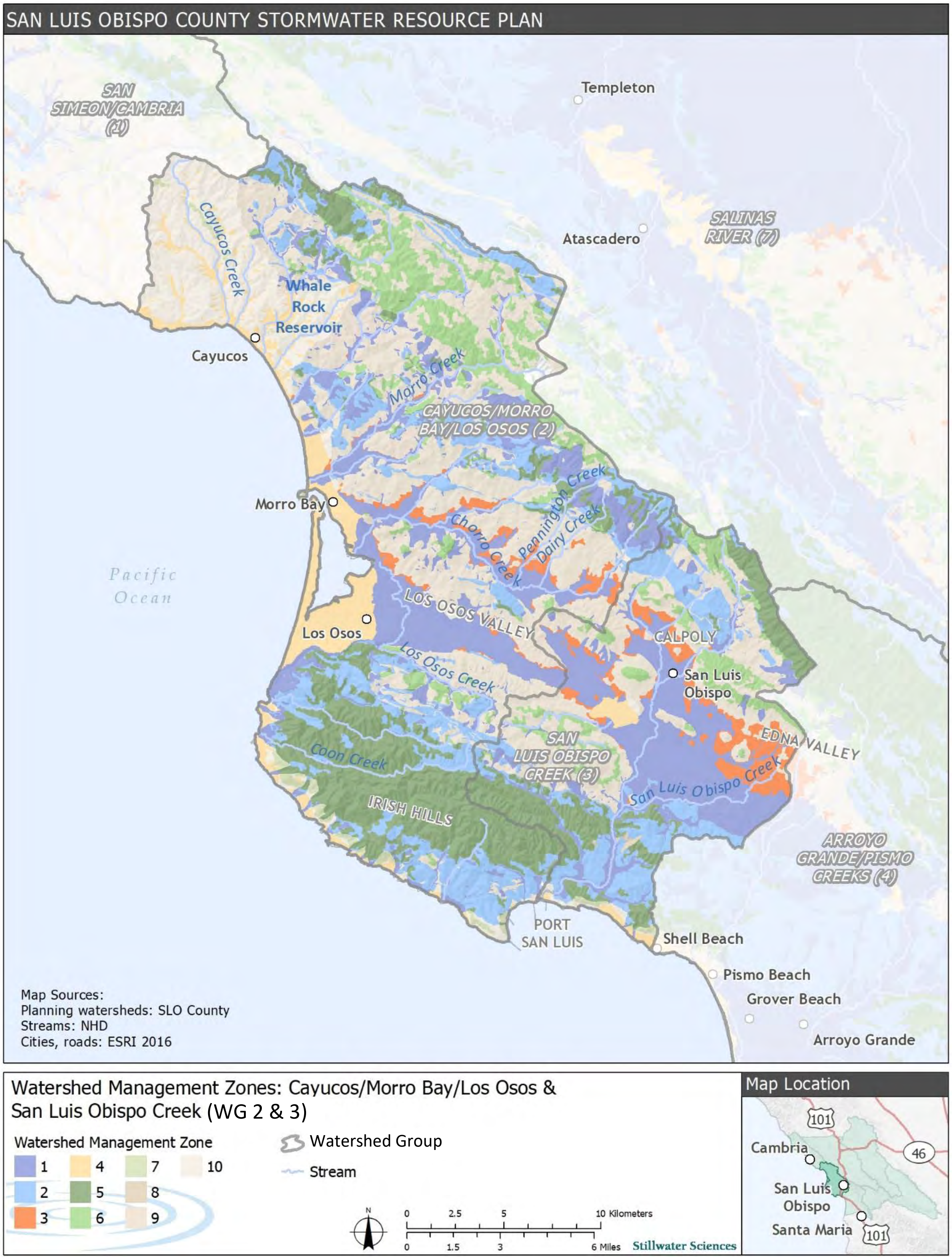
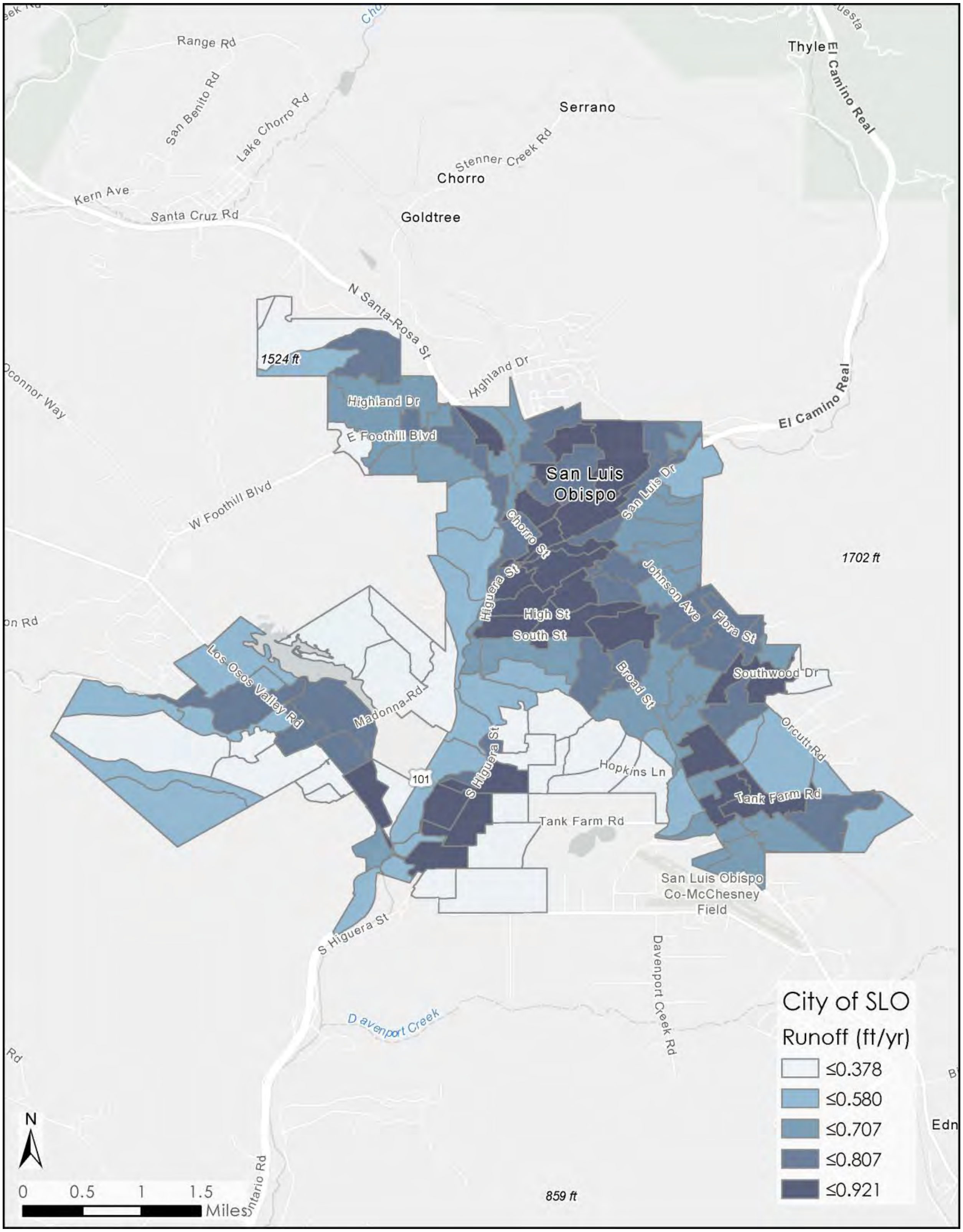
Cambria
San Luis Obispo
Santa Maria
101

