Volume One Unabridged

Watershed Characteristics Report

Chapter 7

Natural Setting

Prepared for the
Santa Clara Basin Watershed Management Initiative

by

Watershed Assessment Subgroup

August 2003

Watershed Characteristics Report
Chapter 7: Natural Setting

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Funded by:
Santa Clara Valley Urban Runoff Pollution Prevention Program
Task SC 18.01

August 2003

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ANADROMOUS FISH SUPPLEMENTARY INFORMATION

This Anadromous Fish Supplementary Information (April 2002) amends the Watershed Characteristics Report (February 2001). This Supplementary Information (1) replaces a statement on the implications of genetic testing for determining geographic origins of Chinook salmon with excerpts from two relevant scientific reports, (2) adds excerpts from documentary references and oral statements concerning the historical occurrence of Chinook salmon in Santa Clara streams, and (3) amends a table that summarizes occurrence of freshwater fish in local streams, by adding a clarifying footnote on the uncertainty of origins of chum salmon.

Statement on Genetic Testing

The following statement, which appears in the Watershed Characteristics Report, (page 7-68 and pages 7-131 through 132), is hereby deleted due to disagreement between WMI members regarding the interpretation of current genetic testing information:

"Although genetic testing suggests that some of these adult Chinook are of Central Valley hatchery origin, an unknown portion of the adult Chinook run may be from local wild production (Federal Register 1999; Neilsen 1995; Neilsen at al 1999)."

Though WMI members agree that Chinook salmon are present in the Guadalupe River, they disagree whether the current population of Chinook salmon is a remnant of a historical wild run, a run populated by strays from Central Valley hatcheries, or a mixture of the two. There is also disagreement about the degree to which previously conducted genetic testing can be used together with other data to determine the origin of this population. WMI members hope that further research will help resolve these disagreements.

The deleted quote is replaced with excerpts below from: (1) "Salmon from the Sacramento-San Joaquin Basin and Guadalupe River 1992-1994", by Dr. Jennifer L. Nielsen, USDA Forest Service (1995), and (2) "Final Rule of National Marine Fisheries Service re: Endangered and Threatened Species; Threatened Status for Two Chinook Salmon Evolutionarily Significant Units (ESUs) in California," 64 Federal Register 50,393 (Sept 16, 1999). These excerpts do not interpret these documents or state a position on any findings made therein.

Excerpts from: "Salmon from the Sacramento-San Joaquin Basin and Guadalupe River 1992-1994", by Dr. Jennifer L. Nielsen, USDA Forest Service (1995):

"Fin tissue was collected by the California Department of Fish and Game (CDFG) and amplified for mtDNA from 455 chinook from 8 rivers and 5 hatchery stocks of the Sacramento-San Joaquin basin in Central Valley, CA (1992-94) and from 29 spawning chinook (1994) collected from the Guadalupe River, a southern tributary of San Francisco Bay." (page 2)

"Chinook from the Guadalupe River drainage that were collected by CDFG showed distinct haplotypes, not found in any Central Valley population (wild or hatchery). These unique genotypes appear to be distributed throughout the spawning run and not temporally distributed into the early or late spawning population on the Guadalupe River. The genetic origins of these fish remain unknown, but they are definitively not hatchery strays based on the evidence available from the hatchery collections we have analyzed. It is, however, important to look further in the hatchery populations where these genotypes may be more temporally distributed before we exclude a hatchery origin for these fish." (pages 13-14)

"It is interesting that of the eight fish carrying unique mtDNA haplotypes (two haplotype #9s and six haplotype #11's) collected by CDFG in 1994, six were males and only two were females, suggesting the uneven sex ratio one expects to see in an opportunistic migration....The remaining fish collected from the Guadalupe River could not be differentiated from Chinook from the Merced and Feather River Hatcheries using the mtDNA locus." (page 14)

Excerpts from "Final Rule of National Marine Fisheries Service re: Endangered and Threatened Species; Threatened Status for Two Chinook Salmon Evolutionarily Significant Units (ESUs) in California," 64 Federal Register 50,393 (Sept 16, 1999):

"Microsatellite DNA variation has also been used in recent studies to examine genetic relationships among populations of chinook salmon in California. Nielsen et al. (1994) found significant heterogeneity among fall-run hatchery stocks and also among naturally spawning fall-run populations but there was no significant geographic structure at the basin level for wild fall-run chinook salmon. However, comparisons of wild fall-run carcasses and hatchery stocks suggest that naturally spawning fall-run fish in several basins retain some degree of genetic distinctiveness not found in hatcheries. Allele-frequencies for carcass collections made on the American, Tuolumne, Merced, and Feather Rivers were significantly different from samples of hatchery populations found within the same drainage. The Merced and Mokelumne Rivers were found to be most similar to hatchery populations on their respective rivers. The heterogeneity comparisons for some wild fall-run carcass collections may have been biased by small sample sizes. Fall-run hatchery populations were differentiated from populations of other run times but samples of wild fall-run populations were not compared to populations of winter, spring, or late-fall runs. Naturally spawning late fall-run fish were differentiated in allozyme analysis from all other populations including CNFH late fall-run salmon. The naturally spawning late fall-run population was most genetically similar to either winter-run fish or the CNFH late fall-run population, depending on the genetic distance measure used. Nei's measure of genetic distance indicated that late fall-run populations were most similar to hatchery fall-run populations.

Nielsen et al. (1994) and Nielsen (1995) examined mtDNA variation in 14 samples of chinook salmon from Central Valley rivers and hatcheries and one sample from the Guadalupe River, a southern tributary of San Francisco Bay. Nielsen et al. (1999) concluded that their data support their earlier conclusions (Nielsen et al., 1994) that fall, late-fall, spring, and winter runs of Central Valley chinook salmon show consistently significant differences for the mtDNA locus, indicating infrequent straying and limited gene flow among the temporal spawning runs.

Nielsen et al. (1999) concluded that additional sampling is needed to test for significant genetic differences among natural spawning and hatchery populations of fall-run chinook salmon. A sample of chinook salmon from Guadalupe River showed significant haplotype frequency differences from samples of the four spawning runs in the Central Valley, primarily due to a haplotype (CH9) found in 2 fish in the Guadalupe River. This haplotype has not been observed in fish from the Central Valley but has been found in samples of Russian River chinook salmon. The remaining 27 samples from the Guadalupe River could not be differentiated from the chinook salmon in the Merced and Feather River hatcheries through the use of mtDNA." (pages 50,400-401)

"The status of chinook salmon spawning in tributaries to San Francisco Bay was also considered. The presence of chinook salmon adults and juveniles (including observed spawning activities) has been recorded in a number of rivers and creeks draining into San Francisco Bay (Leidy, 1984; Myers et al., 1998; San Francisco Estuary Project, 1998; Jones, 1999, unpubl. data). However, NMFS was unable to establish if any of these populations were self-sustaining. Although the historical relationship between chinook salmon spawning in San Francisco Bay tributaries and the coastal and Central Valley Evolutionarily Significant Units (ESUs) is not known, present day adults may have originated from the numerous off-site releases of Central Valley hatchery fall-run chinook salmon into the delta or San Francisco Bay. Additional information on genetic and life history traits for San Francisco Bay chinook salmon and their relationships with Central Valley and coastal chinook salmon populations is necessary to resolve this issue." (page 50,402)

Documentary References and Oral Statements

Compiled below are documentary references and oral statements by local fishermen concerning the historical occurrence of Chinook salmon in Santa Clara streams. WMI members disagree whether this information demonstrates that Chinook salmon spawned and reared in these streams. Therefore, this Supplementary Information does not interpret the information or express an opinion on its accuracy.

Excerpts from Documentary References

The presence of both Chinook and Coho salmon and steelhead trout in South Bay waterways is referred to in a number of historic accounts.

