4.2 SUB-BASINS WITHIN THE SAN JUAN AND WESTERN SAN MATEO CREEK WATERSHEDS

4.2.1 PHYSICAL PROCESS AND CONDITIONS OF SUB-BASINS

Although the sub-basins in the San Juan Creek Watershed and the western portion of the San Mateo Creek Watershed are hydrologically and biologically connected, each major sub-basin has somewhat unique or distinctive attributes.

In the San Juan Watershed, the areas that are available for consideration for future land use changes include portions of Chiquita, Gobernadora (including Wagon Wheel), Verdugo, and Central San Juan Creek (including Trampas Canyon). In the San Mateo Watershed, available areas include portions of Gabino (including Blind Canyon), La Paz, Upper Cristianitos, and Talega. Sub-basins of the two watersheds are shown in Figure 2-1. The subsections below summarize the major characteristics of these sub-basins using the USACE Engineer Research and Development Center (ERDC) Functional Assessment and the Watershed Planning Principles. The ERDC Functional Assessment is provided as Appendix E2 to this EIS. The Watershed Planning Principles are provided in Appendix B2.

Sub-basins not specifically discussed (e.g., Lucas, Bell, Oso, and lower Arroyo Trabuco Sub-basins) are unlikely to undergo future land use changes, as they are already conserved, developed, or currently undergoing development. Therefore, these sub-basins are not discussed in the following subchapters.

4.2.2 USACE ENGINEER RESEARCH AND DEVELOPMENT CENTER

The USACE Engineer Research and Development Center characterized aquatic resources within the San Juan Creek Watershed and the western portion of the San Mateo Creek Watershed in terms of their areal extent and their functional integrity through their planning-level delineation and landscape level functional assessment. Previous subchapters described the acreage of aquatic resource habitats for the entire SAMP Study Area. This subchapter summarizes the aquatic resources of the SAMP Study Area by sub-basin, providing a better characterization of local conditions for smaller geographic units.

Table 4.2-1 summarizes the planning-level delineation by sub-basin. The acreage data in the table was determined using the planning level delineation (USACE Engineer Research and Development Center, 2000a). The planning level delineation is an estimate of the amount of wetland, riparian, and aquatic resources using primarily aerial photographs with site visits chosen through stratified sampling. Consequently, these data are approximations of the amount of aquatic features present within the SAMP Study Area. The planning-level delineation is different from a site-specific jurisdictional determination, which uses exclusively measurements on the ground to determine the extent of wetland vegetation, limits of stream or wetland hydrology, and occurrence of hydric soils. Because of the differences in the methodologies for performing a planning-level delineation compared to a site-specific delineation, there are differences in results due to the use of distinct methodologies for different purposes.

TABLE 4.2-1
AQUATIC RESOURCES FOR EACH SUB-BASIN WITHIN THE SAN JUAN CREEK AND WESTERN SAN MATEO CREEK WATERSHEDS

Sub-Basin	Total Aquatic Resources (acres)	Aquatic Resource[a] Types Common to the Sub-Basin (acres)
Trabuco	2,229	Southern Coast Live Oak Riparian Forest (575), Bigcone Spruce-Canyon Live Oak Forest (319), White Alder Riparian Forest (237), Coast Live Oak Woodland (189), Southern Willow Scrub (182), Mulefat Scrub (139), Canyon Live Oak Forest (122), Southern Sycamore Riparian Woodland (120), Canyon Live Oak Ravine Forest (119), Intermittent Rivers and Streams (106), Perennial Rivers and Streams (30), and Floodplain Sage Scrub (18)
Bell Canyon	1,549	Southern Coast Live Oak Riparian Forest (669), Coast Live Oak Woodland (257), Southern Sycamore Riparian Woodland (125), Bigcone Spruce-Canyon Live Oak Forest (88), Canyon Live Oak Ravine Forest (79), White Alder Riparian Forest (78), Canyon Live Oak Forest (69), Intermittent Rivers and Streams (53), Mulefat Scrub (34), Ephemeral Streams (25), Southern Willow Scrub (24), and Open Water (23)
Upper San Juan	1,009	Southern Coast Live Oak Riparian Forest (497), Southern Willow Scrub (165), Southern Sycamore Riparian Woodland (162), Bigcone Spruce-Canyon Live Oak Forest (71), Ephemeral Streams (39), Coast Live Oak Woodland (27), and White Alder Riparian Forest (25)
Central San Juan	618	Southern Coast Live Oak Riparian Forest (201), Mulefat Scrub (118), Southern Arroyo Willow Forest (76), Coast Live Oak Forest (59), Coastal Freshwater Marsh (48), Open Water (43), Intermittent Rivers and Streams (24), and Coast Live Oak Woodland (20)
Gobernadora	548	Southern Coast Live Oak Riparian Forest (130), Coast Live Oak Woodland (124), Southern Arroyo Willow Forest (81), Southern Willow Scrub (58), Mulefat Scrub (47), Coastal Freshwater Marsh (36), and Open Water (33)
Gabino	504	Southern Coast Live Oak Riparian Forest (279), Mulefat Scrub (121), Southern Sycamore Riparian Woodland (51), and Coast Live Oak Woodland (20)
Oso	431	Open Water (200), Southern Willow Scrub (55), Southern Arroyo Willow Forest (46), Mulefat Scrub (32), Flood Control Channels (27), Spreading Grounds and Detention Basins (20), and Coast Live Oak Woodland (19)
Middle San Juan	431	Floodplain Sage Scrub (164), Coast Live Oak Woodland (114), Intermittent Rivers and Streams (39), Canyon Live Oak Ravine Forest (32), Southern Sycamore Riparian Woodland (31), and Mulefat Scrub (26)
Cristianitos	403	Southern Coast Live Oak Riparian Forest (218), Coast Live Oak Forest (96), and Mulefat Scrub (56)
Chiquita	342	Intermittent Rivers and Streams (62), Mulefat Scrub (51), Southern Arroyo Willow Forest (47), Southern Willow Scrub (44), Southern Coast Live Oak Riparian Forest (37), Coastal Freshwater Marsh (26), Southern Sycamore Riparian Woodland (19), and Coast Live Oak Woodland (15)
Lower San Juan	258	Perennial Rivers and Streams (72), Southern Willow Scrub (59), Mulefat Scrub (32), Southern Coast Live Oak Riparian Forest (27), Coastal Freshwater Marsh (19), Southern Arroyo Willow Forest (19), and Intermittent Rivers and Streams (19)
Verdugo	233	Southern Coast Live Oak Riparian Forest (129), Southern Willow Scrub (36), Mulefat Scrub (28), and Floodplain Sage Scrub (21)
La Paz	184	Mulefat Scrub (60), Southern Sycamore Riparian Woodland (37), Southern Coast Live Oak Riparian Forest (31), Coast Live Oak Woodland (28), and Floodplain Sage Scrub (17)
Lucas Canyon	155	Floodplain Sage Scrub (44), Southern Coast Live Oak Riparian Forest (38), Southern Willow Scrub (31), and Mulefat Scrub (21)
Wagon Wheel	141	Southern Coast Live Oak Riparian Forest (82), Southern Willow Scrub (33), and Coast Live Oak Woodland (9)
Tijeras Creek	121	Southern Coast Live Oak Riparian Forest (37), Southern Sycamore Riparian Woodland (34), and Open Water (18)
Blind	102	Southern Coast Live Oak Riparian Forest (46), Coast Live Oak Forest (46), and Southern Sycamore Riparian Woodland (6)
Horno	29	Southern Willow Scrub (14), Southern Coast Live Oak Riparian Forest (5), and Open Water (4)
Talega[b.]	1	Mulefat Scrub (1)
Total	**9,288[c.]**	

a. Habitat types represent natural and non-native types comprising at least 15 acres within a sub-basin, or the predominant three habitats within the sub-basin.
b. Not all of Talega Canyon in the SAMP Study Area was surveyed as part of the SAMP.
c. Numbers do not add up due to rounding.

In practice, the planning-level delineation does not substitute for site-specific jurisdictional delineations. Whenever a site-specific delineation is available, the site-specific data should be used for determining project level impacts for environmental evaluation, geographical limits for avoidance, and compensatory mitigation ratios. The planning level delineation is valuable for planning purposes and for understanding broad landscape issues. The planning-level delineation can best be used to understand the extent of aquatic resources such as wetlands, streams, and riparian areas within the larger geographic area, something that cannot be accomplished solely from site-specific delineations.

The sub-basins represent smaller geographical regions within the SAMP Study Area. Given the size of the overall SAMP Study Area, the areal extent and condition of aquatic resources including riparian areas are not homogenous throughout the watershed. Aquatic resources are more prevalent in specific sub-basins compared to others. In addition, the functional integrity of riparian areas differs from sub-basin to sub-basin. Consideration of the areal extent of aquatic resources and the functional integrity of riparian resources at the sub-basin level allows for more detailed discrimination of the aquatic resources within the SAMP Study Area, allowing for development of better regulatory policies.

The total SAMP Study Area contains approximately 9,288 acres of mapped habitat within aquatic resource areas consisting of wetlands, riparian habitat, and streambeds among the various sub-basins (Table 4.2-1). The sub-basins include those for Oso Creek, Trabuco Creek, Tijeras Creek, Horno Creek, Chiquita Creek, Wagon Wheel Creek, Gobernadora Creek, Talega Creek, Blind Creek, Bell Creek, Gabino Creek, Verdugo Creek, Lucas Creek, and Lower, Central, Middle, and Upper San Juan Creeks. Of the 9,288 acres of aquatic resource area, over half of the acreage is within the Trabuco Creek, Bell Canyon, and upper San Juan Creek Sub-basin. In general, the more natural habitats are located in the northeastern portion of the SAMP Study Area.

A particular subset of the mapped aquatic resources is riparian habitat. Riparian habitat was mapped to allow the implementation of the landscape level functional assessment, an assessment methodology developed explicitly for riparian areas. The landscape-level functional assessment was used to evaluate the functional integrity of these aquatic resources in terms of their hydrologic, water quality, and habitat integrity using historical conditions as a baseline. Functional integrity can be thought of as the quality of the riparian habitat, with higher integrity riparian areas possessing higher overall quality with respect to hydrologic, water quality, and habitat functions.

As identified in Table 4.2-2, approximately 3,021 acres of riparian habitat were mapped within the SAMP Study Area by the USACE Engineer Research and Development Center. For each sub-basin within the SAMP Study Area, the amount of riparian habitat was quantified with respect to the three functional integrity index scores assessing hydrology, water quality, and habitat integrity. Riparian habitat achieving at least 70 percent of the maximum score for all of the three integrity indices was considered to have very high integrity. Riparian habitat achieving at least 70 percent of the maximum score for one or two of the three integrity indices (but not all three) were considered to have high integrity. Riparian habitat achieving at least 40 percent of the maximum score for at least one of the three indices but less than 70 percent for all three were considered to have medium integrity.