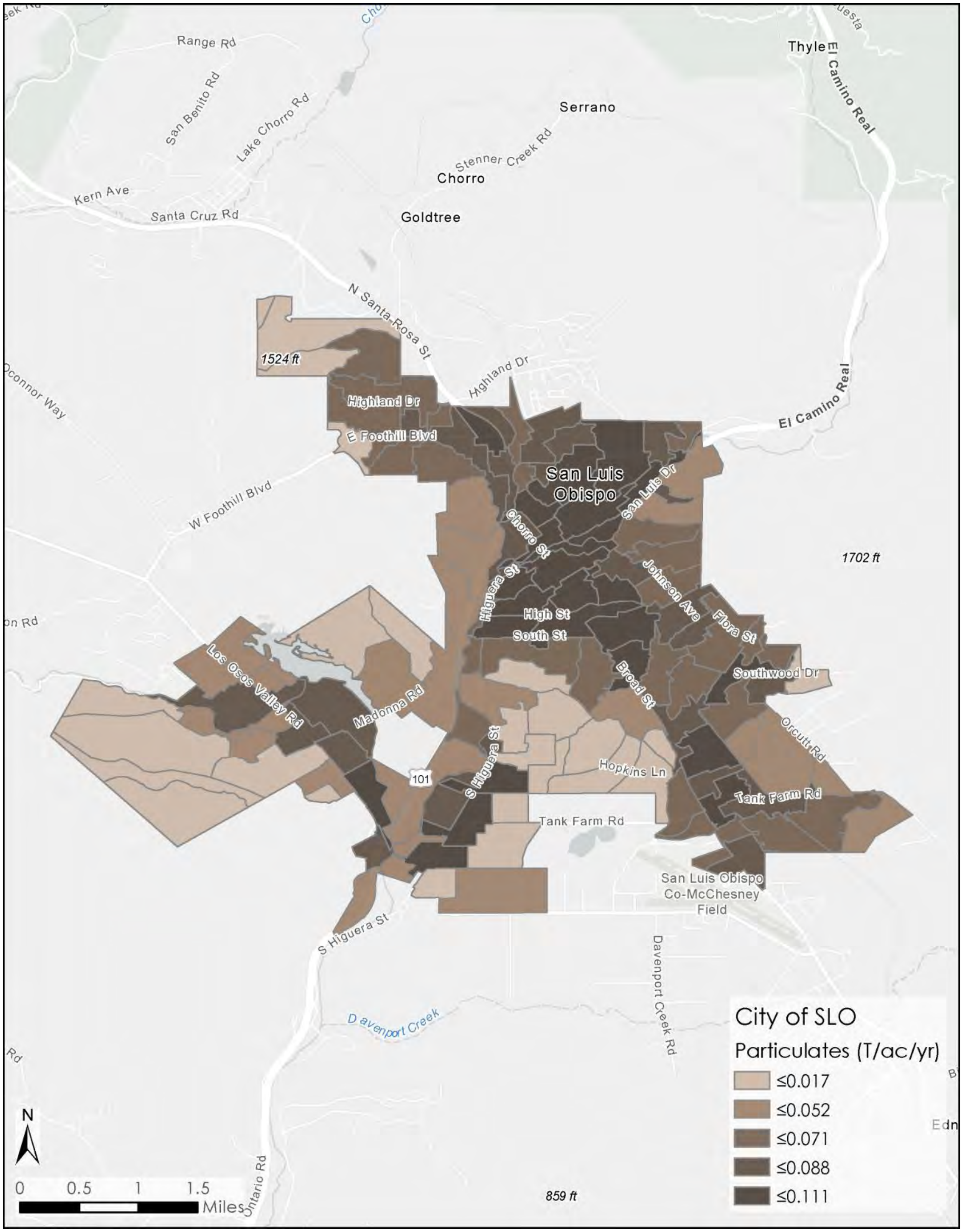

SAN LUIS OBISPO COUNTY STORMWATER RESOURCE PLAN
SAN SIMEON/CAMBRIA (1)
Templeton
Atascadero
SALINAS RIVER (7)
Cayucos Creek
Whale Rock Reservoir
Cayucos
Morro Creek
CAYUCOS/MORRO BAY/LOS OSOS (2)
Pennington Creek
Morro Bay
Chorro Creek
Dairy Creek
Pacific Ocean
LOS OSOS VALLEY
Los Osos
CALPOLY
Los Osos Creek
San Luis Obispo
EDNA VALLEY
SAN LUIS OBISPO CREEK (3)
Coon Creek
IRISH HILLS
San Luis Obispo Creek
ARROYO GRANDE/PISMO CREEKS (4)
PORT SAN LUIS
Shell Beach
Pismo Beach
Grover Beach
Arroyo Grande
Map Sources:
Planning watersheds: SLO County
Streams: NHD
Cities, roads: ESRI 2016
Watershed Management Zones: Cayucos/Morro Bay/Los Osos & San Luis Obispo Creek (WG 2 & 3)
Watershed Management Zone
1
2
3
4
5
6
7
8
9
10
Watershed Group
Stream
0 2.5 5 10 Kilometers
0 1.5 3 6 Miles
Stillwater Sciences
Map Location
101
Cambria
46
San Luis Obispo
Santa Maria
101

APPENDIX 2

Map folio of modeled baseline runoff and particulate pollutant loading for the City of San Luis Obispo

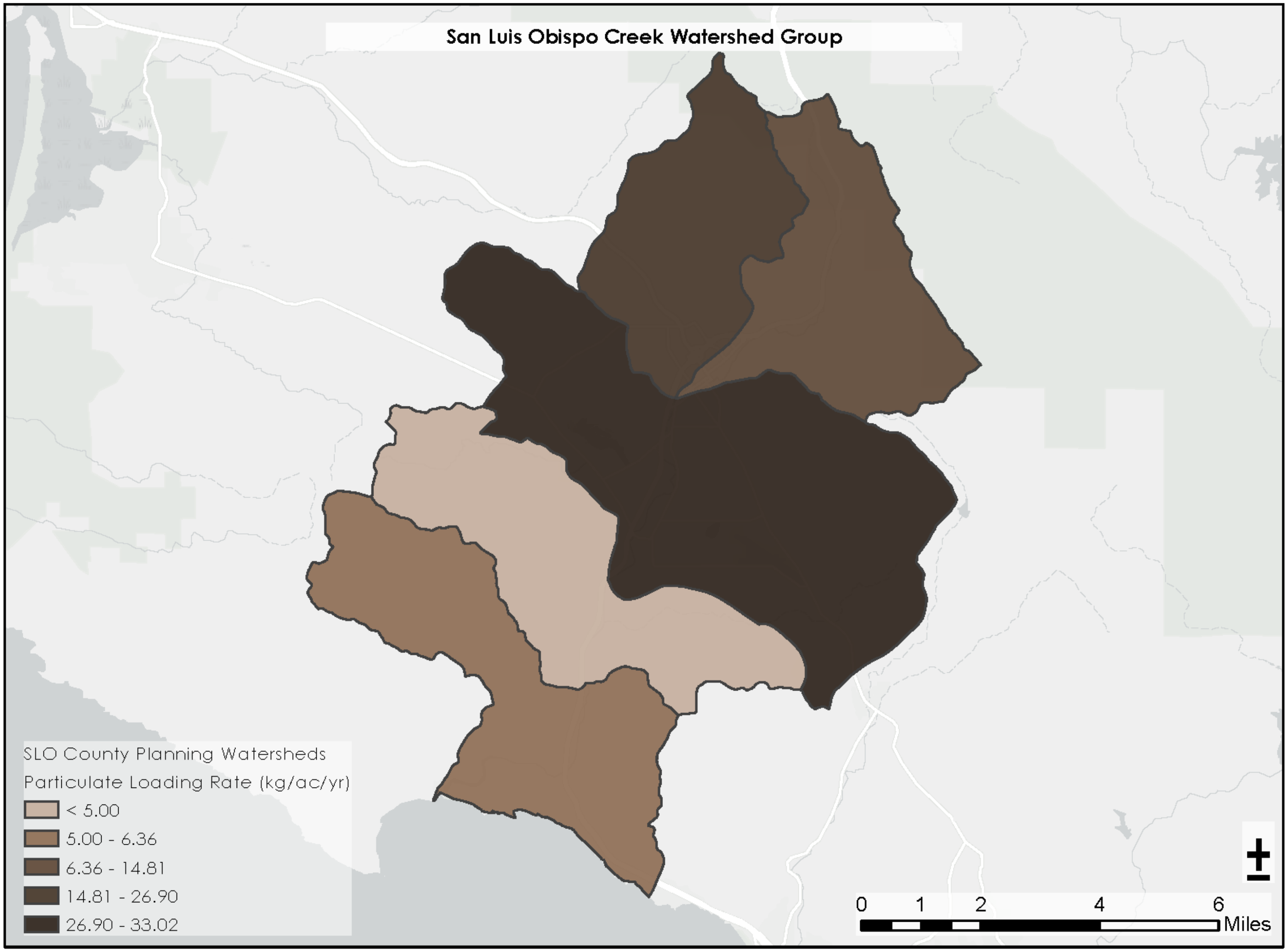
Data from TELR (Tool to Estimate Load Reductions).