Ohlone life was busy. They lived in an area with numerous salmon streams and developed a lifestyle to adjust to the salmon seasonality. (Galvan) The early Spanish explorers and missionaries found indigenous people depended heavily on the seasonal rush of fish. "The Ohlone held confidence in catching and preserving enough to last to the next spawning. The favorites and most numerous were the King Salmon, the Silver Salmon and the Steelhead/Rainbow Trout." (Heizer & Elsasser). "The Ohlone found joy and satisfaction with the profusion of salmon in the area. Every tribe north of Monterey used its stream to its advantage during the seasonal salmon runs." (Heizer and Elsasser). The Ohlone trapped trout and salmon in the creeks and ponds of the hills at the end of the season. In some cases the Ohlone would dam the creeks, toss soaproot and mashed buckeye in to stun the fish. The fish would rise to the surface and the Natives could catch & eat them (Margolin). More often, the principal method of catching fish was with nets, the effectiveness of this method is reported in personal journals of visitors (Heizer). (A1)

The Indians of Santa Clara Valley had a great abundance of food. The creeks or rivers, many now no longer extant, ran year-round all teaming with trout, steelhead and salmon. Trips to Alviso Bay, Pescadero or Santa Cruz provide clams, mussels and wild duck. (A2)

The Mission has an abundance of water obtained from the River of Nuestra Senora de Guadalupe which is about a quarter league distance from the houses. In this river good trout are caught in the summer. The Thamien-Socoistaca site at the confluence of the surface arroyo and the Rio Guadalupe was a hillock of laurel trees, tall & straight at hand for building. The Mission Creek, with its ready supply of surface water for cooking and cleaning, was attractive at any point. In the full but not yet overflowing Rio Guadalupe, there were salmon for the fishermen. (A3)

Anadromous fish were an important part of aboriginal subsistence economies in northern Native California. Of the five species of Pacific salmon the two most abundant in the freshwater systems of Northern California were the Chinook and silver or Coho. Chinook are normally more prevalent in larger rivers while the Coho frequents smaller streams. In addition to these salmon species, large populations of steelhead are seasonally common in nearly all coastal streams of California. The king and silver salmon entered the rivers and streams in the latter half of the year and the king salmon also entered the larger rivers in the spring, creating an important spring-fall cycle of runs. Chinook ranged as an important resource as far south as Monterey Bay and could be found in smaller numbers as far south as the Ventura River. (A4)

King, Chinook or Quinnant salmon run in the spring and fall, Silver or Coho Salmon and Chum or Dog salmon run in the fall. Every Northern California stream of whatever kind has more or less of these fall run salmon. The southern limit for Chinook salmon is the Ventura River. The flesh of spring run fish is pink and the fall run white which makes fall run fish pretty much worthless for canning. It is not generally possible to capture any species in large numbers until they enter the rivers and streams. (A5)

"Quinnant or Chinook Salmon Range from Alaska to California, southward to the Ventura River, ascending all large streams and are especially abundant in the Columbia and Sacramento Rivers." "Dog Salmon ranges from Kamchatka to San Francisco Bay ascending all streams in the fall and spawning no great distance from the sea." Silver or Coho salmon are abundant from San Francisco Bay to Alaska ascending small streams in the fall to no great distance." (A6)

Historical migration routes for salmon and steelhead are shown leading to the South Bay. Most South Bay streams, including the Guadalupe River, Los Gatos Creek, Stevens Creek and Coyote Creek are shown as Silver salmon and steelhead streams. (A7)

1890 photo of O.A. Hale of San Jose with catch of about 24 salmon. Some salmon identified as probably Chinook by Dr. Stacy K. Li, others believed to be chum or coho salmon. (A8)

San Jose Mercury News article dated March 1988 documents two fishermen fishing for salmon in the Guadalupe River and stated they had been doing so for over a dozen years, (since the mid 1970's). The article also indicates that Linda Ulmer, CA Dept. of Fish & Game biologist stated they had evidence confirming a viable run of salmon and steelhead in the river. (A9)

In August 1994 Alviso residents reported to the San Jose Mercury News that a fish kill had occurred in the Guadalupe River, and that their carcasses were in the vicinity of Alviso. GCRCD and Silichip Chinook reported that the fish kill involved Chinook salmon and occurred in the vicinity of the Route 237 Bridge construction project. This incident was reported in the San Jose Mercury News. The news article states that Dr. Jerry Smith, of San Jose State University, documented Chinook salmon in the Guadalupe River in the mid 1980's. (A10)

On November 27, 2000, Dr. Jerry Smith, San Jose State University, distributed and e-mail stating that "Chinook salmon were reported in San Thomas Aquino Creek in the early 1980's in response to a reported sighting of a possible coho salmon in the creek." Dr. Smith stated that Chinook carcasses were investigated by Dennis Eimoto of the CA Dept of Fish and Game office in Monterey. (A11)

<u>Citations</u>:

A1. "A River Ran Through It. The Cultural Ecology of the Santa Clara Valley Riparian Zone," Erin M. Reilly, <u>Research Manuscript Series No. 3</u>, Dept. of Anthropology and Sociology, Santa Clara University, Santa Clara, CA, 1994.

A2. "Lo, the Poor Indian" of the Santa Clara Valley, Ralph Rambo, Historical Booklet, University of Santa Clara, Santa Clara, CA Orrandre Library, 1967

A3. "The Five Franciscan Churches of Mission Santa Clara 1777 to 1825," Arthur Dunning Spearman, S. J., <u>National Press</u>, University of Santa Clara, Santa Clara , CA

A4. "Ritual Management of Salmonid Fish Resources in California," Sean L. Swezey & Robert F. Heizer, <u>The Journal of California Anthropology</u>

A5. "Salmon and Trout of the Pacific Coast" Dr. David Starr Jordan, President Stanford Univer-sity, <u>Thirteenth Biennial Report of the State Board of Fish Commissioners of California for 1893</u>.

A6. "Fishes of North America," Jordan and Evermann, <u>Bulletin 47, United States National Museum</u>.

A7. "Fish and Wildlife Resources of the San Francisco Bay Area", John B. Skinner, CA <u>Dept. of Fish & Game</u>, 1962.

A8. "San Jose, California's First City," E. Beilharz and D.O. DeMers Jr.

A9. "Fish Discovery Spawns Protest," Pat Dillon, San Jose Mercury News, March 18, 1988.

A10. "Pipes Trap Salmon, Construction Crew's Pipes Trap, Kill Salmon in River," San Jose Mercury News, September 3, 1994.

A11. E-mail letter to Distribution from Dr. Jerry Smith, San Jose State University, Nov. 27, 2000.

Fishermen's Oral Statements

Numerous long-time fishermen and other residents in the South Bay area also provide accounts of observing and catching all three species of fish, chinook and coho salmon and steelhead trout, in south bay waters from the early 1900's until the 1970's. A number of these men also provided accountings from the late 1800's from their grandfathers. From the 1980's until the present day, Chinook salmon and steelhead trout have be observed, captured and photographed in major South Bay waterways, in increasing numbers over the past ten years.

Mr. & Mrs. Joseph Altieri long time area residents reported seeing salmon behind their home on Los Gatos Creek during most wet years for at least the past 30 years. (B1)

Mr. Kenneth Anderson, long time resident and fisherman stated that he observed steelhead trout and silver salmon in the Guadalupe River for many years and used to catch loads of steelhead in his younger days. " He indicated that the steelhead were so plentiful you could almost walk across the river on their backs." Mr. Anderson provided the Natural Heritage Institute a written deposition on these facts in support of the South Bay Salmon & Steelhead Restoration Coalition's legal actions. (B2)

Sandy Christiansen, long time resident on St. John Street, San Jose stated he has observed salmon and steelhead, from the windows of his home, in the Guadalupe River for as long as he can remember as they migrated upstream and spawned in the area. (B3)

Brian Collins, a long time resident of the area stated that he and his friends would go down to Los Gatos Creek when he was attending Del Mar High School in the 1970's and observed and caught spawning salmon in the fall with his bare hands. (B4)

Frank Cucuzza long time resident of the area and avid fisherman stated he could remember catching steelhead in the Guadalupe River as a little boy and throughout his young adult life. He stated he had also observed spawning salmon in Los Gatos Creek from the deck of his home on the creek for many years. Mr. Cucuzza reported he caught several steelhead just above the Taylor Street Bridge several years ago in the same location he used to fish as a boy. Frank serves on one of the SCVWD's Flood Control Zone Planning Committees. (B5)

Mr. George Garbarino, 85 year old resident and fisherman of San Jose lived in a house next to the Guadalupe River and owned and operated a Machine Shop on Los Gatos Creek. Mr. Garbarino stated he caught loads of silver salmon and steelhead trout in Los Gatos Creek, just behind his business from the 20's to the 60's and continued catching steelhead until several years ago when mobility problems kept him off of the creek's steep banks. He stated he observed Chinook salmon in the Guadalupe River over this time period and they seemed to prefer the larger river. He indicated that in his younger days he would sometimes use a pitchfork to collect salmon out of the creek. Mr. Garbarino provided the Natural Heritage Institute a written deposition on these facts. (B6)

Bud Heft, long time resident reported that he observed steelhead in the Guadalupe River for as long as he could remember. (B7)

Mr. George Kasper, long term San Jose resident and avid fisherman, stated he was a member of San Jose Flycasters and fished the Guadalupe River watershed all of his life, as did his father and grandfather. He stated his grandfather and father used to catch Chinook, coho and steelhead in the river when they were young. In the 1930's his father continued to catch these species after he returned from World War II, although in lesser quantities. Mr. Kasper stated that he caught silver salmon in the upper watershed when he was younger and still fishes for and catches trout. He stated that he used to net salmon and steelhead at the base of the dam behind the Santa Clara Valley Water District offices, upstream of Blossom Hill Road, before the fish ladder was installed and released them above the dam. Mr. Kasper indicated his father used to keep detailed records of the fish he caught and indicated that he would try to locate them. (B-8)