Table 4.2-2 quantifies the amount of acreage of riparian habitat within each sub-basin with very high integrity, with high to very high integrity, and with medium to very high integrity in order to characterize the relative quality and condition of riparian habitat within each sub-basin. Some sub-basins such as that for Oso Creek exhibit low functional integrity, showing that the riparian

habitat in that sub-basin in general is of poorer condition. Other watershed such as that for middle and upper San Juan Creek exhibit very high functional integrity, showing that the riparian habitat in those sub-basin areas in general are of better condition. The condition of the riparian habitat in each sub-basin listed in the table is described in more detail in this chapter.

TABLE 4.2-2
RIPARIAN HABITAT RESOURCES WITHIN THE SAN JUAN CREEK AND WESTERN SAN MATEO CREEK WATERSHEDS BY SUB-BASIN

Sub-Basin	Total Acres	Very High Integrity[a.]		High to Very High Integrity[b.]		Medium to Very High Integrity[c.]	
		Acres	%[d.]	Acres	%[d.]	Acres	%[d.]
Trabuco	639	188	29%	503	79%	609	95%
Central San Juan	296	225	76%	282	95%	296	100%
Middle San Juan	292	292	100%	292	100%	292	100%
Chiquita	283	168	59%	279	98%	283	100%
Gobernadora	241	13	5%	87	36%	164	68%
Bell Canyon	218	193	89%	213	98%	217	100%
Lower San Juan	176	6	3%	30	17%	104	59%
Upper San Juan	176	176	100%	176	100%	176	100%
Oso	161	1	1%	31	19%	49	31%
Cristianitos	133	31	23%	133	100%	133	100%
Gabino	106	94	89%	106	100%	106	100%
Lucas	83	83	100%	83	100%	83	100%
La Paz	76	73	95%	76	100%	76	100%
Verdugo	64	64	100%	64	100%	64	100%
Tijeras	48	0	0%	0	0%	45	94%
Wagon Wheel	11	2	14%	8	66%	11	100%
Horno	10	0	0%	0	1%	<1	1%
Blind	8	8	100%	8	100%	8	100%
Totals	**3,021**	**1616**	**53%**	**2,370**	**78%**	**2,717**	**90%**

a. Very high integrity riparian areas are those that have attained at least 70% of the maximum integrity scores for the hydrology, water quality, and habitat integrity indices.
b. High to very high integrity riparian areas are those that have attained at least 70% of the maximum integrity scores for one or two of the hydrology, water quality, or habitat integrity indices.
c. Medium to very high integrity riparian areas are those that have not attained at least 40% of the maximum integrity scores for the hydrology, water quality, or habitat integrity indices.
d. % of the total existing riparian habitat (e.g., 639 acres for Trabuco and 296 acres for Central San Juan)

4.2.3 SAN JUAN CREEK WATERSHED SUB-BASINS

4.2.3.1 Overview of Verdugo Canyon Sub-basin

Terrain

The 4.80-square mile Verdugo Canyon Watershed has roughly an east-west orientation with several tributary channels entering the main valley stream from the north and south. The Verdugo Canyon Sub-basin is underlain by bedrock of the Williams, Ladd, and Trabuco

formations and the Santiago Peak Volcanics. Approximately one-half to two-thirds of the Verdugo Canyon drainage basin lies within the SAMP Study Area boundary. Within the boundaries of the SAMP Study Area, the underlying bedrock consists of the Schulz Ranch and Starr members of the Williams formation, the Holz Shale and Baker Canyon members of the Ladd Formation, and the Trabuco formation. Surficial geologic units within the SAMP Study Area consist of alluvium, colluvium, nonmarine terrace deposits, and a few landslides. The landslides located within the SAMP Study Area are shallow and of relatively limited areal extent.

Hydrology

Drainage density for the Verdugo Canyon Sub-basin varies spatially, with an average density of 13 linear miles per square mile (mi/mi.^{2}). The eastern headwaters of Verdugo Canyon have a lower drainage density, while the area north of Verdugo Creek in the central canyon area has a higher drainage density. This increased drainage density likely reflects the geologic substrate beneath the central Lucas and Verdugo basins. Overall, 562 first order drainages are delineated in the Verdugo Canyon Sub-basin. Similar to Lucas Canyon, these first order reaches comprise about 51 percent of the total stream length in the basin. Verdugo Canyon is a fifth order stream system at its confluence with the main San Juan channel, immediately downstream of Bell Canyon.

The hydrographs for Verdugo Creek show two distinct peaks with a smaller yet distinct peak, occurring prior to the main peak of the hydrograph. This shape is characteristic of the hydrographs for Lucas Canyon, Verdugo Canyon, and the Central San Juan catchments, and likely results from the shape of the precipitation hyetograph modeled for this portion of the watershed. Peak flows from Verdugo Creek arrive at San Juan Creek approximately 2.4 hours, 2.8 hours, and 4.8 hours before the flow in San Juan Creek for the 2-year, 10-year, and 100-year peak flows, respectively. Therefore, peak flows from Verdugo Canyon do not significantly increase peak flows in San Juan Creek at the confluence or downstream. Runoff volumes and peak flows from Verdugo Canyon are relatively small, as is expected given the high infiltration rates in the sub-basin. Verdugo Canyon contributes less than 4 percent of the runoff volume to San Juan Creek at its confluence with Verdugo Canyon, while it occupies approximately 6.2 percent of the watershed area at that point. Peak flows from Verdugo Canyon are also less than 4 percent of the total peak flows in San Juan Creek at the confluence. Verdugo Canyon produced less runoff on a per-acre basis than four out of the five other San Juan sub-basins analyzed. Only the central San Juan catchments had lower runoff per-area values.

Sediment Processes

Verdugo Canyon, along with Lucas and Bell Canyons, constitute the more silty portions of the San Juan Creek Watershed, with upper portions of the sub-basins containing crystalline terrains. These areas are characterized by coarser substrates, shallower soils, and steeper slopes than Chiquita or Gobernadora. The combination of substrate type and slope results in Verdugo Canyon having the highest sediment transport rate per unit area of any of the sub-basins in San Juan Creek Watershed. Sediment yield for Verdugo is second behind Bell Canyon. Like many of the steep silty and crystalline areas of the SAMP Study Area, much of the sediment in Verdugo is mobilized during episodic events and, when mobilized, has the potential to have substantial effect on sediment delivery and on the geomorphology of the downstream areas.

Water Quality

The large quantities of highly erodible soils in the Verdugo Sub-basin can be expected to provide a source of phosphorus loading to San Juan Creek. Nitrogen loading from the sub-basin is expected to be low. Because only six percent of the watershed is covered with grasslands, there are limited anthropogenic sources and little channel incision. The terrain and steep slope of Verdugo Canyon likely result in direct nutrient and pollutant pathways to surface waters. The existence of an intact riparian corridor implies that there is potential for sequestration of constituents of concern within floodplain terraces with increased amounts of organic carbon available to augment nitrogen cycling. Speciation is expected to favor the transport of metals and pesticides (were any to be present) in an adsorbed form.

Groundwater

Verdugo Canyon had one of the highest predicted infiltration rates of any of the sub-basins studies in the San Juan Watershed. This results from the undeveloped condition of the sub-basin, the relatively high proportion of Type A (8.3 percent) soils (compared to other sub-basins), and relatively low proportion of Type D soils (28.6 percent) compared to other sub-basins in the watershed.

Biological Resources

The streams are predominantly coarse substrate with southern coast live oak riparian woodland, surrounded by sage scrub and chaparral. These areas are more similar to habitats found in the upper San Mateo Watershed than to those found in Chiquita and Gobernadora. Because groundwater is less prevalent than in Chiquita or Gobernadora, the habitats are more mesic than the willow riparian habitats found in those sub-basins. The narrowness of the canyon results in high biological interaction between the habitats of the floodplain and the adjacent uplands. Please refer to subchapter 4.1.3 for a detailed discussion of biological resources.

Summary of USACE Engineer Research and Development Center (ERDC) Functional Assessment

The USACE Engineer Research and Development Center Functional Assessment concludes the following about the Verdugo Canyon Sub-basin:

The Verdugo Canyon Sub-basin originates from the Cleveland National Forest in Riverside County and drains southwesterly to San Juan Creek in Orange County. The sub-basin is mostly undeveloped with the land uses associated with the Cleveland National Forest and some light ranching operations. USACE Engineer Research and Development Center mapped 176 acres of riparian habitat within this sub-basin. Notable aquatic habitat types include southern coast live oak riparian forest, southern willow scrub, and mulefat scrub. The sub-basin has experienced little degradation to riparian habitat due to the low amount of impacts associated with the ranching and national forest operations. The entire riparian habitat is categorized as having very high integrity.

Planning Considerations from Watershed Planning Principles

Planning considerations for the Verdugo Canyon Sub-basin from the Watershed Planning Principles are as follows:

- Verdugo Canyon has one of the highest soil infiltration rates of any of the sub-basins studied in the San Juan Watershed.

- Substrate types and slope result in Verdugo Canyon having the highest sediment transport rate per unit area of any San Juan Creek Watershed Sub-basin, with sediment yield second behind Bell Canyon. Much of the sediment in Verdugo is mobilized during episodic events and, when mobilized, has the potential to have substantial effects on sediment delivery and on the geomorphology of downstream areas.

- The large quantities of highly erodible soils in the Verdugo Sub-basin are expected to provide a source of phosphorus loading to San Juan Creek.

- The upper portion of the Verdugo Sub-basin is underlain by the Trabuco and Ladd formations, which lack shallow groundwater and yield little baseflow. Due to the relative absence of groundwater and the presence of the steep slopes, both upland and riparian habitats reflect drier conditions than in other sub-basins.

- The stream course has a predominantly coarse substrate and is strongly influenced by the narrowness of the canyon.

4.2.3.2 Overview of Central San Juan and Trampas Canyon Sub-basin

Terrains

In the central portion of the San Juan Watershed, about 10 to 12 miles upstream from the coast, there is a 7.4-square mile area (between the mouths of Cañada Gobernadora and Bell Canyon upstream) that contains several small tributary drainages which feed directly into the main stem of San Juan Creek. The area surrounding the Color Spot Nursery drains directly southward into the main San Juan system and, as such, is not part of either the Gobernadora or Bell Canyon Sub-basins. This triangular area is drained by two third order creeks and one fourth order stream. On the south side of San Juan Creek, Trampas Canyon, and two unnamed fourth order streams drain steep terrain directly to San Juan Creek. The central portion of the main stem of San Juan Creek, downstream of Bell, Lucas, and Verdugo Canyons, consists of a meandering river with several floodplain terraces in a wide valley bottom.

The Central San Juan and Trampas Canyon drainage basin is underlain by bedrock of the Santiago, Silverado, and Williams formations. Bedding within the bedrock of the Santiago, Silverado, and Williams formations is near horizontal to gently dipping. Surficial geologic units within the SAMP Study Area consist of alluvium, colluvium, nonmarine terrace deposits, and a few landslides. There are two large landslide complexes located south of San Juan Creek along the western boundary of the drainage basin. In addition, two Late Quaternary fault systems−the Cristianitos and the Mission Viejo faults−trend through this drainage basin. The Cristianitos fault trends approximately northwest–southeast along the western boundary of the drainage basin south of San Juan Creek. Two branches of the Mission Viejo fault trend approximately north-south through the eastern portion of the drainage basin. Review of available geologic literature indicates these fault systems are not considered active pursuant to the guidelines of the Alquist-Priolo Earthquake Fault Zone Map.