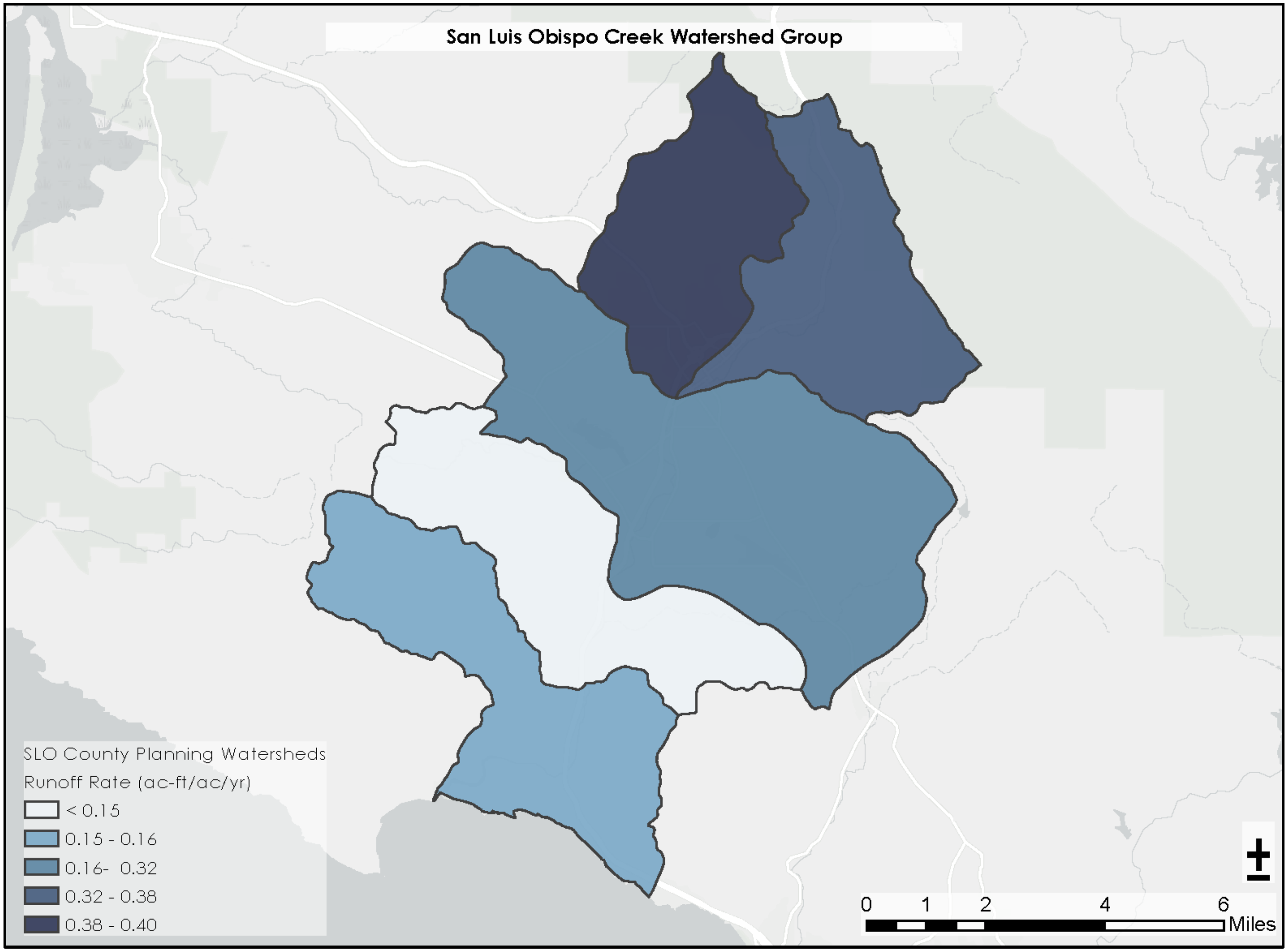

City of SLO
Runoff (ft/yr)
≤0.378
≤0.580
≤0.707
≤0.807
≤0.921
San Luis Obispo
Highland Dr
E Foothill Blvd
W Foothill Blvd
N Santa-Rosa St
San Luis Dr
Chorro St
Higuera St
High St
South St
Johnson Ave
Flora St
Broad St
Southwood Dr
Orcutt Rd
Tank Farm Rd
Hopkins Ln
S Higuera St
Madonna Rd
Los Osos Valley Rd
101
El Camino Real
San Luis Obispo Co-McChesney Field
Davenport Creek Rd
Davenport Creek
Range Rd
San Benito Rd
Lake Chorro Rd
Stenner Creek Rd
Serrano
Chorro
Goldtree
Kern Ave
Santa Cruz Rd
Thyle
Oconnor Way
1524 ft
1702 ft
859 ft
N
0 0.5 1 1.5
Miles