Mr. Ken Lawrence, long-term area resident and fisherman, stated he fished the Guadalupe River for steelhead thirty to forty years ago. He is a retired local police officer and currently sits on the Board of the CA Dept. of Fish & Game. He indicated he recalls seeing his father, who just passed away, catching salmon in the Guadalupe River when he was very young. (B9)

Mr. N. Morano, long time area resident on St. John Street reported observing large salmon in the Guadalupe River system for many years, at least since the early 1970's, although he was not able to identify if they were Chinook or Coho. (B10)

Robert von Raesfeld, long time resident, attorney and well known fly fishing instructor, stated his family came to the San Jose area in the 1800's and his father and grandfather were also both avid fishermen. He learned to fish from his father who in turn learned from his grandfather. When he was young his family lived near the Guadalupe River at Vermont and Chestnut Streets. He said most South Bay waterways had salmon and steelhead runs. He said his father taught him how to distinguish between Coho and Chinook salmon (black versus light gums and the number of rays on the anal fin). He said that the Guadalupe River had runs of both coho and Chinook salmon and that he frequently caught 20 pound Chinook salmon in the 40's and early 50's from Taylor Street all the way up to the Almaden area. He used to fish the area waters intensely all the way down to Morgan Hill where he now resides and every vacation he took was a fishing vacation. He indicated his father told him many stories of catching loads of salmon in the 20's and 30's and that they were so plentiful that people used to either pitch fork or shovel them out of the river and load them in sacks for fruit tree fertilizer. (B11)

Mr. Clyde L. Ritchie, 80-year-old resident, indicated his family came to the area from Italy and first lived in Woodside. He used to fish the area waters extensively and all of the area streams had steelhead and salmon runs. He used to catch steelhead and silver salmon in San Francisquito Creek and the Guadalupe River System in the 30's and 40's. He said that the Guadalupe River also had runs of Chinook salmon that were very large in wet years. (B12)

Paul Stark stated that his grandfather, John DeBona, a long time resident and retired area sheriff's officer, now living in Eugene Oregon, used to tell him about the large runs of salmon in the South Bay waterways back in the 20's & 30's. He recalls the numerous photos his grandfather showed him of the fish. He said that they were so plentiful that people used to pitch fork them out of the waterways. (B13)

Mr. Mike Trojan, Alviso resident and retired commercial fisherman, and other long time local residents of Alviso interviewed by the GCRCD and Silichip Chinook indicated they had knowledge of salmon migrating through Alviso Slough in the August/September time frame almost every year for as long as they could remember. (B14)

Citations:

B1. Altieri, Joseph, 1280 Dr., San Jose, CA, personal conversations and meetings with L.M. Johmann, (GCRCD) 1995, 1996.

B2. Anderson, Ken, San Jose, personal meetings and conversations with L.M. Johmann (GCRCD) 1995. Interview and deposition with NHI attorney, M. Wolfe, 1996.

B3. Christiansen, St. John Street, San Jose, CA, personal conversations and meetings with L.M. Johmann, R. Castillo, 1994, 1995, 1996, 1997 & GCRCD Board of Directors, 1995.

B4. Collins, Brian, Campbell, CA, personal meeting with L.M. Johmann (GCRCD) 1996.

B5. Cucuzza, Frank, 1309 Glen Eyrie Ave. San Jose, personal conversations and meetings with L. M. Johmann & R. Castillo, (GCRCD) 1995, 1996, 1997, 1998.

B6. Garbarino, George, 34 Autumn Street, San Jose, (business address) personal conversations and meetings with L. M. Johmann and R. Castillo 1996, 1997. Interview and deposition with the GCRCD Board members and NHI attorney, M. Wolfe, 1996.

B7. Heft, Bud, Ironwood Court, San Jose, personal conversations and meetings with L.M. Johmann and R. Castillo 1995.

B8. Kasper, George, San Jose, personal conversation with L.M. Johmann (GCRCD), Nov 4, 2001.

B9. Lawrence, Ken, San Jose, personal conversations with L.M. Johmann (GCRCD) 1996.
B10. Morano, N, St John St., San Jose, personal meetings and conversation with L.M. Johmann (GCRCD), 1995

B11. Von Raesfield, Robert, 900 Lafayette St. Suite 706, Santa Clara, CA, personal conversation with L.M. Johmann (GCRCD), 2000.

B12. Ritchie, Clyde, 1448 Willowmont Ave. San Jose, personal conversation with L.M. Johmann (GCRCD), 2000.

B13. Stark, Paul, San Jose, personal meetings and conversations with Roger Castillo and L.M. Johmann, from 1990 to 2000.

B14. Trojan, Mike and other Alviso residents interviewed by the GCRCD, Silichip Chinook and the San Jose Mercury News, September 1994.

Origins of Chum Salmon

Table 7-4b, "Current Freshwater Fishes Observed in Santa Clara Basin Watersheds" is amended to delete the "I" for "Introduced Species" in the origin column for chum salmon and replace it with a footnote 6, which states: "Native to California, but origins of individuals observed in the Guadalupe River in recent years is unknown."

Chapter 7
Natural Setting

7.1 Santa Clara Basin Natural and Ecological History

7.1.1 Geography

The Santa Clara Basin (the Basin) is located in the northern part of California's Central Coast Range. The Basin is in the southern portion of the San Francisco Bay Area (the Bay Area). The Basin encompasses approximately 824 square miles of mountainous slopes, foothills, and valley bottomlands at the southern end of the South Bay (excluding the open waters of the South Bay). The Basin is bounded on the west by the Santa Cruz Mountains and on the east by the Diablo Range. All of the creeks and rivers in the Basin ultimately discharge into the South Bay. The northern limit of the Basin is defined by the Dumbarton Bridge, which crosses the South Bay between the cities of East Palo Alto and Fremont.

The Santa Cruz Mountains are a complex of steep, rugged ridges ranging in elevation up to almost 4,000 feet and separating the Basin from the Pacific coastline. The Santa Clara Valley (the lowland portion of the Basin) is nestled between the forested, east-facing slopes of the Santa Cruz Mountains and the drier grasslands, chaparral, and oak savanna on the west-facing slopes of the Diablo Range. The Diablo Range separates the Basin from the inland San Joaquin Valley (the southern portion of California's Central Valley). The portion of the Diablo Range on the east side of the Basin is often referred to as the Hamilton Range. Mount Hamilton, the highest point in the southern portion of the Diablo Range (elevation 4,213 feet), is outside and to the east of the Basin.

The cities of Palo Alto, East Palo Alto, and Menlo Park and the towns of Woodside and Portola Valley are located in the northwestern portion of the Basin. The Cities of Fremont, Newark, and Milpitas are located in the northeastern portion of the Basin. Portions of unincorporated lands in San Mateo and Alameda Counties are also included in the Basin (see Figure 7-1).

The central portion of the Basin is generally referred to as the Santa Clara Valley.[1] The Santa Clara Valley is bordered by the Santa Cruz Mountains to the west and the Los Buellis Hills and the Diablo Range to the east. Some of the larger cities in the "valley" portion of the Basin include Cupertino, Mountain View, Santa Clara, Sunnyvale, San Jose, and Campbell. The cities

[1] The term "Santa Clara Valley" appears to be used in two ways in the literature. Sometimes writers refer to Santa Clara Valley as extending from San Jose to Gilroy. When used in this context the writer is generally referring to all of the valley bottomlands in Santa Clara County. Other authors appear to differentiate between Santa Clara Valley to the north, Coyote Valley in the central part of the county, and Llagas Creek/Uvas Creek "Valley" in the Gilroy area. In this report, the term "Santa Clara Valley" is used to refer to the valley bottomlands and low-lying foothills surrounded by the mountains within the Basin.

of Saratoga, Monte Sereno, and Los Gatos are located at the southwestern end of the valley, nestled up against the base of the Santa Cruz Mountains. Almaden Valley is a narrow, northwesterly trending valley located within the larger Santa Clara Valley. At the southern end of San Jose, it is enclosed by the Santa Cruz Mountains on the southwest and south, and the Santa Teresa Hills on the northeast.

The southern end of the Basin is in Coyote Valley. Coyote Valley[2], part of the Santa Clara Valley, is at the southern end of the Santa Clara Valley. Part of the City of Morgan Hill is in the Basin. At Morgan Hill the alluvial fan of Coyote Creek forms a drainage divide as it emerges on the valley floor. Runoff on the north side of this low divide flows to the South Bay. South of Morgan Hill, runoff flows in a southerly direction to the Pajaro River and then west to Monterey Bay.