The majority of the Central San Juan Sub-basin area is underlain by soils of hydrologic groups C (52.6 percent) and D (29.2 percent). Of the six sub-basins studied in the watershed, the Central San Juan catchments had nearly the highest maximum loss rate, second only to Lucas

Canyon. This is likely reflective of the shallow slope and broad floodplain valley that facilitates infiltration.

Hydrology

This sub-basin differs from the other studied sub-basins in that the other sub-basins typically consist of a single canyon whose discharge joins San Juan Creek at a single confluence. The effects of these discharges on San Juan Creek occur primarily at the confluence point. By contrast, within the Central San Juan catchments sub-basin, effects of the surface runoff are distributed in numerous locations along the reach of the main San Juan Creek channel.

In the Central San Juan catchments, peak flows from the tributaries occur approximately 4.4 hours, 2.4 hours, and 2.0 hours before the San Juan Creek peak flows through this area for the 2-year, 10-year, and 100-year events, respectively. Partially due to this difference in peak timing and also due to the moderate rates and volumes or runoff from this sub-basin, peak flows from the Central San Juan catchments do not have a significant impact on peak flows in San Juan Creek at the confluence and downstream. In absolute terms, runoff volumes and peak flows from the Central San Juan catchments are among the lowest of the six San Juan Sub-basins studied. For all three events, the Central San Juan catchments contribute between 2 percent and 5.5 percent of the runoff volume to San Juan Creek at their confluence, while they occupy approximately 8.8 percent of the watershed area at that point. Peak flows from the Central San Juan catchments are between approximately 3.5 percent and 5.5 percent of peak flows in San Juan Creek at the confluence. For the three events modeled, the Central San Juan catchments produced between 24 percent and 69 percent as much runoff on a per-acre basis as the average for the San Juan Creek Watershed as a whole, and peak discharge per unit area was among the lowest of the San Juan Sub-basins. These low runoff values are likely due to the large proportion of undeveloped areas in the sub-basin, particularly along the central San Juan Creek floodplain, and the small size of the sub-basin in comparison to the other reported sub-basins. Low sub-basin slopes and a broader sub-basin shape may also reduce runoff by increasing infiltration.

Sediment Processes

The central portion of San Juan Creek is most important as a sediment transport reach. All the catchments that drain into this portion of San Juan Creek together produce a comparable amount of sediment as the Chiquita Canyon Sub-basin. In addition, due to its size, there is a substantial amount of bedload transport that occurs along the central portion of San Juan Creek. However, the yield per unit area for the central catchments is the lowest of any area studied in the San Juan Watershed. Like Cristianitos Creek, the central portion of San Juan functions as a sediment conduit between the major sediment-producing sub-basins and downstream areas.

Water Quality

The nature of the soils in the central San Juan tributaries favors the relatively rapid mobilization of constituents into surface water flows and ready transport of pollutants out of the central sub-basins (e.g., Trampas Canyon) and into the main stem of San Juan Creek. The combination of predominant grasslands, erodible soils, and anthropogenic sources means that the sub-basins can be expected to generate relatively large nitrogen and phosphorus loadings for their size and may be a contributor to the increases in nutrient concentrations between Caspers Regional Park and La Novia that is evident in the Orange County Public Facilities and Resources Department (PFRD) monitoring program. However, some of the constituents may be sequestered (at least

seasonally) within the permeable alluvial aquifers of San Juan Creek. High loads of fine sediment and particulates should favor the adsorbed phases of heavy metals and pesticides.

Groundwater

The central portion of San Juan Creek has intermittent to near-perennial flow that is supported by alluvial groundwater that is near the surface, at least seasonally. The riparian habitats and pool and ponds depend on sufficient duration of shallow groundwater. This groundwater is recharged from sub-basins higher in the watershed and is conveyed in the alluvium through the central portion of San Juan Creek.

Biological Resources

Agricultural and developed lands cover approximately 12 percent of the land in this sub-basin; nurseries are a prominent land use. On the north side of San Juan Creek, above the Color Spot Nursery, there are two major tributaries. The first bisects the sub-basin beginning as a moderate- to high-gradient, scrub-oak-dominated riparian zone in a chaparral matrix. As the gradient decreases, the sinuosity increases, and the stream corridor supports mature oak woodland. The lowest portion of the stream transitions into a 3-foot-deep-by-5-foot-wide incised channel, characterized by mule fat scrub habitat. The substrate of the stream is dominated by rock and boulders indicating a high energy system where the stream condition is controlled by episodic high velocity flows that convey a lot of debris from the upper watershed. The second drainage feature on the north side of the creek flows out of a canyon to into a manmade impoundment. The upper portion of the stream consists of high gradient, scrub-oak-dominated riparian habitat in a chaparral matrix, similar to the main canyon. As this stream flows toward the impoundment, the slope flattens and the vegetation community transitions into southern-willow riparian habitat with an understory dominated by *Scirpus* spp. (bulrush) and *Baccharis salicifolia* (mule fat). Although not currently occupied, the structure and composition of the lower portion of the drainage appears to be suitable for occupation by least Bell's vireo or southwestern willow flycatcher. The pond at the terminus of this drainage is impounded by a road fill and lacks any substantive fringing wetland vegetation.

The area along Radio Tower Road, on the south side of San Juan Creek, contains representatives of all the major wetland types in the SAMP Study Area: riverine, alkali marsh, slope wetlands, vernal pool, and lacustrine fringe wetlands. The riverine areas on the site are generally high-gradient, low-order streams characterized as steep canyons dominated by sycamore or willow riparian forest. Portions of the drainages appear to have perennial flow, probably associated with groundwater discharge and areas of heavy soils (i.e., relatively high clay content).

Two portions were found to contain slope wetlands associated with localized slumps that result in groundwater discharge. The first area has formed in a small slump adjacent to the main dirt road traversing the area, while the second area is above a corral and contains two slope wetlands. A natural spring has been altered to create a stock pond; a 240-foot-long-by-45-foot-wide slope wetland has formed in association with the spring and pond. A second slope wetland is located approximately 200 feet west of the spring, in association with a cut in the slope. Both slope wetlands are saturated at or near the surface for the majority of the year. The area contains three distinct areas that support vernal pools. All the pools have recently been documented to support the federally listed endangered San Diego and the Riverside fairy shrimp. Several manmade stock ponds in this area support fringing lacustrine wetlands. These stock ponds provide year-round habitat for amphibians (including bullfrogs) and waterfowl. All upland areas have been heavily grazed and are dominated by non-native grasslands.

Sand, hard rock, and minerals have been mined from Trampas Canyon over the last 50 years. A lake in the quarry pit dominates this sub-basin. The lake is steep-sided, relatively deep, and does not support any aquatic resources of note. The surrounding uplands are dominated by ruderal vegetation and contain minimal habitat value. Consequently, there are minimal sensitive resources associated with this artificial lake area.

The middle reach of the main stem of San Juan Creek is a broad, meandering stream with several floodplain terraces. The middle reach of San Juan Creek supports a mosaic of southern willow riparian woodland, mule fat scrub, open water, and sand bars. The adjacent terraces support coast live oak woodland and southern sycamore riparian woodland. The creek has relatively coarse substrate and high topographic complexity, with a variety of secondary channels, pits, ponds, and bars. An abandoned aggregate mining pit has been filling in on its own from upstream sources over the last several years and supports an open water and emergent marsh community. The southwestern arroyo toad is known to occur in the middle reaches of San Juan Creek, but the bullfrog population associated with the old mining pit may affect the population size.

Summary of USACE Engineer Research and Development Center (ERDC) Functional Assessment

The USACE Engineer Research and Development Center Functional Assessment concludes the following about the Central San Juan and Trampas Canyon Sub-basin:

The central San Juan Creek Sub-basin bounds the area draining into San Juan Creek starting from just downstream of San Juan Creek's confluence with Verdugo Canyon down to just upstream of San Juan Creek's confluence with Gobernadora Creek. The most notable tributary draining into central San Juan Creek is Trampas Canyon. This sub-basin has some human activities related to ranching, crop agriculture, nursery operations, and mining along San Juan Creek and within the Trampas Canyon. USACE Engineer Research and Development Center mapped 218 acres of riparian habitat within this sub-basin. Notable aquatic resource habitat types include southern coast live oak riparian forest, mulefat scrub, southern arroyo willow forest, and coastal freshwater marsh, intermittent rivers, and streams. This sub-basin has experienced moderate degradation to riparian habitat due to the presence of various human activities. However, due to the localized nature of a lot of these activities, the riparian habitat is still in good condition. About 76 percent of the riparian habitat is categorized as having very high integrity; 95 percent of the riparian habitat is categorized as high to very high integrity; and 100 percent of the riparian habitat is categorized as medium to very high integrity.

Planning Considerations from Watershed Planning Principles

Planning considerations for the Central San Juan and Trampas Canyon Sub-basin from the Watershed Planning Principles are as follows:

- Clayey silts and sands that underlie smaller areas east of the Mission Viejo fault have a high propensity for shallow mudflows following periods of extended rainfall.

- The area along Radio Tower Road contains representative wetland types including riverine, alkali marsh, slope wetlands, vernal pool, and lacustrine fringe wetlands. The slope wetlands appear to be associated with localized bedrock landslides from the San Onofre and Monterey formations that store groundwater discharge over a prolonged period. The vernal pools are also associated with landslides and support both the federally listed endangered San Diego and the Riverside fairy shrimp. Manmade stock

ponds support fringing lacustrine wetlands. Riverine reaches within this area are generally high-gradient, low-order streams characterized as steep canyons dominated by sycamore or willow riparian forest. Some areas appear to have perennial or near-perennial flow.

- Trampas Canyon is disturbed and has adjacent areas with low to moderate hydrologic, water quality and habitat integrity function and value.

- Sand, hard rock, and minerals have been mined from Trampas Canyon over the last 50 years. An artificial lake dominates this sub-basin. The lake is steep-sided, relatively deep and the uplands surrounding the artificial lake are dominated by ruderal vegetation.

- Runoff and baseflow from Trampas Creek may contribute to supporting a small arroyo toad population near its confluence with San Juan Creek.

4.2.3.3 Overview of Cañada Gobernadora Sub-basin (including Wagon Wheel and Sulfur Canyons)

Terrains

The 11.10-square-mile Cañada Gobernadora Sub-basin is an elongated valley that is aligned north to south. At 9.7 miles, it is the longest sub-basin in the San Juan Creek Watershed and represents about 11.6 percent of the total watershed area upstream of the Cañada Gobernadora and San Juan Creek confluence.