City of SLO
Particulates (T/ac/yr)
≤0.017
≤0.052
≤0.071
≤0.088
≤0.111
San Luis Obispo
Range Rd
San Benito Rd
Lake Chorro Rd
Serrano
Thyle
El Camino Real
Stenner Creek Rd
Chorro
Kern Ave
Santa Cruz Rd
Goldtree
N Santa Rosa St
1524 ft
Highland Dr
Oconnor Way
E Foothill Blvd
W Foothill Blvd
San Luis Dr
Chorro St
1702 ft
Higuera St
Johnson Ave
High St
South St
Flora St
Los Osos Valley Rd
Madonna Rd
Southwood Dr
Broad St
Orcutt Rd
101
S Higuera St
Hopkins Ln
Tank Farm Rd
San Luis Obispo Co-McChesney Field
S Higuera St
Davenport Creek Rd
Davenport Creek
Ontario Rd
859 ft
N
0 0.5 1 1.5
Miles

APPENDIX 3

R-TELR Map Outputs


San Luis Obispo Creek Watershed Group
SLO County Planning Watersheds
Particulate Loading Rate (kg/ac/yr)
< 5.00
5.00 - 6.36
6.36 - 14.81
14.81 - 26.90
26.90 - 33.02
0
1
2
4
6
Miles


San Luis Obispo Creek Watershed Group
SLO County Planning Watersheds
Runoff Rate (ac-ft/ac/yr)
< 0.15
0.15 - 0.16
0.16- 0.32
0.32 - 0.38
0.38 - 0.40
0 1 2 4 6
Miles

APPENDIX 4

Identified Project Descriptions

Project/ Program Name	Project/ Program Location	Project/ Program Type	Status	Summary
Meadow Park Capture and Use	Meadow Park, City of San Luis Obispo	Capture and reuse	Concept Design	A StormTrap system (or other proprietary system) would be installed, with stormwater runoff routed to the system. Additionally, the design includes an irrigation component so that captured stormwater can be used to irrigate the park
Mitchell Park Bioretention	Mitchell Park, City of San Luis Obispo	constructed project-Biofiltration LID	Concept Design	The Mitchell Park Bioretention Project will manage stormwater runoff from the surrounding residential neighborhood. This project will capture and infiltrate approximately 25% of the 85th percentile, 24-hour storm event from the contributing 4 acres.
Higuera Widening Project	Vicinity of Higuera and Broad streets, City of San Luis Obispo	constructed project-Biofiltration LID	Concept Design	A variety of road-widening, conveyance-improvement, and biofiltration project elements along this arterial in the southern part of the city.

APPENDIX 6

Quantitative Metric Scores for the CalWater Planning Watersheds in the San Luis Obispo Creek Watershed

			Water Quality												
CALWATER	NAME	ACRES	*%Sensitive DS RW WMZ*	*PCR*	***Sensitive DS RW Score***	*Nitrate Values*	*Nitrate Score*	*303d Waterbody Length (feet)*	*303d Score*	*PCR*	***Impaired Waterbody Score***	*Particulates (tons/yr)*	*PCR*	***Particulates Score***	***Total Water Quality Score***
6162	Stenner Lake	7259	1.0	1.0	2.0	0.2	0.0	39322.9	1.0	1.0	2.0	215.256	1.0	1.9	**5.9**
6172	Reservoir Canyon	7999	1.0	1.0	2.0	0.6	0.0	11505.5	1.0	0.8	2.0	130.554	0.9	1.8	**5.8**
6196	Laguna Lake	18172	1.0	1.0	2.0	4.9	0.0	34783.0	1.0	0.9	2.0	661.518	1.0	2.0	**6.0**
6219	Prefumo Canyon	9531	1.0	1.0	2.0	1.0	0.0	31440.6	1.0	0.9	2.0	52.484	0.7	1.5	**5.5**
6231	Sea Canyon	10131	0.9	0.3	0.6	0.8	0.0	19864.5	1.0	0.9	2.0	70.993	0.8	1.6	**4.2**