The Basin is comprised of 13 major watersheds plus the Baylands and the South Bay. Major west-side watercourses draining the east-facing slopes of the Santa Cruz Mountains include: San Francisquito Creek, Matadero Creek, Barron Creek, Adobe Creek, Permanente Creek, Stevens Creek, Calabazas Creek, San Tomas Aquino/Saratoga Creeks, and Guadalupe River. The west-facing slopes of the Diablo Range are drained by Coyote Creek and Lower Penitencia Creek. Additional lowland areas that drain to the South Bay include the Sunnyvale East and West Channels and Arroyo la Laguna in southern Alameda County.

Portions of the Basin lie in three counties: Santa Clara County, San Mateo County and Alameda County (see Figure 7-1). The vast majority of the Basin is located in Santa Clara County; however, parts of Santa Clara County are not included in the Basin. The northeastern portion of Santa Clara County that drains to Calaveras Reservoir and to Alameda Creek is not part of the Basin. The southern part of Santa Clara County that drains via Llagas Creek, Uvas Creek, and Pacheco Creek to the Pajaro River and then to Monterey Bay is also not part of the Basin. The northwestern portion of the Basin (i.e., most of the San Francisquito Creek watershed) is in southern San Mateo County. The northeastern portion of the Basin (Arroyo la Laguna) is in Alameda County.

The Basin is accessible from San Francisco and the San Francisco Peninsula (San Mateo County) via U.S. Highway 101 and Interstate 280. The Basin can be reached from the East Bay (e.g., Oakland, Hayward) via Interstate 880. Drivers coming from southern Alameda County (e.g., Livermore, Pleasanton) and Contra Costa County (e.g., Walnut Creek) enter the Basin via Interstate 680. Motorists driving to the Basin from the Monterey Bay area (e.g., Santa Cruz, Capitola) generally travel over State Highway 17 to Los Gatos. The southern end of the Basin is reached by driving north on U.S. Highway 101 from Gilroy. Scenic Skyline Boulevard (State Highway 35) follows the crest of the Santa Cruz Mountains on the western boundary of the Basin, offering excellent views of the Diablo Range, the Baylands, and Santa Clara Valley.

[2] The term "Coyote Valley" is used to refer to the valley floor between the "narrows" and the rise in the valley floor separating Coyote Valley (and the Coyote Creek drainage system) from the Llagas Creek drainage. In this document Coyote Valley is considered as a lesser valley within greater Santa Clara Valley.

Insert Figure 7-1 (Front)

Insert Figure 7-1 (Back)

Mount Hamilton Road (State Highway 130) winds its way through Halls Valley (in Grant Ranch County Park) on its way to the Lick Observatory atop Mt. Hamilton.

The Basin is referred to as the Coyote Watershed by the California Rivers Assessment (CARA) and the U.S. Environmental Protection Agency (EPA). The CARA Identification Number for the Coyote Watershed is 97, and the U.S. Geological Survey (USGS) Cataloging Unit number for the Coyote Watershed is 18050003 (CARA 1997; EPA 1999). According to CARA, the Coyote Watershed (i.e., Santa Clara Basin excluding the open waters of the South Bay) is 527,548.62 acres. According to CARA, there are 937 miles of "naturally occurring waterways" in the Coyote Watershed (CARA 1997).

7.1.2 Geology

The Basin is situated in the northern part of the Central Coast Ranges, which extend southward from San Francisco for about 200 miles. The coast range landscape is characterized throughout its length by a series of rugged, subparallel, northwest-trending mountain ranges and intervening valleys. Located in one of the most seismically active areas in the world (Graf, undated), the Basin is nestled between the northwest-trending Santa Cruz Mountains and the San Andreas fault to the west, and the Diablo Range and the Hayward and Calaveras faults to the east. Although the geology of the area is complex, the overall picture is fairly straightforward. The Santa Clara Valley is a large trough that has been filled by sediment (gravel, sand, silt and clay) eroded from the adjacent mountain ranges. The structure of the area is controlled by faulting, the trend of which is predominantly in a northwesterly direction, as is so commonly the case in California (Lindsey 1974).

The geologic formations of the Basin are of two kinds – the hard rocks of the mountain borders, and the unconsolidated materials of the valley fill (Clark 1924). The ancient rocks exposed in the mountain ranges (which are collectively referred to as the Franciscan formation) originated as volcanic sea floor. Between 160 and 70 million years ago, these pieces of oceanic crust were subjected to intense shearing, pressure, and deformation when the tectonic plate that they were part of, the Pacific plate, was subducted (overridden) by the North American plate (Iwamura 1999). The mountains that border the Santa Clara Valley are composed of many different types of rocks. The region is particularly well known for the occurrence of serpentine, a rock created almost exclusively in oceanic subduction zones where cold, wet pieces of seafloor are subjected to intense pressures and deformation at relatively low temperatures.

While the Pacific plate was being forced beneath the North American plate, sand, silt, and clay were eroded off the growing North American continent and were transported westward to the sea. These sediments were deposited in the ocean off of the western edge of the continent, and were buried and hardened into rocks such as the sandstone, siltstone, and shale that are associated with the Franciscan formation exposed today in the mountain ranges. These rocks, which were deposited between 136 and 65 million years ago, are collectively known as Cretaceous sedimentary formation, or the Great Valley Sequence. Mountain-making processes (such as faulting) then raised up two strips of land that would later become the Santa Cruz Mountains and the Diablo Range, and dropped down the area in between them, creating a deep trough that would eventually become the Santa Clara Valley and the South San Francisco Bay. The valley floor was originally below sea level, and the older rocks deposited in it include sandstones containing many marine fossils, as well as cherts (derived from silica-rich oozes) and marine shales. As the valley sediments accumulated, the floor of the valley emerged above sea level and also received deposits of ash and bedded volcanic flows from active volcanoes in the region.

During a time period ranging from approximately 2 million to 10,000 years ago, the valley filled with gravel, sand, and silt that eroded from the mountains. These deposits comprise the Santa Clara Formation, which is found adjacent to and under the valley floor. These sediments were deposited by streams that transported the broken and weathered pieces of rock from the higher elevations to the valley floor (Iwamura 1999). Many of these sediments were deposited at the mouths of the streams that transported them, and formed deposits called alluvial fans. An alluvial fan is a cone-shaped deposit of stream sediment that forms where a narrow canyon stream suddenly disgorges into a flat valley. Between 1 million and 8,000 years ago, gravels, sands, silts, and clays were laid down in small mountain valleys. The accumulation of this "old alluvium" most likely resulted from high sediment yields in the recent geologic past when the region was wetter. Between 10,000 years ago and the present, gravel, sand, silt, and clay have been eroded from the mountains and deposited in the valleys of the Basin. This material, referred to as the "young alluvium" is an important groundwater-bearing unit of the Basin. The thickness of these deposits exceeds 1,500 feet in the Santa Clara Valley (Iwamura 1999).

During the past 30,000 years, while the southern portion of the Santa Clara Valley was being shaped largely by rivers, the northern portion of the valley was experiencing somewhat different influences. San Francisco Bay (the Bay) was formed in much the same way as the Santa Clara Valley, when a large chunk of faulted crust dropped downward with respect to its neighbors. The Bay trough was flooded repeatedly by global rises in sea level associated with the melting of glaciers. Sediment-rich glacial meltwater traveled down the Sacramento River and deposited large quantities of silt and clay in the Bay, creating blue-gray deposits of bay mud that extend well into the northern portion of the Basin (McDonald et al. 1978). Today, the Bay has retreated from its maximum extent of inundation, and significant areas of these deposits stand exposed as dry land. Many of the geologic processes that have shaped the Basin continue to alter the landscape. Gravels, sands, silts, and clays are weathered from the mountain hillslopes as a result of gradual processes, as well as episodic ones such as earthquakes, fires, and floods, and are transported down stream channels to the valley flat where they are deposited (Iwamura 1999).

Mineral deposits, mines and quarries can play important roles in the water quality of a watershed. Of particular note in the Basin is the occurrence of a significant number of inactive mercury mines, most of which are located in the vicinity of New Almaden in San Jose. Historically, nickel and copper have also been mined in the Basin. In the recent past, quarrying of alluvial gravels took place in many parts of the Basin, although few of these activities have continued to the present day (Iwamura 1999). There are three active quarries in the Basin: Stevens Creek Quarry (formerly Voss Quarry), which supplies baserock, located in the Stevens Creek watershed; and Hanson Cement Company Quarry (formerly Kaiser Permanente Cement), which supplies limestone for cement and baserock, located in the Permanente Creek watershed

(Bret Calhoun, pers. comm., 1999). The DeSilva quarry at the eastern end of the Dumbarton Bridge produces sand and gravel in the Arroyo La Laguna watershed.

7.1.3 Soils

Just as the Basin is the home of a wide variety of different kinds of rocks, it also plays host to many different kinds of soils. The type of soil that develops in a particular location is influenced by five major factors: climate (especially temperature and precipitation), living organisms, the parent material (such as bedrock) from which the soil forms, topography (slope and elevation), and the amount of time that the soil has had to develop (Brady 1990). Because there are so many different combinations of these factors within the Basin, many different individual soils have developed, each with its own unique properties. Figure 7-2 depicts the typical progression of soils across the northern portion of Santa Clara County, and emphasizes the relationships between topography, soil type, and vegetation (Weir and Storie 1947).