The geology, soils, and resultant terrains in Cañada Gobernadora are extremely complex. The Cañada Gobernadora Sub-basin has the lowest percentage of Class D (low infiltrating) soils of any of the sub-basins analyzed and is underlain by geologic formations associated with shallow aquifers. The upper portion of the sub-basin (mainly beyond the RMV Planning Area) is underlain by the Sespe Formation, while the lower portion of the sub-basin (within the RMV Planning Area) is underlain by the Santiago Formation. Surficial geologic units within the SAMP Study Area consist of alluvium, colluvium, nonmarine terrace deposits, and a few landslides.[1] Consequently, the Cañada Gobernadora Sub-basin contains some of the highest potential infiltration areas in the SAMP Study Area. This condition is especially true in the valley floor, which is characterized by deep alluvial deposits with interbedded clay lenses that support seasonally shallow groundwater. However, the sandy and silty substrates on many of the hill slopes and ridges in the sub-basin are overlain by several feet of exhumed hardpan or contain exposed rock outcrops. These areas presently exhibit rapid runoff comparable to Class D soils.

Hydrology

Runoff patterns in the Cañada Gobernadora Sub-basin are influenced by the shape of the watershed, the underlying soils and geology, and upstream development in Coto de Caza. In the northern portion of the sub-basin, upstream of the Wagon Wheel confluence, the main valley is drained by a fifth order channel for most of its length. Downstream of the confluence with Wagon Wheel, Gobernadora becomes a sixth order system until it joins San Juan Creek further downstream. More than 30 third order channels and 6 fourth order stream courses converge on the main Cañada Gobernadora channel from the western and eastern side slopes. The overall drainage density is approximately 9 mi/mi.^{2} for the combined basins, which share 500 first order

[1] Review of aerial photographs and available geologic maps indicates that the landslides located within the SAMP Study Area are shallow and of relatively limited aerial extent.

channels. First order drainages represent about 45 percent of the total stream length, whereas fifth and sixth order drainages comprise 8.6 percent of total channel length. Due to the elongated configuration of this basin, first order streams are proportionally less of the total stream length than in some of the other sub-basins like Verdugo, Lucas, or Bell Canyons. In addition, many of the tributaries are channel-less swales. These areas represent high infiltration zones that likely convey stream runoff to the main-stem of Cañada Gobernadora and only exhibit surface connection following extreme runoff events. These infiltration zones may also contribute to baseflow and the perennial nature of Cañada Gobernadora.

Runoff volumes and peak flows from Cañada Gobernadora are relatively high in comparison to the other San Juan Sub-basins. Cañada Gobernadora contributes about 8 percent of the runoff volume to San Juan Creek at their confluence while it occupies approximately 11.6 percent of the watershed area at that point. For the three events modeled, Cañada Gobernadora produced approximately 62 to 75 percent as much runoff on a per-acre basis as the average for the San Juan Creek Watershed as a whole. However, runoff response is rapid. This results from the long, thin shape of the sub-basin; the impervious hardpan and bedrock outcrops; and the relatively greater proportion of developed areas in this sub-basin (particularly in the northern basin). Peak flows from Cañada Gobernadora arrive at San Juan Creek approximately 4.4 hours, 2.4 hours, and 1.6 hours prior to the passing of peak flows along San Juan for the 2-year, 10-year, and 100-year events, respectively. Although this represents a substantial time separation, peak flows from Cañada Gobernadora do have a recognizable impact on peak flows in San Juan Creek at the confluence and downstream due to the relatively large size of the peak flow from the canyon.

Sediment Processes

The Cañada Gobernadora Sub-basin is predominantly underlain by sands and silts and has the potential to generate relatively high amounts of sediment where the surface is disturbed and channelized. Currently, high sediment yields (mainly from the disturbed upper portion of the sub-basin outside the RMV Planning Area) result in a transport limited system with yields and transport rates (both absolute and per unit area) for Cañada Gobernadora that are the highest of any sand-dominated sub-basin. Sediment yield and transport rates are comparable to the Verdugo Sub-basin, which is a steeper and coarser substrate basin, and absolute sediment transport is second only to the larger Bell Canyon Sub-basin. In recent years, natural sediment sources have been augmented by sediment runoff from graded slopes in the developing areas of the upper sub-basin (outside the RMV Planning Area). Much of the sediment generated from the upstream development in Coto de Caza deposits in the lower portion of the canyon, typically within the riparian zone.

Water Quality

Pollutant transport within the Cañada Gobernadora Sub-basin is quite complicated with different pathways dominating by location and even season. Much of the watershed land in the middle and lower reaches are underlain by the permeable Santiago sandstone. Therefore, early in the winter it is reasonable to assume that most rainfall infiltrates and that groundwater pollutant pathways are predominant. The presence of sandy apron deposits at the mouth of side canyons can locally encourage infiltration. Where the channel is aggrading, there is a greater connectivity with the floodplain and more possibilities for the riparian corridor to play a role in assimilating constituents of concern. However, surface water pathways likely predominate in the lower reaches due to incision that has led to a loss of channel-floodplain connectivity and the presence of heavy clays that bring groundwater to the surface. This sub-basin is likely a significant source of nitrogen and phosphorus loadings from grasslands/agriculture, urbanization

in the upper reaches with minimal use of BMPs, and the presence of large nursery operations. Conditions favor the transport of metals and pesticides in particulate form.

Groundwater

Along with Chiquita, the Cañada Gobernadora Sub-basin is the only portion of the SAMP Study Area where shallow subsurface water plays an important role in the ecology of aquatic resources. The Santiago formation that dominates the lower portion of the sub-basin is associated with lateral groundwater flow along interfaces between thinly interbedded impermeable clay and permeable sand. This creates areas of shallow groundwater in the valley bottom and the lower portion of some of the lateral swales. The shallow groundwater (along with urban runoff from upstream development) contributes to the perennial nature of Cañada Gobernadora. In addition, several of the tributaries to Cañada Gobernadora, such as Wagon Wheel and Sulfur Canyons, support wetlands along faults or fracture zones that cut the sands of the Sespe formation, releasing water stored in the sandstone.

Biological Resources

The broad floodplain valley bottom and shallow groundwater found in Cañada Gobernadora allow the creek to support relatively dense riparian habitat. The lowest portion of the main creek (upstream from the confluence with San Juan Creek) has been restored and enhanced as mitigation for authorized impacts to riparian habitats in other areas of Orange County. This portion of San Juan Creek supports dense thickets of willow scrub, open water, and emergent marsh. An area adjacent to the middle portion of the creek has recently been used to create emergent wetlands as mitigation for impacts in other locations. Over time, this area is expected to develop to a matrix of willow scrub, emergent marsh, and woodland communities that will increase the overall width of the riparian zone in this location. Upstream of the confluence with Wagon Wheel Canyon, the stream contains a mix of southern willow riparian and sycamore-willow woodland to the boundary with the community of Coto de Caza. Several of the major tributaries to Cañada Gobernadora support mature oak woodland with coarser substrate streambeds.

Summary of USACE Engineer Research and Development Center (ERDC) Functional Assessment

The USACE Engineer Research and Development Center Functional Assessment concludes the following about Cañada Gobernadora Sub-basin and Central San Juan North of San Juan Creek:

The Gobernadora Creek Sub-basin originates in the community of Coto de Caza and drains southerly into San Juan Creek. The northern portion of the sub-basin consists of the Coto de Caza residential community, and the southern portion has undergone ranching operations. USACE Engineer Research and Development Center mapped 241 acres of riparian habitat within this sub-basin. Notable aquatic habitat types include southern coast live oak riparian forest, southern arroyo willow forest, southern willow scrub, mulefat scrub, and coastal freshwater marsh. This sub-basin has experienced considerable degradation due to the Coto de Caza development and the ranching activities. About 5 percent of the riparian habitat is categorized as having very high integrity; 36 percent of the riparian habitat is categorized as high to very high integrity; and 68 percent of the riparian habitat is categorized as medium to very high integrity.

The USACE Engineer Research and Development Center Functional Assessment concludes the following about the Wagon Wheel Sub-basin: The Wagon Wheel Canyon Sub-basin originates near the City of Rancho Santa Margarita and drains southeasterly. The sub-basin has residential development in the northern portion and the southern portion is within the Thomas F. Riley Wilderness Park. The USACE Engineer Research and Development Center mapped 11 acres of riparian habitat within this sub-basin. Notable aquatic habitat types include southern coast live oak riparian forest and southern willow scrub. The sub-basin has experienced moderate amounts of degradation due to the residential development, but the activities associated with the wilderness park minimize the amount of degradation that occurs. About 14 percent of the riparian habitat is categorized as having very high integrity, 66 percent of the riparian habitat is categorized as high to very high integrity, and 100 percent of the riparian habitat is categorized as medium to very high integrity.

Planning Considerations from Watershed Planning Principles

Planning considerations for the Cañada Gobernadora Sub-basin and Central San Juan north of San Juan Creek are as follows:

- Cañada Gobernadora contains some of the highest potential infiltration areas in the SAMP Study Area, particularly in the valley floor, which is characterized by deep alluvial deposits with interbedded clay lenses. However, high groundwater levels may affect the overall infiltration capacity of the sub-basin.

- Total runoff in Cañada Gobernadora is proportionately higher than other sub-basins, due to the size, elongated shape, and amount of existing development in the upper portion of the watershed.

- The hill slopes and ridges in the sub-basin exhibit areas of exhumed hardpan overlying sandy and silty substrates (the eroded remnants of claypans formed in the geologic past) or contain exposed rock outcrops or other areas of steep slopes. These areas presently exhibit rapid runoff comparable to Class D soils, although having less soil moisture storage they likely generate runoff with most storms.

- Due to the elongated configuration and the predominance of sandy terrains in the Gobernadora Sub-basin, first order streams are proportionally less of the total stream length than in several other sub-basins. Many of the tributaries consist of channel-less swales. These swales likely convey a combination of surface and subsurface flow to the main-stem creek and may exhibit surface connection following extreme runoff events.

- Historic photos indicate that the mainstem creek meandered freely across the valley floor over most of the length of the valley downstream from the mouth of Wagon Wheel Canyon.

- Groundwater derived from beneath the hill slopes and ridges is a major source of water contributing to the perennial nature of the creek system. Inferences have been drawn indicating that water levels in the alluvium below Cañada Gobernadora are at least in large part isolated from those in the sands and gravels beneath San Juan Creek, due to a sub-surface barrier to groundwater movement into San Juan Creek. The perennial nature of the creek in its upper reaches is likely influenced primarily by urban runoff from upstream development, while perennial flow in the lower portion of the creek is influenced by a combination of urban runoff, increased recharge from upstream areas, and lateral subsurface inflow to the valley floor.

- High sediment yields are currently generated from the already developed, disturbed upper portion of the sub-basin and have been deposited in the flats below Coto de Caza where flows from Wagon Wheel Canyon enter the sub-basin. In 2001, the creek moved out of its previous channel in this location, cut a new channel (i.e., avulsed) and resulted in downstream deposition of sediments.

- Emergent marsh habitat, including alkali wetlands, and willow habitats are present in the GERA wetlands restoration area with a mix of southern willow riparian and sycamore-willow woodland areas upstream to the boundary of Coto de Caza.