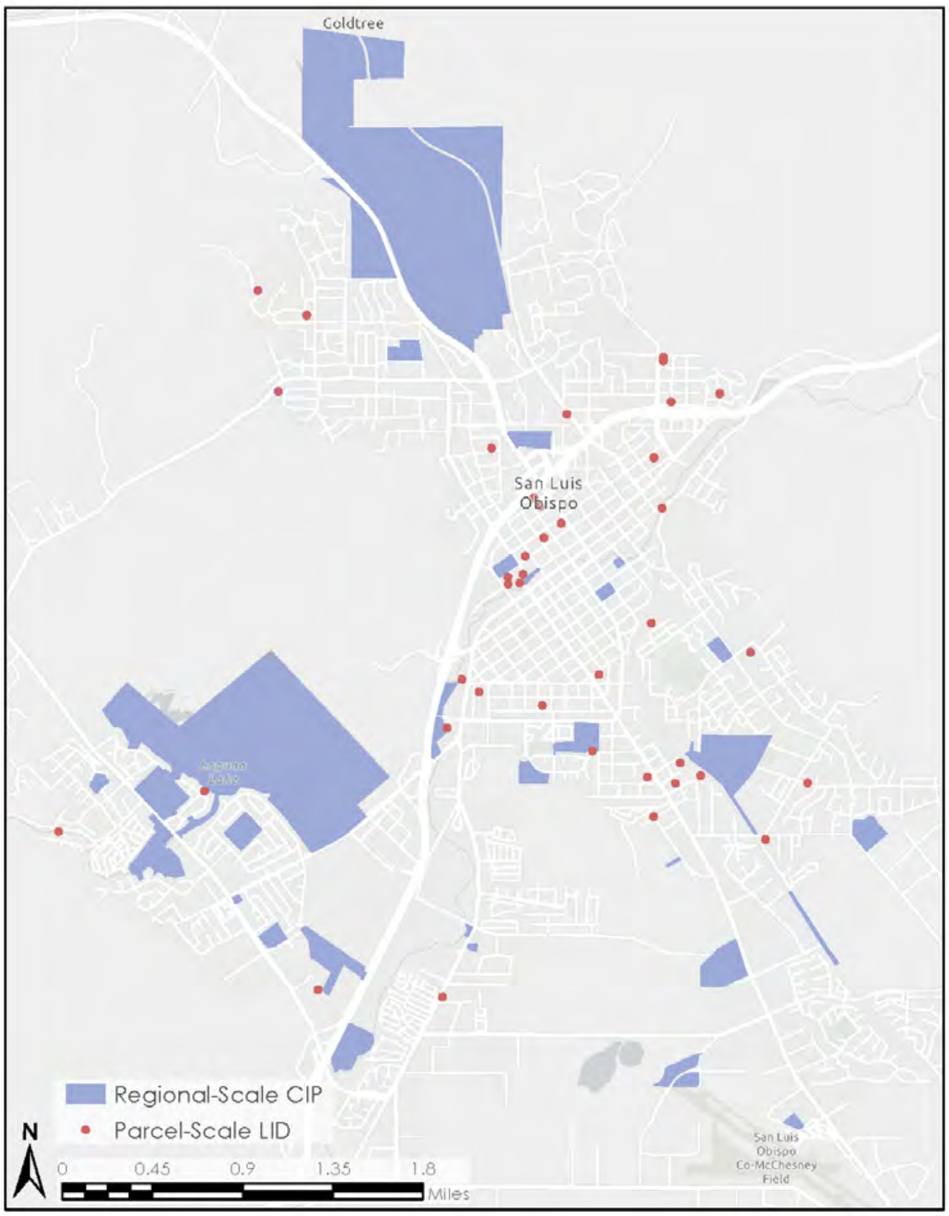
	Water supply											
CALWATER	*Critical overdrafted basins (acres)*	*% Infiltration-favorable WMZ*	*PCR*	**Infiltration Favorable Score**	*Current Supply Limited Area (Average subsidence (ft/yr))*	*PCR*	**Supply Limited Area Score**	*Future Supply Limited Area (Avg GW Dependence Index Score)*	*PCR*	**Future Supply Limited Area Score**	***Total Water Supply Score***
6162	0	0.44	0.1	0.2	2.0	1.0	2.9	5.8	0.8	0.8	**3.9**
6172	0	0.49	0.1	0.2	1.8	0.9	2.7	5.8	0.8	0.8	**3.7**
6196	0	0.57	0.2	0.4	1.8	0.9	2.6	7.2	1.0	1.0	**3.9**
6219	0	0.45	0.1	0.2	1.5	0.4	1.3	7.3	1.0	1.0	**2.5**
6231	0	0.87	0.4	0.8	1.5	0.4	1.3	6.4	0.9	0.9	**3.0**

							Environmental										
CALWATER	NAME	ACRES	*Runoff (afy)*	*PCR*	**Runoff Rank Score**	**Total Flood Management Score**	*Number of At-Risk Aquatic Species*	*PCR*	**Number of At-Risk Aquatic Species Score**	*Length of Identified Steelhead Habitat (feet)*	*PCR*	**Steelhead Habitat Score**	*Runoff (afy)*	*PCR*	**Runoff Rank Score**	**Total Environment Score**	TOTAL SCORE
6162	Stenner Lake	7259	2881.6	0.9	1.9	**1.9**	3.3	1.0	1.9	46804.9	0.9	2.8	2881.6	0.9	0.9	**5.7**	**4.4**
6172	Reservoir Canyon	7999	3041.9	1.0	1.9	**1.9**	2.6	0.9	1.9	34491.8	0.9	2.7	3041.9	1.0	1.0	**5.5**	**4.2**
6196	Laguna Lake	18172	5782.1	1.0	2.0	**2.0**	3.0	1.0	1.9	36427.0	0.9	2.7	5782.1	1.0	1.0	**5.6**	**4.4**
6219	Prefumo Canyon	9531	1404.3	0.8	1.6	**1.6**	2.7	0.9	1.9	23382.6	0.8	2.5	1404.3	0.8	0.8	**5.2**	**3.6**
6231	Sea Canyon	10131	1636.0	0.9	1.7	**1.7**	3.6	1.0	2.0	67168.9	1.0	2.9	1636.0	0.9	0.9	**5.7**	**3.6**

APPENDIX 7

Public Parcels in the City of San Luis Obispo that Meet Minimum Screening Requirements

On the map covering the City of San Luis Obispo (below), blue polygons identify the public parcels that meet the criteria for Regional- and Neighborhood-scale CIPs (public land; any NLCD category except 22, 23, 24; within WMZ 1, 2, 4, 5, 8; slope <10%; acres > 0.25). The red dots identify the public parcels that meet the criteria for parcel-scale LID treatments (public land, acres <0.25; too small to outline at map scale). Tables of the parcels displayed on these maps are provided on the pages following the map sheet.



Prospective Regional- and Neighborhood-Scale CIP parcels within the City of San Luis Obispo.