The Natural Resources Conservation Service (formerly the Soil Conservation Service) has classified 20 soil associations for Santa Clara County alone (Silva, undated), and each soil association is comprised of up to five or six different individual soils. Because of the large number of different soils that have been identified in the region, it is useful to group them and to discuss their general properties rather than to treat each soil individually. This type of analysis was most effectively articulated by Walter Weir and Earl Storie in their classic 1947 publication on the soils of Santa Clara County. Most recent soils mapping of the area was carried out in 1968 and in 1974, but a new study, scheduled to begin in 2001, will produce an updated soils map.

A useful way to group soils is based on physiographic land divisions, a parameter that takes into account both the topography (elevation) and the genesis (origin) of landforms. Based on this concept, soils form on five major types of landforms in the Basin: alluvial fans, basin land, low terrace land, high terrace land, and uplands (Weir and Storie 1947).

Alluvial fan soils form from sediment transported and deposited by rivers, and are located on the valley floor bordering streams. They tend to be deep and are easily penetrated by both roots and water due to the lack of accumulation of clay in the subsoil. Historically, these soils comprised some of the most desirable agricultural land in the area and were used to support a wide variety of crops. As seen on Figure 7-3, alluvial fan soils tend to be distributed on the margins of the valley flat, where streams flowing out of the hills have deposited sediment as a result of a loss in velocity upon reaching the flat lands (Weir and Storie 1947).

The soils in the region that occupy basins or basin-like locations are described as having a “heavy texture” and contain large amounts of clay. Because they form in very flat places, they tend not to be very well drained and sometimes contain alkali deposits that render them unfit for agricultural use because of the high concentrations of salts and ions found in them. There is a large proportion of basin land soils in the northern portion of the Basin, adjacent to the Bay. At times in the geologic past, when sea levels were higher, these areas accumulated bay muds, which have evolved into basin land soils when sea levels retreated, and these formerly underwater environments were exposed as dry land (Weir and Storie 1947).

In many places around the edges of the Santa Clara Valley, between the alluvial fan soils and the upland soils, there are soils occupying terrace positions somewhat above the general level of the valley floor. For the most part, these low terrace land soils represent remnants of older valley-filling materials through which the present streams flow, although these areas are no longer subject to deposition or overflow. Low terrace land soils tend to have significant percentages of clay in their subsoil, and can be difficult for both roots and water to penetrate.

Along the edges of the valley and merging into the hills are soils occupying older and higher terraces. These areas are usually somewhat rolling, and here the soils are more fully developed and more erosive than those occupying lower terraces (Weir and Storie 1947).

Upland, or primary, soils (soils derived in place from the weathering of underlying bedrock) occupy large portions of the Basin and are found on the slopes of both the Diablo and Santa Cruz Mountain ranges. Although some of the flatter areas are farmed or grazed, these soils are currently of little agricultural importance and support a diverse range of natural plants and animals (Weir and Storie 1947).

Unfortunately, systems of soil classification and nomenclature are often unique to a specific county. Although the names used to refer to particular soils often differ between counties, the characteristics of the soils are continuous across political boundaries. Because the Basin spans three counties, it can be difficult to trace the occurrence of a particular soil or soil group across the Basin. Additionally, soils in the portions of San Mateo and Alameda counties that lie within the Basin have not been mapped by the Natural Resources Conservation Service. Figure 7-4 (Soil Association Map of Santa Clara County) illustrates the soil classifications across most of the Basin's land area.

7.1.4 Climate and Hydrology

The movement and occurrence of water in the Basin is governed by the hydrologic cycle. Although the cycle is a closed loop and has no beginning or end, it is convenient to describe the hydrologic cycle as starting with the oceans. As illustrated on Figure 7-5, water evaporates from the surface of the oceans and water vapor moves through the atmosphere. When atmospheric conditions are suitable, water vapor condenses and forms droplets or ice crystals that fall to the ground as precipitation.

Precipitation that falls on the land surface can follow any number of paths through the hydrologic cycle. Some of the water may reside temporarily in puddles or lakes as depressional storage. Some proportion of the total precipitation that falls drains to stream channels via overland flow. If the ground surface is porous, some rain infiltrates into the subsurface. Below the land surface, water that has infiltrated can be drawn into the rootlets of plants. As the plants use the water, some of it is transpired to the atmosphere. Excess soil moisture is pulled downwards by gravity, and flows as groundwater through rocks and soil until it discharges as a

Insert Figure 7-2 (Front)

Insert Figure 7-2 (Back)

Insert Figure 7-3 (Front)

Insert Figure 7-3 (Back)

Insert Figure 7-4 (Front)

Insert Figure 7-4 (Back)

Insert Figure 7-5 (Front)

Insert Figure 7-5 (Back)

spring, or a seepage into a wetland, pond, lake, stream, river, or ocean. Water flowing in a stream can come from overland flow, from groundwater that discharges into the streambed, or from a combination of sources. Small streams flow together and join larger streams, until eventually rivers and streams flow into the ocean or sea. The Basin is the home of more than 900 miles of creeks and rivers. All of the major watersheds in the Basin ultimately have surface outflow to the lower South Bay.

The Basin has a Mediterranean climate, characterized by extended periods of precipitation during winter months and virtually none from spring through autumn. The wet season generally extends from approximately November through April, while rainfall during May through October tends to be minimal. Annual average rainfall amounts vary significantly due to topography. Portions of the Basin in the Santa Cruz Mountains receive 40 to 60 inches per year, while the central Santa Clara Valley receives on average 13 to 14 inches in the vicinity of downtown San Jose (see Figure 7-6). Average figures can be somewhat misleading, however, because in addition to seasonal variation, droughts in California are not uncommon. For example, the average annual rainfall amount for San Jose of approximately 13 inches per year tends to obscure the fact that rainfall over the last 100 years or so has ranged from 6 to over 30 inches in any 1 year (Santa Clara County 1994). Temperatures in the Basin tend to be fairly mild, and rarely drop far below freezing in the valley flat. Although snow is not uncommon in the mountainous portion of the Basin in winter, it does not last long. North of San Jose, the average summer temperatures are rarely higher than 90°F. South of San Jose both summer and winter extremes are somewhat greater. In summer, the humidity of the air is relatively low, while in winter it is near the saturation point a large part of the time (USDA 1968).

"Drought" is defined as any period of below-average precipitation. Rainfall statistics indicate that short-term droughts of 5 to 7 years have occurred many times just within the last hundred years. Tree-ring analyses indicate that 10- to 20-year periods of below-average precipitation have occurred at least three times since the mid-1500s. Although in other regions of the country drought is considered a temporary aberration in weather patterns, in much of California and in the Basin, drought should serve as a basis for planning (Santa Clara County 1994).

In the Basin, rainfall occurs chiefly during the winter, when the capacity of the atmosphere to evaporate water is at a minimum. The average annual evaporation from the surface of a pond or lake is estimated to be about 57 inches per year in the Basin, but only about 22 percent of this yearly total evaporation occurs during the rainy season, from November through April (Clark 1924). Plants draw water from the soil through their roots and discharge it into the air through their leaves. In the Basin, most of the native plants become inactive or die back during the summer months due to a lack of soil moisture, and no new growth takes place until the rains come again. Therefore, in nonurbanized areas, transpiration is highly seasonal, and is much lower in the summer than during the winter months, except adjacent to flowing streams and lakes, where water is available to riparian vegetation all year.

Runoff, which is the percentage of precipitation that is carried away by streams, is highly variable and depends upon a number of factors such as the character of the topography, the character of the soil and soil covering, and the density of urbanization and the depth to groundwater. It is estimated that between 16 and 34 percent of the precipitation that falls in various portions of the Basin becomes runoff. Like runoff, the amount of water that infiltrates into the soil and rocks is also highly variable within the Basin, and is dependent upon many of the same factors. In the Basin, groundwater generally exists at depths below the streambeds, except in the lower courses of a few of the larger streams, notably Coyote Creek north of downtown San Jose. Because it is sustained by groundwater, Coyote Creek flows year round (i.e., is perennial). Historically, most of the other creeks on the valley floor were naturally dry during the summer (Clark 1924). As patterns of water use and water importation into the Basin have evolved, many creeks have experienced increased summer flow. Some creeks flow due to artesian wells, springs, water releases and urban runoff. Many of the creeks involved are not uniformly affected, but rather display a mixture of wet and dry sections (Doug Padley, pers. comm., 1998). In an effort to recharge the groundwater basin, stored and imported water is released from reservoirs and other parts of the water distribution system during summer months into many creeks that would otherwise be dry under natural conditions. Because the upper reaches of the creek beds tend to be composed of much coarser sediment than are the lower reaches, most recharge takes place closer to the headwaters of the watersheds. Often, when water is released for recharge, only enough is made to flow through the stream channels so that all of the water has infiltrated before reaching the less permeable, lower reaches of the channel. Flows released for groundwater recharge purposes are often by design not sufficient to provide water to the lower reaches of the creeks (Barry Hecht, pers. comm., 1998). Some streams are currently perennial in their lower reaches due to urban runoff or high groundwater.