- The Central San Juan Sub-basin north of San Juan Creek has two major tributaries of note. One tributary is a major canyon that bisects the Gobernadora Planning Area, beginning as a moderate- to high-gradient, scrub-oak dominated riparian zone in a chaparral matrix, transitioning to a mature oak woodland as the gradient decreases, until it becomes a moderately incised channel characterized by mule fat scrub. The other tributary consists of high gradient scrub-oak in a chaparral matrix in its upper portion, transitioning to southern-willow riparian habitat as the slope flattens. This second drainage flows into a man-made impoundment with limited wetland fringe vegetation.

- Unlike other sub-basins and Cañada Gobernadora, whose discharges join San Juan Creek at a primary confluence point, stormwater runoff from the Central San Juan catchments is distributed in numerous locations along the adjoining reach of the main San Juan Creek channel.

- The reaches of the central portion of San Juan Creek in the vicinity of the Gobernadora Sub-basin are important as sediment storage and transport reaches, conveying, storing, and sorting coarse sediments from upstream terrains. Due to the size of this reach of San Juan Creek, there is a substantial amount of bedload sediment transport to downstream areas that occurs during major episodic events.

- The middle reach of the main stem of San Juan Creek is a broad, meandering stream with a coarse substrate and several floodplain terraces. San Juan Creek supports a mosaic of southern willow riparian woodland, mule fat scrub, open water, and sand bars, with the adjacent terraces supporting coast live oak woodland and southern sycamore riparian woodland.

- The high topographic complexity of San Juan Creek, which includes a variety of secondary channels, pits, ponds and bars, supports a small population of the federally listed arroyo toad. Several factors, such as the invasive species and the limited extent and duration of water sources may influence the arroyo toad populations in this area.

The Significant Terrains and Hydrologic Features identified as Planning Considerations for Wagon Wheel are included in the Gobernadora Sub-basin.

4.2.3.4 Overview of Cañada Chiquita and Narrow Canyon Sub-basin

Terrains

The Cañada Chiquita and Narrow Sub-basin is the northwesternmost sub-basin in the SAMP Study Area. With a catchment of 9.24 square miles, it is aligned north to south. Local relief (from ridge top to channel) gradually increases southward in this watershed, reaching a maximum of about 500 feet. Cañada Chiquita is the downstream-most major tributary before the confluence

of Trabuco Creek, near Mission San Juan Capistrano. Approximately 60 percent of the San Juan Watershed lies upstream of the confluence with Cañada Chiquita.

The Cañada Chiquita drainage basin is underlain by bedrock of the Monterey, San Onofre, Topanga, Sespe, and Santiago formations. The lower portion of the sub-basin is underlain primarily by the Santiago formation. The Cristianitos fault zone runs through the vertical extension of Chiquita Canyon. Faulting associated with the major portion of the Cristianitos fault zone results in highly variable bedding within the bedrock along the southern half of the east side of the canyon. The surficial geologic units within the SAMP Study Area boundaries consist of alluvium, colluvium, nonmarine terrace deposits, and landslide deposits. Several large bedrock landslide complexes occur along and adjacent to the Cristianitos fault system, especially west of the fault zone (Morton, 1974). These larger landslides are located within the southwestern one-third of the drainage basin and appear to have failed along weak, sheared bedrock associated with the Cristianitos fault system.[2] These large landslides are likely remnants of the glacial ages, when the climate was wetter and Cañada Chiquita was 50 to 100 feet deeper than the present-day valley floor.

Hydrology

Cañada Chiquita is a fifth order stream at its confluence with San Juan. There are 470 first order drainages within this sub-basin that represent about 47 percent of the total stream length within the sub-basin. The drainage density of this watershed is lower than comparably sized sub-basins in the region, and many of the lateral valleys are channel-less swales. The terrains of Cañada Chiquita are considered to be primarily sandy and, as such, the sub-basin generally has high infiltration capacity. This is especially true in the long channel-less swales, which contain deep sandy terrace deposits. This sub-watershed is primarily underlain by soils from three hydrologic groups: B (25.7 percent), C (36.7 percent), and D (36.0 percent). The dominant land use is agriculture (approximately 40 percent of the sub-basin), with developed lands accounting for less than 2 percent of the sub-basin.

The relatively high proportion of permeable soils and low percentage of developed area result in Cañada Chiquita having a moderate- to low-runoff response to precipitation events compared to the other sub-basins analyzed. The high infiltration rates also contribute to the perennial nature of Chiquita Creek. Peak flows from Cañada Chiquita do not have a significant impact on the magnitude of peak flows in San Juan Creek at the confluence and downstream. Relative runoff volumes for Chiquita Creek are also relatively low; the sub-basin contributes 4 percent and 6 percent of the runoff volume to San Juan Creek at their confluence, while occupying approximately 9 percent of the watershed area at that point. Peak flows from Cañada Chiquita are also approximately 4 percent to 6 percent of peak flows in San Juan Creek at the confluence. For the three events modeled, Cañada Chiquita had between 42 percent and 74 percent as much runoff on a per-acre basis as the average for the San Juan Creek Watershed as a whole. However, during extreme flow events (i.e., 50-year or 100-year storms), the infiltration capacity of the soils may be exceeded (partially due to shallow groundwater). During such major storm events, the soils may behave like poorly infiltrating Class C and D soils.

[2] Review of available geologic literature indicates this fault systems is not considered active, pursuant to the guidelines of the Alquist-Priolo Earthquake Fault Zone Map.

Sediment Processes

Below the "narrows" in middle Chiquita Canyon, soils are predominantly sands, silts, and clays. Above the narrows, the soils contain slightly more gravels and cobbles. The sandy substrates mean that the main creek is prone to incision under altered hydrologic regimes. Several active headcuts are present in Chiquita Creek, and the channel is presently incising in several locations. Continued channel incision will increase the sediment generation for the sub-basin by increasing in-channel sediment generation. The Chiquita Sub-basin provides some of the lowest sediment yields and transport rates of the sub-basins analyzed in the San Juan Watershed and produces substantially less sediment than Gobernadora Canyon. However, during episodic events, sediment stored in the lateral channel-less swales may be mobilized and transported to the main portion of Chiquita Creek and further downstream.

Water Quality

The underlying Monterey shale bedrock, prevalence of grassland valleys, and the presence of a relatively high proportion of clay terrain in the valley floor means that nitrogen and phosphorus loadings from this sub-basin are likely quite high, with limited capacity for assimilation within the watershed itself. This may be especially true for phosphorus loadings given the presence of the Monterey formation and evidence of channel incision. Both metals and any pesticides would tend to move in particulate forms.

Groundwater

Chiquita Creek is one of the few naturally perennial streams in the watershed. Water likely flows from the ridge tops toward the valley bottom along subsurface impermeable layers and comes to the surfaces at changes in topography or where substrates of differing transmissivities intersect (i.e., where terrace deposits intersect floodplain alluvial deposits). The valley bottom is characterized by shallow sub-surface water for long portions of the year. This shallow sub-surface water daylights at the toe of the valley wall in several locations, supporting a series of slope wetlands.

Biological Resources

The perennial nature and subsurface water movement in Chiquita Canyon support riparian habitats, freshwater and alkaline marsh, and slope wetlands. The majority of Chiquita Creek is southern willow riparian forest and willow scrub with pockets of alkaline marsh. The middle portions of Chiquita Creek (below Oso Parkway) support a mixture of southern willow scrub and coast live oak riparian woodland. The riparian canopy is mostly intact, but the soils and understory vegetation exhibit some effects from cattle grazing. In areas where Chiquita Creek has incised (up to 15 vertical feet), connection with the floodplain has been lost and over bank flow seldom occurs. Lateral canyons support primarily California live oak and scrub oak woodlands. The majority of the slope wetlands in the SAMP Study Area occur in the lower portion of Chiquita Canyon. These perennially moist wetlands occur in series along the toe of the slopes (primarily on the east side) and may provide refugia or act as stepping-stones for several taxa of animals. Chiquita Ridge contains several vernal pools including the largest pool in Orange County that supports the federally listed endangered Riverside fairy shrimp and San Diego fairy shrimp. The slopes and ridges adjacent to the main creek are dominated by coastal sage scrub that supports one of the largest populations of California gnatcatcher in the SAMP Study Area.

Summary of USACE Engineer Research and Development Center (ERDC) Functional Assessment

The USACE Engineer Research and Development Center Functional Assessment concludes the following about the Chiquita Sub-basin:

The Chiquita Creek Sub-basin originates in the foothills north of Oso Parkway and Tesoro High School and drains southerly into San Juan Creek. This sub-basin has numerous activities and impacts including regionally important roads (Oso Parkway and the SR-241), Tesoro High School, crop agriculture, and ranching activities. USACE Engineer Research and Development Center mapped 218 acres of riparian habitat within this sub-basin. Notable aquatic habitat types include intermittent rivers and stream, mulefat scrub, southern arroyo willow forest, southern willow scrub, southern coast live oak riparian forest, coastal freshwater marsh, and southern sycamore riparian woodland. Even without pervasive development, this sub-basin has experienced some disturbance, resulting in direct and indirect impacts to riparian habitat through road and school construction and indirect impacts from crop agriculture and grazing. About 59 percent of the riparian habitat is categorized as having very high integrity, 98 percent of the riparian habitat is categorized as high to very high integrity, and 100 percent of the riparian habitat is categorized as medium to very high integrity.

Planning Considerations from Watershed Planning Principles

Planning considerations for the Chiquita Canyon Sub-basin from the Watershed Planning Principles are as follows:

- Main canyon and side canyon terrains are primarily sandy or silty sand and the sub-basin generally has high infiltration capacity.

- Side canyons (particularly east of the creek) contain deep sandy deposits and serve important hydrologic functions through infiltrating low volume storms to groundwater and high volume storms to the main stream channel.

- Ridges on the east side of the valley are characterized by, rock outcroppings, and areas of hardpan which are eroded remnants of claypans formed in the geologic past that have eroded to form mesas and locally steep slopes. These areas have minimal infiltration and channel flows into the major side canyons.

- The sandy substrates beneath the tributary swales make them prone to incision under existing and altered hydrologic regimes.

- Based on comparisons with 1938 aerial photographs, the main creek channel has been relatively stable over the last 60 years. The deepening of the creek channel in portions of the mainstem of Chiquita Creek may be a result of long-term, gradual geologic processes, terrains, land use, or a combination of factors. The current channel bed elevation may be somewhat stabilized by pre-historic cohesive lake-bed or quiet-water sediments.

- Groundwater derived from beneath the hill slopes and ridges is a major source of water contributing to the perennial nature of the creek system. Inferences have been drawn indicating that water levels in the alluvium below Chiquita Creek are at least in large part isolated from those in the sands and gravels beneath San Juan Creek, by a sub-surface barrier to groundwater movement into San Juan Creek.

- The sub-basin provides some of the lowest predicted sediment yields and transport rates of the sub-basins analyzed in the San Juan Watershed, except during extraordinary episodic events, when large volumes of coarse sediment may be mobilized and transported to San Juan Creek.