APN	County Use Code	County Use Code Definition	NLCD Landcover Value	NLCD Landcover Definition	Slope (%)	Watershed Management Zone	Acres	CalWater Watershed Number	MS4
001-031-028	854	Government - Recreational	21	Developed, Open Space	0.7	1	10.1	6162	San Luis Obispo
002-411-002	820	School	21	Developed, Open Space	1.0	1	4.5	6162	San Luis Obispo
002-423-006	857	Government	21	Developed, Open Space	0.8	1	1.3	6172	San Luis Obispo
002-446-029	857	Government	21	Developed, Open Space	0.4	1	1.1	6172	San Luis Obispo
003-543-001	854	Government - Recreational	21	Developed, Open Space	0.5	1	3.0	6172	San Luis Obispo
003-682-042	851	Government - Office	21	Developed, Open Space	2.0	1	4.9	6196	San Luis Obispo
003-711-025	857	Government	21	Developed, Open Space	0.9	1	3.7	6196	San Luis Obispo
004-251-056	857	Government	71	Grassland	5.3	1	7.6	6196	San Luis Obispo
004-261-085	850	Vacant Government	21	Developed, Open Space	0.5	4	3.5	6196	San Luis Obispo
004-271-032	857	Government	21	Developed, Open Space	0.9	4	1.7	6196	San Luis Obispo
004-291-007	857	Government	95	Emergent Herbaceous Wetlands	0.3	4	7.5	6196	San Luis Obispo
004-291-008	857	Government	95	Emergent Herbaceous Wetlands	0.1	4	51.9	6196	San Luis Obispo
004-401-031	857	Government	21	Developed, Open Space	0.3	4	11.6	6196	San Luis Obispo
004-422-035	857	Government	21	Developed, Open Space	0.3	1	0.8	6196	San Luis Obispo
004-431-009	820	School	21	Developed, Open Space	0.2	1	0.9	6196	San Luis Obispo
004-431-028	857	Government	21	Developed, Open Space	0.2	1	5.2	6196	San Luis Obispo
004-451-013	857	Government	11	Open Water	0.3	4	28.3	6196	San Luis Obispo
004-451-019	857	Government	21	Developed, Open Space	1.4	4	9.2	6196	San Luis Obispo
004-451-021	857	Government	21	Developed, Open Space	0.9	4	14.8	6196	San Luis Obispo
004-511-018	857	Government	21	Developed, Open Space	0.4	1	5.2	6196	San Luis Obispo
004-591-010	857	Government	21	Developed, Open Space	8.4	1	0.7	6196	San Luis Obispo
004-822-045	857	Government	21	Developed, Open Space	0.2	1	3.7	6196	San Luis Obispo
004-831-005	857	Government	21	Developed, Open Space	0.7	1	10.3	6196	San Luis Obispo
004-852-024	857	Government	21	Developed, Open Space	2.9	1	0.3	6196	San Luis Obispo
004-853-022	850	Vacant Government	71	Grassland	1.6	1	1.1	6196	San Luis Obispo
004-861-005	857	Government	21	Developed, Open Space	1.3	1	39.8	6196	San Luis Obispo
004-871-005	854	Government - Recreational	71	Grassland	3.3	4	316.5	6196	San Luis Obispo
004-951-014	854	Government - Recreational	21	Developed, Open Space	1.3	1	2.8	6196	San Luis Obispo
004-962-022	850	Vacant Government	21	Developed, Open Space	1.1	1	1.9	6196	San Luis Obispo
052-031-001	857	Government	21	Developed, Open Space	0.8	1	9.0	6162	San Luis Obispo
052-252-001	857	Government	21	Developed, Open Space	1.2	1	7.4	6162	San Luis Obispo
052-252-014	857	Government	21	Developed, Open Space	0.8	1	2.8	6162	San Luis Obispo
052-601-003	857	Government	21	Developed, Open Space	2.8	1	1.6	6162	San Luis Obispo
053-051-072	854	Government - Recreational	21	Developed, Open Space	0.0	1	0.8	6196	San Luis Obispo
053-061-054	860	Public Utility	21	Developed, Open Space	0.6	1	3.8	6196	San Luis Obispo
053-084-043	860	Public Utility	21	Developed, Open Space	0.4	1	0.8	6196	San Luis Obispo
053-111-058	854	Government - Recreational	21	Developed, Open Space	0.6	1	25.4	6196	San Luis Obispo
053-141-012	857	Government	21	Developed, Open Space	0.2	1	18.7	6196	San Luis Obispo
053-152-006	850	Vacant Government	82	Cultivated Crops	0.2	1	9.2	6196	San Luis Obispo
053-152-009	850	Vacant Government	82	Cultivated Crops	0.1	1	13.0	6196	San Luis Obispo
053-212-019	854	Government - Recreational	21	Developed, Open Space	0.7	1	3.1	6196	San Luis Obispo
053-231-038	854	Government - Recreational	71	Grassland	1.5	1	23.5	6196	San Luis Obispo

053-246-041	857	Government	21	Developed, Open Space	1.7	4	3.4	6196	San Luis Obispo
053-252-081	850	Vacant Government	21	Developed, Open Space	0.2	1	1.0	6196	San Luis Obispo
053-412-009	850	Vacant Government	21	Developed, Open Space	0.6	1	2.6	6196	San Luis Obispo
073-341-026	857	Government	82	Cultivated Crops	2.2	1	541.3	6162	San Luis Obispo
076-382-006	857	Government	21	Developed, Open Space	0.2	1	12.6	6196	San Luis Obispo
076-532-028	860	Public Utility	21	Developed, Open Space	1.6	1	11.6	6196	San Luis Obispo

Prospective Parcel-Scale LID sites in municipalities.