Flooding is another common process that plays a major role in the Basin. Tidal flooding along the Bay may occur due to levee failure, and its severity is increased in areas that have subsided due to overdrafting of groundwater basins. More importantly, stormwater flooding has been a long and continuing problem for much of the Basin ever since permanent settlement of the valley floor began. To the valley's early residents, the Ohlone Indians, flooding meant the temporary inconvenience of relocating their villages, most of which were built along streams. The Spaniards who colonized the valley followed suit, building the first mission and pueblo near the Guadalupe River in the late 1700s. Their earthen dams and irrigation ditches failed to protect against the river's frequent floods, and before the century's end, both the pueblo and the mission were moved to higher ground. When agriculture and towns spread across the valley, winter and spring floodwaters provided much-needed irrigation for fields and orchards. As the valley's land uses changed from agricultural to residential/industrial, and development moved into the foothills, flood damage became a larger concern (Water District, undated [b]).

Much of the valley floor is flood prone (approximately 60 out of 300 square miles) (Santa Clara County 1994). As flooding problems intensified, levees were constructed to contain floodflows along some creeks, although flood control measures have historically been sporadic and of varying effectiveness. Major floods have struck recently in 1952, 1955, 1982, 1983, 1986, 1995, and 1997, among other years. In addition, the amount of urban development in flood-prone areas over the last 20 to 30 years has dramatically increased the estimates of potential property damage from major flooding, while the increase in the amount of impervious surfaces from development has increased total stormwater runoff (Santa Clara County 1994).

Insert Figure 7-6 (Front)

Insert Figure 7-6 (Back)

As urbanization and development takes place, more and more of the ground surface is covered with asphalt, concrete, and roofs. This causes a greater percentage of rainfall to rapidly move into stream channels because it is not soaking into the ground and slowly traveling through the subsurface. The decreased infiltration and increased runoff associated with urbanization can cause the size of peak floods to increase unless measures to reduce peak runoff are included as a part of each development project (Santa Clara County Planning Department 1969). According to recent reports by the Santa Clara Valley Water District (Water District), two areas most threatened by flooding are along Guadalupe River in downtown San Jose and San Francisquito Creek in Palo Alto and East Palo Alto (Santa Clara County 1994). Additional areas subject to flooding include Coyote Creek near Williams Street, Calabazas Creek near Bollinger Road, and some areas in Milpitas (Jim Wang, pers. comm., 1998).

7.1.5 Plants and Plant Habitats

7.1.5.1 Historical Perspective

During the time of the Ohlone Indians (prior to Spanish settlement), the Basin had a rich variety of plant communities and wildlife habitats (Margolan 1978). Tall stands of native bunchgrasses covered the vast meadowlands and dotted the savannas. "Marshes that spread out for thousands of acres fringed the shore of San Francisco Bay," which was much larger before landfill practices in the Bay (Margolan 1978). The rivers and streams draining into the Bay supported large estuaries and tule marshes. Along the lower salty margins of the Bay, there were vast pickleweed and cordgrass marshes (Margolan 1978).

When Portola's party stumbled on the Santa Clara Valley in 1769, and camped near what is now called the El Palo Alto redwood on San Francisquito Creek at El Camino Real, they found a spacious, oak-studded grassy plain. Through the valley at several places ran small streams, prone to flooding in the winter and drying in the summer. The banks of the streams and arroyos were densely wooded with cottonwoods, willows, and sycamores. Portola and those who followed him encountered large marshes in places, especially near the lower portions of Coyote Creek and the Guadalupe River and on the fringes of the Bay, that rendered foot travel difficult or impossible. To the west, the mountains were heavily timbered with redwoods of considerable dimensions, and redwoods followed the streambeds of Stevens Creek and others down into the valley itself. To the east of the valley, the grassy hills were, with the exception of densely wooded arroyos, barren of trees or sparsely wooded with oaks and pines (Bolton 1927, 1930).

The arrival of European settlers dramatically changed the distribution and species composition of the plant communities in the Basin. The displacement of the once prevalent native perennial grasslands by European nonnative, annual grassland species is well known. The once heavily forested foothill areas were significantly reduced by lumbering practices in the mid- to late-1800s (Santa Clara County 1973). Douglas fir and coast redwoods were the most important lumber trees. "In the relatively short time of fifty to seventy-five years, nearly all of the timber of Santa Clara County had been removed" (Santa Clara County 1973). As settlement continued, natural stands of vegetation were converted for agricultural use such as grazing lands, crops, vineyards, and orchards. As the development of the Bay Area continued, much of the agricultural land was later replaced by urban development. Much of the valley oak woodland that was present historically in the lower foothills has been lost.

"Historically, the South Bay supported large expanses of tidal flat and tidal marsh. In many of the marshes between the tidal creeks were salt marsh ponds or pans" (Goals Project 1999). "Also much of the periphery of the baylands were wet grasslands ….." (Goals Project 1999). In the South Bay, large areas of tidal flat and tidal marsh were converted to shallow ponds of varying salinities for salt production (Goals Project 1999). "Other development along the bayshore, including sewage treatment facilities, landfills, and residential and industrial uses, also reduced the area of natural baylands habitats"(Goals Project 1999). In the South Bay Subregion (south of Coyote Point on the west side, and south of San Leandro Marina on the east side), tidal flat habitat has declined 29 percent and tidal marsh has decreased by 84 percent, compared to historical conditions (Goals Project 1999).

7.1.5.2 Changes Due to Human Activity

As a result of human activities, many invasive nonnative plant species have become introduced into the Basin. Such invasive species outcompete and displace the native or indigenous plants of natural plant communities and lower the habitat value for wildlife. Problematic, invasive, nonnative plants in grassland habitats include: ripgut brome, red brome (*Bromus rubens*), yellow star thistle (*Centaurea solstitialis*), field mustard (*Brassica rapa*), bull thistle (*Cirsium vulgare*), slender-flowered thistle (*Carduus tenuiflorus*), bindweed (*Convolvulus arvensis*), and milk thistle (*Silybum marianum*).

Various invasive nonnative plant species have become established in riparian habitats such as giant reed/arundo (*Arundo donax*), German (Cape) Ivy (*Senecio mikanioides*), poison hemlock (*Conium maculatum*), white sweet clover (*Melilotus albus*), and Himalayan blackberry (*Rubus procerus*). Periwinkle (*Vinca major*), an invasive vine, has become established in the understory of many woodlands, forests, and streambanks. Some of the invasive species commonly found in riparian habitats are listed in Table 7-1.

Open and disturbed areas often encourage the establishment of invasive nonnative species. For example, the disturbed roadsides along State Highway 17 in the Santa Cruz Mountains (within mixed evergreen forest) have become invaded by French broom (*Genista monspessulana*). To a much lesser extent, Scotch broom (*Cytisus scoparius*) also occurs along State Highway 17 near Lexington Reservoir.

Several species of introduced tidal marsh plants occur in the lower South Bay. Smooth cordgrass (*Spartina alterniflora)* is a perennial grass that has invaded low tidal marsh and open mudflats in the Bay (Grossinger et al. 1998). It is a potentially serious invasive in the lower South Bay (Gale Rankin, pers. comm., 1998). Perennial pepperweed is a serious invasive of South Bay brackish marshes (Gale Rankin, pers. comm., 1998). Infestations are known to occur at Warm Springs Marsh, and in marshes adjacent to Coyote Creek, Alviso Slough, Guadalupe Slough, and Charleston Slough (Grossinger et al. 1998). Other introduced tidal marsh plants that have

Table 7-1

invaded South Bay salt and brackish marshes include giant reed and glasswort (*Salsola soda*) (Grossinger et al. 1998).

7.1.5.3 Plant Habitat Descriptions

The ecosystems of the Basin have been catalogued, mapped, and described by previous authors in a number of different ways. General descriptions of the ecology of the region speak of broad groupings of "habitats." Many of these habitat types are also vegetated, and are thus often referred to as vegetation types. Each vegetation type is generally broken down further into plant communities. Most of the reports describing the vegetation in the Basin refer to the occurrence of plant species within each plant community present.

Some habitat types are either unvegetated or appear to be devoid of vegetation to the casual observer. These habitats are generally overlooked in a description of vegetation types and plant communities, but are discussed in texts and reports dealing with fish and aquatic resources, wildlife, and water quality. We have elected to use the combined term "habitat/vegetation types" to cover all the habitats in the Basin.