- Relative to Gobernadora Creek and lower Gabino Creek, the area of floodplain connection is fairly limited. The hydrologic connections, both surface and subsurface, to the main side canyons appear to be more important in hydrologic terms than the floodplain connection.

- The combination of perennial flow in the Chiquita Creek and subsurface water movement in Chiquita Canyon support riparian habitats, freshwater and alkaline marsh, and slope wetlands.

- Many of the slope wetlands on the east side of the valley appear to be sustained by large volumes of stored groundwater within the Santiago (and to a lesser extent the Sespe) formations that move along low permeability silt beds and discharge at breaks in the slope. The slope wetlands on the west side of the valley are sustained by fairly localized recharge of San Onofre breccia and derivative landslide deposits.

4.2.4 WESTERN SAN MATEO CREEK WATERSHED SUB-BASINS

4.2.4.1 Overview of La Paz Canyon Sub-basin Characteristics

Terrain

La Paz Creek is the major tributary drainage to Gabino Creek, and the two sub-basins share many common characteristics. Approximately two-thirds of the 7.3-square-mile La Paz Sub-basin is within the RMV Planning Area. The La Paz Canyon drainage basin is underlain by bedrock of the Williams and Trabuco formations and the Santiago Peak Volcanics. Within the boundaries of the RMV Planning Area, the underlying bedrock consists of the Schulz Ranch Member of the Williams Formation and the Trabuco formation. Surficial geologic units within the SAMP Study Area consist of alluvium, colluvium, nonmarine terrace deposits, and a few landslides.

Hydrology

La Paz Creek is a lengthy, fifth order stream and has several fourth order parallel drainages joining it from the eastern hill slopes. Like most of the sub-basins in the upper San Mateo Watershed, the steep crystalline terrains produce high drainage density and multiple confluence points. The sub-basin includes 575 first order and 110 second order drainages and has a drainage density of 10 mi/mi.^{2} The longest watercourse is approximately 6.8 miles. First order drainages comprise 54 percent of the total stream course length in the basin. The narrow western strip of La Paz Canyon is characterized by short, second order streams which drain from the dividing ridge with Upper Gabino Canyon and feed into the main La Paz channel. The fourth order confluence points in the eastern tributaries are associated with dense stands of oak and sycamore woodland and may represent zones of relatively high geomorphic and habitat function.

Runoff and infiltration patterns are similar to those predicted for Gabino Canyon, but at a lower magnitude due to the smaller size of the sub-basin. Runoff per unit area is greater for La Paz Canyon than for Gabino Canyon. This difference results from the fact that the headwaters of La

Paz Canyon are approximately 800 feet higher than those of Gabino Canyon. The higher portions of the sub-basin receive greater rainfall due to orographic effects. In addition, the upper portions of La Paz Canyon have a high proportion of crystalline terrains and class D soils. Therefore, the portions of La Paz Canyon that receive the most rainfall have the highest expected runoff volumes, resulting in high runoff per unit area for the sub-basin as a whole. The calculated infiltration and loss rates fall in the middle of the calculated range for the reported San Mateo Watershed sub-basins. These mid-range rates reflect a balance between poor infiltrating soils in an undeveloped watershed. The majority of the sub-basin is underlain by soils of hydrologic groups C (43.8 percent) and D (47.8 percent) and the sub-basin is nearly entirely undeveloped (99.6 percent). Agricultural and developed lands (mostly roads) cover approximately 0.4 percent of the sub-basin. Therefore, only a very small fraction of the basin is impervious to infiltration. The timing of peak flows is identical to the peak time for upper Gabino Canyon at its confluence with La Paz Canyon; the Upper Gabino Canyon and La Paz Canyon drainages are very similar in size and shape. As a result, peak stream flow from La Paz Canyon directly contributes to increasing peak discharge at Gabino Canyon and further downstream. Runoff per unit area for La Paz Canyon is between 61 percent and 73 percent of the average for the entire San Mateo Watershed for the 2-year, 10-year, and 100-year events.

Sediment Processes

Predicted sediment yields and transport rates for La Paz Canyon are the lowest of any of the sub-basins analyzed in the San Mateo Watershed. Rates and yields are comparable to those of the upper Cristianitos Sub-basin, which is approximately half the size of La Paz Canyon. The low yields may be partially due to the relatively large proportion of very coarse substrates (i.e., large cobbles and boulders) produced from La Paz Canyon. These coarse substrates are expected to be mobilized very infrequently during large-scale episodic events, at which time they play a significant role in reshaping the geomorphology of the lower portions of the watershed. Groundwater is not a significant contributing factor to the ecology of the riparian systems in the La Paz Sub-basin.

Water Quality

Existing nitrogen loadings in the La Paz Sub-basin should be relatively low. The lack of well-developed floodplain structure likely limits the ability of the sub-basin to store phosphates and fairly significant quantities are probably mobilized and transported to the main stem of the San Mateo during high flow events. Background metal loadings are likely to be relatively low, with metal speciation favoring particulate forms.

Biological Resources

La Paz Creek supports dense stands of structurally diverse, mature coast live oak, and southern sycamore riparian woodlands. The riparian zones are confined by the geology of the valley, but contain high topographic complexity (including bars and ponds that are inundated late into the spring), an abundance of coarse and fine woody debris, leaf litter, and a mosaic of understory plant communities. In the upper reaches of the sub-basin, the streams are narrow and form tight mosaics with the chaparral and sage scrub of the adjacent uplands. The rock and cobble substrate type that dominates the streambed is reflective of the slope and geologic setting of the sub-basin. Portions of the streams that convey seasonal high velocity flows also retain water for extended periods of time in shallow depressions within the active channel. The seasonal depressions, combined with the open bars and variety of plant communities, likely provide many niches and support complex and inter-related communities.

Summary of USACE Engineer Research and Development Center (ERDC) Functional Assessment

The USACE Engineer Research and Development Center Functional Assessment concludes the following about the La Paz Canyon Sub-basin:

The La Paz Creek Sub-basin originates from the Cleveland National Forest in Riverside County and drains southwesterly into Gabino Creek. The sub-basin is undeveloped and experiences some light ranching activities. USACE Engineer Research and Development Center mapped 76 acres of riparian habitat within this sub-basin. Notable aquatic habitat types include mulefat scrub, southern sycamore riparian woodland, and southern coast live oak riparian forest. The sub-basin has experienced little degradation to riparian habitat. About 95 percent of the riparian habitat is categorized as having very high integrity, 100 percent of the riparian habitat is categorized as high to very high integrity, and 100 percent of the riparian habitat is categorized as medium to very high integrity.

Planning Considerations from Watershed Planning Principles

Planning considerations for the La Paz Canyon Sub-basin from the Watershed Planning Principles are as follows:

- The upper one-third of the La Paz Sub-basin, including all of its headwaters, is located outside the SAMP and NCCP/MSAA/HCP Study Areas.

- Runoff per unit area is higher for the La Paz Sub-basin than for Gabino and Talega due to the altitude and steepness of the headwaters, higher rainfall in the upper watershed due to orographic effects, and high proportion of crystalline terrains and Class D soils.

- The headwaters of the La Paz Sub-basin are in the Trabuco formation, which yields more water than other sub-basins in the western portion of the San Mateo Watershed (i.e., within the SAMP Study Area).

- Predicted sediment yields and transport rates for La Paz Canyon are the lowest of any of the sub-basins analyzed in the San Mateo Watershed. The low yields may be partially due to the relatively large proportion of very coarse substrates (i.e., large cobbles and boulders) produced from La Paz Canyon. These coarse substrates are likely mobilized very infrequently during large-scale episodic events, at which time they play a significant role in reshaping the geomorphology of the lower portions of the watershed.

- The riparian zones within the La Paz Sub-basin are confined by the geology of the valley, but contain high topographic complexity (including bars and ponds that are inundated late into the spring), an abundance of coarse and fine woody debris, leaf litter, and a mosaic of understory plant communities. Portions of the streams that convey seasonal high velocity flows also retain water for extended periods of time in shallow depressions within the active channel.

4.2.4.2 Overview of Gabino Canyon (including Blind Canyon) Sub-basin Characteristics

Terrain

Gabino Canyon is underlain primarily by bedrock of the Williams Formation (Pleasants sandstone and Schulz Ranch members), as well as the Santiago, Silverado, Ladd (Baker Canyon member), and Trabuco formations. Surficial geologic units within the SAMP Study Area consist of alluvium, colluvium, nonmarine terrace deposits, and a few landslides. The Mission Viejo fault trends north-south through the southwestern portion of the drainage basin. Although not considered active, this fault affects the terrains and subsurface water movement in the canyon.

The Gabino Sub-basin is underlain by clayey and crystalline terrains that generally produce higher runoff volumes per unit area than sandier areas. However, compared to other crystalline terrains in the SAMP Study Area, Gabino Canyon has the highest infiltration capacity of any of the analyzed sub-basins in the San Mateo Watershed.[3] Approximately 56 percent of the upper sub-basin is underlain by Type C soils, with 31 percent of the upper basin having the least permeable Type D soils. Infiltration capacity is somewhat lower in the lower portion of the sub-basin and Blind Canyon, with D-type soils being predominant.

Hydrology

Gabino Canyon is 8.3 square miles and approximately 10 miles long. Along with Talega Canyon, it is the largest sub-basin in the upper San Mateo Watershed. Its size, position high in the watershed, and steep terrain produce the highest absolute peak flows and runoff volumes in the upper San Mateo Watershed. The crystalline terrains and position in the watershed also result in relatively high drainage density. The 1,274 first order drainages within the Gabino Sub-basin account for approximately 51 percent of the stream miles in the sub-basin. At its confluence with La Paz, Gabino Creek is a sixth order stream until it joins Cristianitos Canyon further downstream. In absolute terms, peak flow rates and volumes at the mouth of Gabino Canyon are at least four times greater than flows entering from the neighboring upper Cristianitos Sub-basin, which is a considerably smaller watershed area. However, Gabino Canyon has lower runoff per unit area than either La Paz or Talega Canyons, reflecting the somewhat higher infiltration capacity than these other sub-basins.

Flows exiting Gabino Canyon peak about 1.2 hours, 0.8 hour, and 0.4 hour after peak flows have exited the upper Cristianitos sub-basin (upstream of the Gabino confluence) for the 2-year, 10-year, and 100-year events, respectively. For the 2-year and 10-year events, storm peaks are somewhat attenuated between the Upper Gabino/La Paz confluence upstream and the Gabino/Cristianitos confluence downstream. This is not the case for the 100-year event where the downstream location has higher peak flows. The proximity of timing of peak flows during more extreme events results in peak flows from Gabino Canyon that have the potential to directly add to peak flows in Cristianitos Canyon at the confluence.