APN	County Use Code	County Use Code Definition	NLCD Landcover Value	NLCD Landcover Definition	slope (%)	Watershed Management Zone	Acres	CalWater Watershed Number	MS4
053-500-002	857	Government	21	Developed, Open Space	2.0	9	0.23	6219	San Luis Obispo
001-023-033	854	Government Recreational	21	Developed, Open Space	0.6	1	0.13	6162	San Luis Obispo
001-141-027	857	Government	22	Developed, Low Intensity	1.1	1	0.25	6172	San Luis Obispo
001-205-012	857	Government	22	Developed, Low Intensity	1.3	1	0.25	6162	San Luis Obispo
001-235-015	857	Government	22	Developed, Low Intensity	1.2	1	0.22	6172	San Luis Obispo
002-313-020	857	Government	22	Developed, Low Intensity	1.8	1	0.01	6162	San Luis Obispo
002-323-008	857 332	#N/A	23	Developed, Medium Intensity	0.9	1	0.15	6172	San Luis Obispo
002-327-003	860	Public Utility	23	Developed, Medium Intensity	1.1	1	0.15	6172	San Luis Obispo
002-412-003	857	Government	23	Developed, Medium Intensity	1.1	1	0.10	6162	San Luis Obispo
002-412-012	857	Government	22	Developed, Low Intensity	1.0	1	0.20	6172	San Luis Obispo
002-412-016	857	Government	22	Developed, Low Intensity	0.6	1	0.21	6172	San Luis Obispo
002-413-010	820	School	22	Developed, Low Intensity	1.7	1	0.21	6162	San Luis Obispo
002-421-020	857	Government	22	Developed, Low Intensity	0.6	1	0.12	6172	San Luis Obispo
002-482-012	857	Government	21	Developed, Open Space	0.4	1	0.15	6196	San Luis Obispo
003-571-019	857	Government	22	Developed, Low Intensity	2.0	1	0.06	6196	San Luis Obispo
003-644-014	857	Government	23	Developed, Medium Intensity	0.9	1	0.18	6196	San Luis Obispo
003-703-002	857	Government	22	Developed, Low Intensity	2.4	3	0.03	6196	San Luis Obispo
003-721-048	820	School	23	Developed, Medium Intensity	0.6	1	0.20	6196	San Luis Obispo
003-736-014	857	Government	22	Developed, Low Intensity	1.0	1	0.16	6196	San Luis Obispo
004-272-049	857	Government	22	Developed, Low Intensity	2.2	4	0.11	6196	San Luis Obispo
004-573-003	857	Government	22	Developed, Low Intensity	2.4	1	0.16	6196	San Luis Obispo
004-582-001	857	Government	23	Developed, Medium Intensity	1.5	1	0.13	6196	San Luis Obispo
004-741-004	854	Government Recreational	22	Developed, Low Intensity	0.2	1	0.18	6196	San Luis Obispo
004-822-010	857	Government	21	Developed, Open Space	1.0	1	0.08	6196	San Luis Obispo
004-912-064	857	Government	22	Developed, Low Intensity	0.9	1	0.00	6196	San Luis Obispo
004-951-022	850	Vacant Government	21	Developed, Open Space	1.1	3	0.22	6196	San Luis Obispo
004-951-024	850 200	#N/A	21	Developed, Open Space	1.6	3	0.15	6196	San Luis Obispo
052-115-001	820	School	23	Developed, Medium Intensity	2.0	3	0.11	6162	San Luis Obispo
052-115-002	820	School	23	Developed, Medium Intensity	2.0	3	0.11	6162	San Luis Obispo
052-115-003	820	School	22	Developed, Low Intensity	2.0	3	0.20	6162	San Luis Obispo
052-133-011	857	Government	21	Developed, Open Space	4.4	9	0.00	6172	San Luis Obispo
052-205-003	860	Public Utility	22	Developed, Low Intensity	0.9	1	0.16	6162	San Luis Obispo
052-231-009	857	Government	21	Developed, Open Space	0.9	3	0.03	6162	San Luis Obispo
052-351-043	857	Government	22	Developed, Low Intensity	1.1	1	0.08	6196	San Luis Obispo
052-482-013	857	Government	22	Developed, Low Intensity	1.9	3	0.05	6162	San Luis Obispo
052-512-011	857	Government	21	Developed, Open Space	4.9	9	0.08	6162	San Luis Obispo

053-071-025	850	Vacant Government	21	Developed, Open Space	1.2	1	0.23	6196	San Luis Obispo
053-151-038	850 035	#N/A	21	Developed, Open Space	0.1	1	0.14	6196	San Luis Obispo
053-212-012	860	Public Utility	21	Developed, Open Space	2.5	1	0.06	6196	San Luis Obispo
053-251-012	857	Government	23	Developed, Medium Intensity	0.2	1	0.02	6196	San Luis Obispo

APPENDIX 8

Potential and Identified Green Streets

This table lists all road segments within the watershed that meet the basic criteria for green street feasibility. An additional segment, Slack Street (bounded by Longview Lane and 1 block east of Henderson at street end), is not within an area of commercial land use but has been previously identified as being a promising location for green street retrofitting.

City/Road	Road Segment Lengths (ft)
San Luis Obispo	**31,974**
Broad St	3,668
Buena Vis	85
Buena Vista Ave	158
Cabrillo Hwy	1,517
California Blvd	1,613
Dalidio Dr	119
el Camino Real	19
Foothill Blvd	1,410
Grand Ave	551
Higuera St	2,760
Johnson Ave	1,865
Laurel Ln	826
Los Osos Valley Rd	2,275
Madonna Rd	2,062
Marsh St	1,836
Monterey St	1,759
Orcutt Rd	583
Osos St	724
Palm St	10
Prado Rd	1,156
Prefumo Canyon Rd	6
S Higuera St	2,008
San Luis Dr	505
Santa Barbara St	757
Santa Rosa St	736
South St	667
Tank Farm Rd	1,369
Toro St	118
Vachell Ln	551
Walnut St	155