The habitat/vegetation types described in this text represent a refinement of the habitat types used in the Santa Clara County General Plan. The Santa Clara County General Plan (Santa Clara County 1994) and the background report for the General Plan (Santa Clara County 1993) refer to four broad groupings of habitats: Baylands Habitats (including estuary, mudflat, salt marsh, salt pond, and levee); Freshwater Habitats (including flowing streams, riparian zones, freshwater marshes, and lentic zones); Grassland/Savanna Habitats (including grassland and savanna); and Chaparral/Forest Habitat (including chaparral, mixed evergreen forest, redwood forest, foothill woodland, and closed-cone pine forest). There was no map showing the distribution of these habitats in either the General Plan or the background study.[3]

The habitat/vegetation types used in this text to describe the natural history and ecology of the Basin are the following: lower South Bay, Baylands habitats, freshwater habitats with standing water (i.e., lentic habitat), freshwater habitats with flowing water (i.e., lotic habitat), freshwater wetlands, nonnative grasslands, native grasslands, scrub and chaparral, riparian and bottomland habitat, woodlands, broadleaved upland forests, coniferous forests, cliffs and rock outcrops, agricultural land, and urban habitat. Table 7-2 presents a comparison of these habitat/vegetation types with the terms commonly used to describe biotic/plant communities and wildlife habitats.

7.1.5.4 Unvegetated Habitat Types

The unvegetated habitat types in the Basin include the lower South Bay (permanent open [salt] water) and the Baylands habitats subject to tidal inundation (tidal [mud] flats and tidal sloughs

[3] A map showing the distribution of Vegetative Resources in Santa Clara County was prepared as part of the general planning process in the early 1970s (Santa Clara County 1973). This color map shows the distribution of the following "General Habitats": salt ponds; salt marsh; riparian (streamside); grassland; woodland and grass; hardwood, woodland, and chaparral; pine forest; coulter pines; redwood; agricultural; and urban. This map has never been updated nor does it exactly correspond to the classification of habitat/vegetation types used in this text.

Insert Table 7-2, Page 1

Insert Table 7-2, Page 2

Insert Table 7-2, Page 3

[brackish water]). These habitat types are commonly referred to as estuarine habitat by fish and wildlife biologists. Salt ponds are also an unvegetated (with the exception of algae) habitat occupying a significant portion of the land area surrounding the lower South Bay. These habitat types are described in Sections 7.1.6 and 7.1.7.

The freshwater habitats with standing water (i.e., lentic habitat) including lakes and reservoirs, natural and the human-made ponds (including percolation ponds), and the flowing water (lotic) habitats (e.g., perennial and intermittent streams), are also described in Sections 7.1.6 and 7.1.7.

7.1.5.5 Vegetated Habitat Types and Plant Communities

The Basin has a wide variety of vegetation types, plant communities, and plant species, which may be attributed to the varying environmental conditions present in the Basin. Differences in topography (elevation, slope, and aspect), climate, soil types, and land management activities (past and present) determine the distribution of the major vegetation types and plant communities.

As a result of varying environments, the following trends in habitat distribution are apparent. In higher and drier areas, chaparrals and grasslands tend to be dominant; whereas in shady or more moist areas, woodlands and forests occur. For example, as one looks at the west-facing slopes of the Diablo Range, oak woodlands are common in drainages and on north-facing slopes. Riparian and wetland habitats are more developed in bottomlands associated with creeks and the Bay.

Plant community designations vary between various authorities and are not necessarily directly correlated. Plant community designations used in this text are as according to *Preliminary Descriptions of the Terrestrial Natural Communities of California* (Holland 1986), unless otherwise indicated. This system for classification of plant communities was used by the California (Department of Fish and Game [CDFG]) Diversity Data Base (CNDDB) until recently. Table 7-2 lists each of the plant communities according to Holland (1986) that are known to occur within each of the major habitat/vegetation types in the Basin. (It should be noted that the “Holland” descriptions do not accurately describe or correlate with all of the plant communities in the Basin [Gale Rankin, pers. comm., 1998]).

The following is a general description of the distribution of vegetation types and plant communities in the Basin, by habitat. Mapped information showing the distribution of the plant communities in the Basin may be obtained from the following sources: CAL VEG ICE Maps; Information Center for the Environment (CARA 1997) (scale 1 inch = 10 miles); Vegetative Resources (Santa Clara County 1973) (scale .4 inches = 2 miles); and the map of Natural Vegetation of California (Kuchler 1977) (scale units 1:1,000,000).

Tidal Marsh Habitat

Tidal marsh habitat occurs in undiked areas of the lower South Bay and in tidal reaches of rivers and streams that are open to complete tidal action. It occurs from the top of the intertidal zone, at the maximum height of the tides, to the lowest extent of vascular vegetation. In the more saline parts of the South Bay, tidal marsh is referred to as tidal salt marsh. In the more brackish areas where there is significant freshwater influence, it is referred to as tidal brackish marsh.

Both types of tidal marsh are typically characterized by three general zones of vegetation, each of which is related to tidal elevation. Low tidal marsh occurs between the lowest margin of the marsh and mean high water (MHW). Middle tidal marsh occurs between MHW and mean higher high water (MHHW). High tidal marsh occurs between MHHW and the highest margin of the marsh (Goals Project 1999).

Salt marshes border the mudflat community, and are composed of a rich community of algae, diatoms, and invertebrates, as well as wetland[4] vegetation. Mudflats and salt marshes are generally found between mean low water (the average water level at low tide) and the extreme high tide line. Salt marshes can be distinguished from the mudflats they border by the presence of upright herbaceous vegetation, which colonizes salt marshes at an elevation approximately equal to mean sea level (msl), extending up to the extreme high tide line. The harsh environment of a salt marsh includes tidal inundations of salt or brackish water. (Brackish water is a mixture of predominantly freshwater and some saltwater). Because the water-saturated soils of salt marshes contain little oxygen and have high salt concentrations, predominantly while the surface is fully exposed to sun and wind, the plants that successfully make their home there are uniquely adapted to this challenging environment (Faber 1982).

The coastal salt marsh community is often stratified into three easily distinguishable community types that correlate with dominant vegetation cover, elevation, and tidal flow. The area from the low tide line to the mid-tidal zone is dominated by cordgrass (*Spartina foliosa*). Cordgrass can tolerate many hours of continuous submergence, as well as salt concentrations slightly higher than the open ocean. Cordgrass is the only salt marsh plant able to tolerate total submergence for more than half of the day, as well as total darkness for several days in a row if high tide occurs near mid-day during the winter (Conradson 1996). Cordgrass is considered one of the most productive land plants in the world, yielding up to eight tons of dried material per acre (Conradson 1996). This rooted aquatic perennial dies back in the fall, and decomposes into minute particles that provide the primary productivity for many organisms in the Bay. Due to land subsidence, large amounts of cordgrass habitat have disappeared in the South Bay.

The mean high tide zone is dominated by another perennial, common pickleweed *(Salicornia virginica).* Pickleweed is a fleshy plant standing approximately 18 inches high with modified succulent leaves resembling stems. Pickleweed can tolerate having its roots in the wet mud, but unlike cordgrass, cannot tolerate long periods of total submergence. Cordgrass and pickleweed zones may overlap for about 3 feet of elevation, but pickleweed has a higher tolerance level for the increase of salt concentration that comes with higher elevations (Conradson 1996). Another

[4]The term wetland does not refer to a single vegetation type or a single plant community. Any habitat where the soil is continuously saturated within 18 inches of the surface for a period of at least 1 to 3 weeks per year may considered a wetland. Because wetlands are periodically waterlogged, the plants growing there must tolerate low levels of soil oxygen. The presence of flood-tolerant species is often a good indication that a site is a wetland even if the ground appears to be dry for most of the year (Barbour et al. 1993).

common plant in the high tide pickleweed zone is a plant that starts its life rooted in the mud then becomes parasitic to pickleweed, avoiding the seasonal increase of salt concentration in the soil. This parasitic plant, the salt marsh dodder (*Cuscuta salina*) looks like orange-colored string, clumped in small patches on top of the pickleweed. The pickleweed plant community also includes Jaumea (*Jaumea carnosa*) and arrow-grass (*Triglochin spp*.).

The upper portion of the high tide zone, which is occasionally inundated, has drier alkali and soils and is dominated by various peripheral species such as salt grass (*Distichlis spicata*). This plant community may contain marsh rosemary or sea lavender (*Limonium californicum*), alkali heath (*Frankenia salina*), fat-hen (*Atriplex triangularis*), brass buttons (*Cotula coronopifolia*), marsh gum plant (*Grindelia stricta var. augustifolia*), curly dock (*Rumex crispus*), and Australian saltbush (*Atriplex semibaccata*).