Sediment Processes

Gabino Canyon was calculated to have the highest sediment yield and transport rate of any sub-basin analyzed in the San Mateo Watershed. These high yields are partially attributable to the size of the sub-basin; however, the transport rate per unit area is also high, second only to

[3] Runoff volumes in Gabino Canyon are higher than those for the sandier areas of the San Juan Watershed.

the Cristianitos Sub-basin. Cobbles and other larger particles comprise the majority of sediment produced in this sub-basin; however, unlike La Paz, sand comprises a substantial portion of the sediment produced. The relatively high proportion of underlying sandy substrates (compared to the rest of the crystalline areas in the SAMP Study Area) likely contributes to the high sediment yield predicted for Gabino Canyon. Incision of the channel in the reaches just upstream of the confluence with La Paz also is a likely source of sediment. However, a significant portion of the sediment production is probably associated with erosion caused by historic cattle grazing activities. Conversion of native habitat to non-native grassland, along with continued grazing, appears to have resulted in extensive gully formation adjacent to Gabino Creek and resultant increases in sediment delivery to downstream areas. A critical feature of the sediment transport characteristics of Gabino Canyon is that most of the sediment is mobilized during extreme episodic events when topography, unstable upland soils, and substrate types contribute to produce large quantities of sediment. This sediment is probably very important to downstream channel structure and provides habitat for sensitive species in the middle and lower watershed.

Water Quality

The high proportion of grasslands in the upper watershed represents a potential source of high nitrogen loadings. Similarly phosphate loadings are expected to be moderate, mainly associated with erosion in the upper watershed. Incision in the upper reaches of Gabino Canyon and the naturally confined floodplain in the lower reaches mean that assimilation of nitrate and phosphate loadings are expected to be low to moderate within the riparian floodplain. Baseline metal loadings should be relatively low under existing conditions with most metals transported in particulate form.

Groundwater

Groundwater is probably not a significant component of the aquatic ecosystems in the Gabino Sub-basin. The channel is typically dry by May or June, even in wet years. However, localized groundwater discharge was observed at several active headcuts in the upper watershed. Therefore, there may be localized areas (or sub-surface lenses) that provide localized shallow groundwater. Because the bedrock beneath Gabino Creek is comprised mainly of old, tightly consolidated sediments, any groundwater discharged would have above average specific conductance (i.e., higher salinity).

Biological Resources

The dominant habitat type in the upper portion of Gabino Canyon (above the confluence with La Paz Creek) is southern coast live oak riparian woodland. The adjacent uplands are primarily ruderal grasslands with sage scrub on the hill slopes. The upper watershed has been heavily grazed and is incised in places with vegetation that has been cropped or trampled. The riparian zone varies in width from relatively narrow to relatively wide and is well developed (depending on the intensity of grazing). Historically, the stream probably migrated through the floodplain, but now is confined by headcutting and incision processes. In some reaches, this incision is in excess of ten feet and appears to have intercepted subsurface flow. A manmade lake/stock pond in upper Gabino canyon, informally known as "Jerome's Pond," captures water from Gabino Creek and three unnamed tributaries. The pond can be characterized as a hemi-marsh mix of open water and bulrush (*S. californicus*). Where Gabino Creek flows into the stock pond, there is a delta dominated by mule fat scrub. The pond outlets into a tributary that supports willow riparian habitat and eventually joins the main flows of Gabino Creek. Above the pond, the tributaries are a mix of oak riparian and broad floodplain sycamore habitats. Portions of these tributaries exhibit slumping and erosion, probably resulting from grazing impacts (perhaps in

conjunction with fires). A major unnamed tributary flows into Gabino Creek just upstream of its confluence with La Paz Creek. The natural drainage pattern of this tributary has been substantially altered over time by mining activities, including the creation of a series of artificial ponds.

Lower Gabino Creek (below the confluence with La Paz Creek), middle Gabino Creek, and La Paz Creek support structurally diverse, mature oak and southern sycamore riparian woodland with dense chaparral on the adjacent slopes. The center of the stream has a rock cobble substrate overlain by areas of shallow alluvial deposits that support mule fat scrub. The floodplain and riparian zones in the lower sub-basin are confined by the geology of the valley, but contain high topographic complexity, an abundance of coarse and fine woody debris, leaf litter, and a mosaic of plant communities. In many years, Gabino Creek flows through the late spring and seasonal pools persist in some locations, but seldom through the summer.

Blind Canyon is a major tributary watershed to Gabino Creek and, as such, was analyzed as part of the lower Gabino system. Blind Canyon is a high gradient, coarse substrate stream, dominated by sycamore and oak riparian gallery forest with a mule fat-dominated understory. The stream contains good topographic complexity, leaf litter, and coarse and fine woody debris. There are numerous high gradient, low order tributaries to Blind Canyon on the site. Some contain scrub oak-dominated riparian forest; others are unvegetated swales. Several of the tributaries appear to pond seasonally at naturally occurring grade changes, but do not exhibit any features of slope wetlands.

Summary of USACE Engineer Research and Development Center (ERDC) Functional Assessment

The USACE Engineer Research and Development Center Functional Assessment concludes the following about the Gabino Canyon Sub-basin:

The Gabino Creek Sub-basin originates in the foothills below the Cleveland National Forest and drains southwesterly into Cristianitos Creek. The sub-basin is undeveloped and has some ranching activities. USACE Engineer Research and Development Center mapped 106 acres of riparian habitat within this sub-basin. Notable aquatic habitat types include southern coast live oak riparian forest, mulefat scrub, and southern sycamore riparian woodland. The sub-basin has experienced little degradation to riparian habitat due to the absence of any major activities. About 89 percent of the riparian habitat is categorized as having very high integrity, 100 percent of the riparian habitat is categorized as high to very high integrity, and 100 percent of the riparian habitat is categorized as medium to very high integrity.

The USACE Engineer Research and Development Center (ERDC) Functional Assessment concludes the following about the Blind Canyon Sub-basin:

The Blind Canyon Sub-basin is a small sub-basin located in the southeastern portion of Orange County. The sub-basin drains westerly into Gabino Canyon right before Gabino Canyon drains into Cristianitos Canyon. The sub-basin is undeveloped except for a few access roads. USACE Engineer Research and Development Center mapped 218 acres of riparian habitat within this sub-basin. Notable aquatic resource habitat types include southern coast live oak riparian forest and southern sycamore riparian woodland. Due to the small amount of direct and indirect disturbance to riparian habitat, the entire riparian habitat is categorized as having very high integrity.

Planning Considerations from Watershed Planning Principles

Planning considerations for the Gabino Canyon Sub-basin from the Watershed Planning Principles are as follows:

- Gabino and Talega Canyons are the largest sub-basins in the western portion of the San Mateo Watershed.

- Gabino Canyon has the highest predicted absolute peak flow and runoff volume of the sub-basins studied in the western portion of the San Mateo Watershed. This is due to its size, position high in the watershed, steep topography, and the narrow geologically confined nature of the middle and lower reaches of the sub-basin. Simulated hydrographs indicate a somewhat "flashy" runoff response in this sub-basin.

- Gabino Canyon has the highest predicted sediment yield and transport rate of any sub-basin analyzed in the western portion of the San Mateo Watershed.

- Fine sediment generation in the upper sub-basin may exceed natural conditions due to extensive gully formation in the headwater areas.

- Terrains in the middle reaches are very steep, with high drainage densities and have very limited stormwater infiltration capacity.

- Sediments produced from the middle portion of the sub-basin are primarily coarse sediments, including sands and cobbles, which are mobilized and transported during extreme episodic events. These sediments are probably very important to downstream channel structure and provide geomorphologic elements of habitats for sensitive species found in the middle and lower reaches of Gabino Creek and further downstream.

- In wet years, the creek flows through the late spring and seasonal pools persist in some locations (probably associated with bedrock outcrops). However, these pools seldom if ever persist through the summer.

- Groundwater does not appear to be a significant element of the Creek's hydrologic system, with the possible exception of the lower reaches (i.e., below the confluence with La Paz). It appears that the alluvium in this sub-basin is recharged during winter runoff events and once the limited aquifer storage has been seasonally depleted, little ongoing replenishment occurs until the next event.

- Along the lower reaches of the Creek, terrains to the north include clayey soils and a major unnamed side canyon that has been extensively modified by clay mining activities.

- The area south of Blind Canyon is comprised of a mesa top that has been grazed and is characterized by high gradient, coarse-bedded channel, and sycamore and oak riparian forest. The slopes of the canyon contain other significant habitat including coast live oak.

4.2.4.3 Overview of Cristianitos Canyon Sub-basin Characteristics

Terrain

The 3.7-square-mile Cristianitos Canyon drainage basin (upstream of the confluence with Gabino Creek) is underlain by bedrock of the Santiago and Silverado formations. Surficial

geologic units within the SAMP Study Area consist of alluvium, colluvium, nonmarine terrace deposits, and a few landslides.

The upper Cristianitos Canyon is a fifth order network with a calculated drainage density of 8 mi/mi.^{2} Compared with other sub-basins in the SAMP Study Area, the upper Cristianitos Watershed has a more rounded, or pear-shaped, configuration. Additionally, the headwater areas are not as steep as many of the other sub-basins. These conditions reflect the physiographic and geologic setting of the upper Cristianitos basin just south of the dividing ridge with the San Juan Watershed. As a result of this setting, third and fourth order tributary arms are distributed fairly evenly and have similar lengths. There are 187 first order drainages that account for almost one-half of the basin's total stream length.

Hydrology

The more gently sloping shape of the headwaters of this drainage, high infiltration rates, and a drainage network which dampens flow peaks results in a less "flashy" hydrograph than observed in other sub-basins of the upper San Mateo Watershed. The hydrograph for Cristianitos Canyon has a broader base with lower flow rates. In absolute terms, runoff volumes and peak flows from Cristianitos Canyon are the lowest of the studied San Mateo Sub-basins, primarily due to the smaller size of this sub-basin. In terms of peak discharge per unit area, upper Cristianitos had the highest rates for the 10-year and 100-year events of the studied San Mateo Sub-basins. This higher result for peak discharge per unit area may seem uncharacteristic since Cristianitos Canyon has more favorable soil and infiltration conditions than the other studied San Mateo Sub-basins. However, routing conditions in the Cristianitos Canyon Sub-basin, which is the least elongated of the San Mateo Sub-basins, appear to enhance flow concentration and generate larger peak flows per unit area. In terms of runoff per unit area, values from Cristianitos Canyon are lower than the other studied sub-basins (only between 43 and 67 percent of the average for the entire San Mateo Watershed).

Sediment Processes

The substrate type in Cristianitos Creek is primarily sands and silts, with a significant portion of clays. However, the lower portion of Cristianitos Creek appears to be actively incising. Review of aerial photographs shows that prior to the extreme flow event of 1938, the reach of Cristianitos Creek upstream from the confluence of Gabino Creek was little more than a swale and seems to have incised 8 to 15 feet since that time. This portion of Cristianitos Creek is likely susceptible to further incision and associated in-channel sediment generation during extreme flow events. Sediment transport rate per unit area for the Cristianitos Sub-basin is the highest of any San Mateo sub-basin studied. However, because of the small size of the Cristianitos Sub-basin, the gross sediment yield and transport rate is the lowest of the study's sub-basins. From a sediment processes perspective, Cristianitos Creek is probably most important as a transport reach, conveying material generated higher in the watershed to downstream areas. Continued incision would interfere with this function.

Water Quality

Pollutant transport and cycling likely occur predominately within surface waters. The large amount of grasslands in the sub-basin strongly suggests that nitrogen loading is currently high, while the high erosion potential indicates that the mobilization of phosphorus sources may be equally high. Metal loadings to the sub-basin are likely low at present and most metal transport can be expected in the particulate form.

Groundwater

The majority of the Cristianitos Sub-basin is underlain by poorly infiltrating soils of hydrologic groups C (43.9 percent) and D (42.7 percent). However, compared to other sub-basins of the San Mateo Watershed studied, the upper Cristianitos Canyon also contains a relatively large portion of the better infiltrating soil group B (12.9 percent). The relatively high proportion of Type B soils and the minimal development in the sub-basin produce relatively high infiltration rates relative to the other reported sub-basins within the San Mateo Watershed.[4]

Biological Resources

Aquatic resources in the Cristianitos Sub-basin consist of both riverine and lacustrine (associated with abandoned clay pit mines and stock ponds) systems. The upper portions of the sub-basin consist of a ridge or spine with canyons on both sides. These canyons are steep and narrow and contain well-developed, mature oak riparian woodland in a matrix of intact chaparral and coastal sage scrub. Although the total jurisdictional area associated with these drainages may be small, their structure, position in the landscape (in the headwaters), and juxtaposition with intact upland plant communities results in high functioning upland/wetland ecosystems. Cristianitos Creek, below an existing stock pond, is a meandering stream that contains alkali marsh communities mixed with willow and mule fat. However this reach is actively incising. Reaches just upstream of Gabino Creek have near-perennial flow, apparently supported by discrete loci of groundwater discharge. The persistent saturation has facilitated development of well-structured hydric soils, and as the gradient flattens, there is a moderate width floodplain associated with the stream. This area supports the highest diversity of wetland species of any of the San Mateo sub-basins studied.

There are several lacustrine wetlands in the sub-basin associated with abandoned clay pits or stock ponds. In general, these areas appear to be functioning as intact wetlands. They contain a mix of open water and emergent marsh vegetation. Most are surrounded by a mix of sage scrub and grasslands. One of the stock ponds on the lower end of Cristianitos Creek has a stream dominated by mule fat scrub draining into it. The ponds generally appear to have low turbidity and are being used by fish, invertebrates, amphibians, and birds. A large, abandoned clay pit exists near the southern boundary of the sub-basin. This pit is approximately 80 to 100 feet deep and dominated by open water with a narrow fringe of emergent marsh habitat. This large, abandoned pit is blue-green in color, and is not functioning as a viable ecosystem. Adjacent uplands in the sub-basin have a percentage of clay soils and support sensitive plant populations.

Summary of USACE Engineer Research and Development Center (ERDC) Functional Assessment

The USACE Engineer Research and Development Center Functional Assessment concludes the following about the Cristianitos Canyon Sub-basin:

The Cristianitos Creek Sub-basin originates near the San Juan Creek Watershed/San Mateo Creek Watershed border and drains southerly into San Mateo Creek in San Diego County. This sub-basin has a few abandoned clay mines on the eastern portion, the Donna O'Neill Conservancy on the western portion, a few private roads, and ranching activities. The USACE Engineer Research and Development Center mapped 133 acres of riparian habitat within this sub-basin. Notable aquatic habitat types include southern coast live oak riparian forest and

[4] Runoff volumes in Cristianitos Canyon are higher than those for the sandier areas of the San Juan Watershed.

mulefat scrub. Due to the historic mining activities, this sub-basin has experienced some degradation to riparian habitat. About 23 percent of the riparian habitat is categorized as having very high integrity, 100 percent of the riparian habitat is categorized as high to very high integrity, and 100 percent of the riparian habitat is categorized as medium to very high integrity.

Planning Considerations from Watershed Planning Principles

Planning considerations for the Cristianitos Canyon Sub-basin from the Watershed Planning Principles are as follows:

- Cristianitos Sub-basin has a less "flashy" hydrograph than other sub-basins of the western portion of the San Mateo Watershed due to its shape, infiltration characteristics, and drainage network.

- The terrains to the west of Cristianitos Creek are generally erodible silty sands while the terrains to the east of Cristianitos Creek are generally less erodible clays (where not disturbed). Intact clayey terrains tend to seal and functionally become nearly impervious upon saturation, generating more rapid runoff than sandy terrains.

- Major riparian areas exist in the northeast and southwest portions of the sub-basin.

- The middle and lower areas to the east of the creek contain few riparian areas and include numerous former open clay pits that are eroding and are not self healing.

- The middle portion of Cristianitos Creek supports alkaline wetlands. The hydrologic support of these wetlands in relation to the surface and subsurface hydrology of this portion of Cristianitos Creek is not fully understood; however, recently installed groundwater monitoring wells are intended to clarify this issue.

- The clay-rich soils to the east of the creek generate fine sediments, generally silts and clays, which contribute to turbidity in downstream waters (as contrasted with coarser sediments such as sands, silty sands, and cobbles contributed by Gabino and La Paz).

- A review of 1938 aerial photos indicates that the mainstem of Cristianitos Creek upstream from the confluence with Gabino Creek appears to have been deepening over the past 60 years.

4.2.4.4 Overview of Talega Canyon Sub-basin Characteristics

Terrains

The Talega Canyon drainage straddles the boundary of RMV Planning Area and MCB Camp Pendleton. The basin is underlain by bedrock of the Santiago, Silverado, Williams, and Trabuco formations and the Santiago Peak Volcanics. Approximately one-third to one-half of the Talega Canyon drainage basin lies within the SAMP Study Area boundary, most of which is occupied by the existing Northrop Grumman TRW Capistrano Test Site facilities. Within the boundaries of the RMV Planning Area, the underlying bedrock consists of the Santiago and Silverado formations and the Pleasants sandstone and Schulz Ranch members of the Williams formations. Surficial geologic units within the SAMP Study Area consist of alluvium, colluvium, non-marine terrace deposits, and a few landslides.

Hydrology

Talega Creek is a fifth order system where it meets Cristianitos Canyon, downstream of the Gabino Confluence. The 8.3-square-mile sub-basin has a drainage density of 9 mi/mi.^{2} with 501 first order channels. The Talega Canyon Sub-basin is extremely elongated; the longest watercourse is over 10.1 miles.

When considered as a percentage of total storm event rainfall, hydrologic losses in Talega Canyon were the lowest of all reported San Mateo sub-watersheds for all three modeled storm events. Overall, the low loss rates calculated for Talega Canyon indicate that infiltration rates within the sub-basin are also low, relative to the other reported sub-basins. In absolute terms, runoff volumes and peak flows from Talega Canyon are in the upper-middle of the range compared to other reported San Mateo sub-basins. Talega Canyon contributes about 33 percent of the runoff volume to Cristianitos Creek at their confluence while it occupies approximately 28.76 percent of the upstream watershed area at that point. Peak flows from Talega Canyon are approximately 25 percent of peak flows in Cristianitos Creek at the confluence. In terms of runoff per unit area, Talega Canyon produced between 66 percent and 78 percent as much runoff on a per-acre basis as the average for the San Mateo Creek Watershed as a whole. Talega Canyon provides a contrast between runoff peaks which are relatively low and runoff volumes which are relatively high. Higher runoff volumes are generated due to the high proportion of poorly draining soils. However, the elongated shape of the sub-basin and long routing distance reduces the magnitude of peak flow rates. Peak discharge rates are attenuated as they travel downstream through the sub-basin.

Sediment Processes

Because a large portion of the basin is outside the SAMP Study Area (in MCB Camp Pendleton and San Mateo wilderness) an analysis of sediment yield or transport rates for this sub-basin area was not performed.

Water Quality

The potential for generating large amounts of fine sediments indicates that the Talega Sub-basin can be a significant source of phosphates. Historical aerial photography shows that a well-vegetated floodplain has often been absent, suggesting that the riparian corridor may play a relatively minor role in cycling of pollutants. However, some sequestration may occur in pockets where sandy substrates are found. Metal partitioning should heavily favor transport in the less biologically available particulate forms.

Groundwater

The majority of the sub-watershed is underlain by soils of hydrologic groups C (18.8 percent) and D (75.6 percent). Talega Canyon has the highest proportion of poorer infiltrating Type D soils of any of the other sub-basins analyzed in the San Mateo Watershed.

Biological Resources

The riparian zones of Talega Creek are similar to those found in upper Cristianitos and Lower Gabino Creeks. The substrate is rock/cobble dominated with sandbars forming in depositional areas. The riparian habitat consists of dense stands of structurally diverse, mature coast live oak, and southern sycamore riparian woodlands. Center portions of the creek support mule fat scrub and open sand bar habitat. The riparian zones are confined by the geology of the valley,

but contain high topographic complexity, an abundance of coarse and fine woody debris, leaf litter, and a mosaic of understory plant communities. Talega Creek contains shallow pools that retain water into the late spring and early summer. Some of the highest concentrations of southwestern arroyo toad in the San Mateo Watershed are located along Talega Creek.

Summary of USACE Engineer Research and Development Center (ERDC) Functional Assessment

No USACE Engineer Research and Development Center general assessment and conclusions are available for the Talega Sub-basin.

Planning Considerations from Watershed Planning Principles

Planning considerations for the Talega Sub-basin from the Watershed Planning Principles are as follows:

- Talega Canyon straddles the boundary of the RMV Planning Area and MCB Camp Pendleton, with at least a third of the upper watershed located outside the SAMP and NCCP Study Areas in the San Mateo Wilderness Area. The existing Northrop Grumman TRW Capistrano Test Site facilities are on the ridge above Talega Canyon, with runoff draining both to Talega Canyon and to Blind Canyon/Gabino Canyon.

- Talega Canyon has the highest proportion of poorer infiltrating Type D soils of any of the other sub-basins analyzed in the San Mateo Watershed and yield relatively high runoff volumes. Although the simulated hydrographs for Talega Creek have a pronounced peak, they are relatively broad. The broader peaking is likely due to the elongated geometry of the sub-basin, which tends to attenuate flood movement as it travels through the sub-basin. Therefore, runoff volumes are high but peak discharge rates are attenuated as stormwater travels downstream through the sub-basin.

- The headwaters of Talega Creek (which are outside the SAMP and NCCP Study Areas) are in weathered granitic rocks that sustain a substantial density of springs. These springs help support a denser riparian corridor in the upper portion of the sub-basin and may contribute to late season moisture in Talega Creek.

- Talega Creek supports one of the two largest populations of arroyo toads in the planning area. The creek substrate is rock/cobble with sandbars forming in depositional areas. Riparian habitat consists of dense stands of mature, structurally diverse coast live oak and southern sycamore riparian woodlands. Central reaches of the creek support mule fat scrub and open sand bar habitat. Riparian zones contain high topographic complexity, an abundance of coarse and woody debris, leaf litter and a mosaic of understory plant communities. The creek contains shallow pools that retain water into the late spring and early summer, a water supply likely to be of significance for arroyo toad breeding habitat, but does not appear to be sufficient to sustain steelhead.