The biodiversity of plant species in saltwater marshes is limited to approximately 15 native species due to the tolerance limits of these plants to high salt concentrations, as well as periods of either desiccation or water inundation due to tidal fluctuations. Although the diversity of plants is low, the three dominant plant species that have physically adapted to estuarine environments have been able to utilize the direct sunlight and abundance of nutrients (either from the land as sediments are washed down into the Bay via rivers and creeks, or from the ocean upwelling currents brought into the Bay by tidal action) to such an extent that estuaries are highly productive environments. In the Lower South Bay, smooth cordgrass is a potentially serious invasive perennial grass in low tidal marsh and open mudflats.

Brackish marshes are found in places where freshwater mixes with saltwater. A brackish marsh is one of the most restrictive types of habitat due to the extreme fluctuations in salinity found there. During the winter and spring season of heavy rains and stream runoff, brackish marshes may be flooded almost entirely by freshwater, while in the summer and fall saltier tidal waters predominate. This condition limits the variety of plants found in brackish marshes to those that can tolerate inundation by both fresh and salty water (Faber 1982). Dominant genera of brackish tidal marsh are *Scirpus* (bulrush) and *Typha spp*. (cattail) (Josselyn 1983).

The primary wetlands associated with the lower South Bay are the northern coastal salt marsh and the coastal brackish marsh (Holland 1986). To a lesser extent, diked salt marshes and estuaries also occur. Within the Basin, the coastal salt marsh is distributed along the southern fringes of the Bay such as in the Palo Alto Baylands and at the Don Edwards San Francisco Bay National Wildlife Refuge. Coastal salt marsh habitat is restricted to a zone that occurs from just below mean tide level to the level of the highest tides along the Bay rim (Santa Clara County 1993). Plants growing in the coastal salt marsh are affected by the twice daily fluctuations in the water level of the Bay and its salinity and temperature (San Mateo County Planning Department 1973). Typical plant species associated with the coastal salt marsh are salt grass, pickleweed, cordgrass, and marsh gum plant.

Coastal (tidal) brackish marsh occupies a similar position to the coastal salt marsh, except it has more freshwater input, and the salinity may vary significantly. Tidal brackish marsh often occurs in estuaries (flatlands where freshwater and saltwater mix) and intergrades with coastal salt marsh or freshwater marsh, where rivers and creeks enter the Bay. In tidal brackish marsh, cattails, California bulrush (tule) (*Scirpus californicus),* and alkali bulrush (*Scirpus maritimus)* dominate the low marsh (Goals Project 1999). A diverse assemblage of species including bulrushes, spike rush (*Eleocharis spp.*), Baltic rush (*Juncus balticus*), silverweed, and salt grass dominates the middle marsh (Goals Project 1999). Common pickleweed, saltgrass, gumplant, and alkali heath characterize the high marsh (Goals Project 1999). There has been a rapid large-scale invasion of perennial peppergrass (*Lepidium latifolium*) in the brackish marsh at the south end of the Bay over the past few years (Gale Rankin, pers. comm., 1998).

An ongoing study has been designed to detect changes in habitat types within the coastal marshes of the South Bay. The study also evaluates the possible contribution of the freshwater discharge from the San Jose-Santa Clara Regional Water Pollution Control Plant on the disruption of different habitat types. Although new marsh formation has occurred, over 127 acres of salt marsh habitat has converted to a less saline environment (mostly brackish marsh habitat) in the last 10 years. The majority of this conversion has taken place since 1996, when freshwater marsh habitats were first mapped. Much of the conversion is caused likely by large-scale influences that are affecting the entire system, including anthropogenic and environmental factors. The ongoing collection of physical data will aid in determining the relative influences of environmental and anthropogenic factors to changes in marsh types (H. T. Harvey & Associates 1999).

Baylands Habitats – Diked Wetlands

There are many acres of diked wetlands in the South Bay. These are historical tidal marshes isolated from tidal influences due to levees or dikes, but that maintain wetland features. Some of these wetlands are connected to tidal sloughs by outlet structures. Depending on the type of outlet, tidal water may be allowed to flow into the site, although the amount of inundation is generally controlled. At other sites there may be no outlet. In these instances, surface runoff collects in the wetland areas behind dikes and levees during the winter months and evaporates in the spring.

A mosaic of pickleweed marsh, bare ground, and higher elevation salt marsh plant species occupies most of the diked wetland areas; however, there is often also a preponderance of weedy/ruderal plant species. Most of these areas have reverted to wetland habitat after being abandoned by farmers. Although the water ponded in these diked wetlands may be freshwater, the soils underlying these areas are saline due to their origin and the high levels of evaporation.

Because of land subsidence, most of these diked wetlands are too low in elevation to function as marsh if subjected to the full range of tidal action. If the levees were breached these areas would become open water habitat and not return to a wetland. Restoration of wetlands located in areas of subsidence requires restoring the subsided marsh plain back to an appropriate elevation in the intertidal zone and restoring the range of functions a tidal marsh provides. In San Francisco Bay tidal wetlands, restoration will proceed primarily by deposition of suspended sediment. It is predicted that about 10 to 15 years would be required for sediment deposition in a subsided South Bay salt pond to raise the marsh plain to an elevation where native vegetation would become established (Goals Project 1999). Muted tidal action has been restored to some of these areas through the installation of water control structures with risers.

Baylands Habitats – Constructed Wetlands

There are a number of restored (constructed) wetlands in the South Bay. In some cases, existing dikes have been breached to allow tidal waters to enter the restoration area. In other instances, water control structures have been installed to control the extent and duration of inundation by tidal waters. In most cases, there has also been some planting of marsh plants.

Freshwater Wetlands

In contrast to brackish water marshes, the freshwater marsh is a less demanding environment for plants and animals to grow and live in. Freshwater marshes are found throughout the coastal drainages of California wherever water slows down and accumulates, even on a temporary or seasonal basis. A freshwater marsh usually features shallow water that is often clogged with dense masses of vegetation. Although pools of water are common, as a marsh ages, vegetation accumulates, often filling in all the open water (Faber 1982). Freshwater marshes occur in lowland areas adjacent to diked tidal wetlands and along the lower reaches of the rivers and creeks upstream of tidal influence.

The following types of freshwater wetlands occur in the Basin: coastal freshwater marsh, freshwater seep, and seasonal wetlands. Freshwater marshes may form around springs, ponds, and along slow moving creeks and rivers. Typical plant species include cattail, California bulrush, common tule (*Scirpus acutus*), and various species of rush (*Juncus* spp.) and sedge (*Carex* spp.). Vernal pools may support endemic or rare and endangered plant species such as Contra Costa goldfields (*Lasthenia conjugans*) and Lobb's aquatic buttercup (*Ranunculus lobbii*). Many of the vernal pools that were present historically have been lost to urban development. For example, a previously known vernal pool in southern Alviso is now occupied by commercial buildings (Sally Casey, pers. comm., 1998).

Near the city of Fremont, a well-known vernal pool is currently being protected at the Don Edwards San Francisco Bay National Wildlife Refuge. A freshwater marsh occurs on Bailey Road west of Santa Teresa Boulevard (near Tulare Hill) (Dr. Rod Myatt, pers. comm., 1998).

Nonnative Grasslands

Grassland habitats occur in the Santa Clara Valley floor, and foothills are interspersed with woodland areas, where the moisture is low and evaporation is high (Santa Clara County 1993). Today, the majority of the grasslands are dominated by nonnative annual plant species, including many European grasses. This plant community is designated nonnative grassland under the Holland (1986) classification system. The native grasslands present before European settlement have been reduced significantly by the invasion of weedy annual grasses and forbs, including wild oat (*Avena* spp.), soft chess (*Bromus hordeaceous*), ripgut brome (*Bromus diandrus*), sheep sorrel (*Rumex acetosella*), and filaree (*Erodium* spp.).

In some areas, nonnative grasslands intermingle with oak woodland habitats, and form a vegetation mosaic often referred to as a savanna. Savanna habitat occurs in portions of the grassy foothills along Interstate 280 in the vicinity of Los Altos Hills.

Native Grasslands

Remnants of native perennial grasslands occur in some areas of the Basin, such as the remote hilltops at Grant Ranch County Park, where there are shallow soils or rocky outcrops that are less accessible by cattle. Native grasslands growing on serpentine soils and outcrops are a special grassland type. Known locations of serpentine bunchgrass grassland occur in Kirby Canyon, 6 miles north of Morgan Hill, and in the Stiles Ranch Easement by Santa Teresa Park (Sally Casey, pers. comm., 1998). Native forbes and annual grasses are found in the serpentine areas of the Jasper Ridge Biological Reserve and perennial native bunchgrasses are found on moister Reserve Lands. (Philippe Cohen, Director, Jasper Ridge Biological Reserve, pers. comm., 7/25/00). Apparently, the native perennial bunch grasses can tolerate shallow and/or rocky soils more than the European grasses, and therefore can compete against them (Santa Clara County 1993). Native grassland plant communities, according to Holland (1986), include valley needlegrass grassland and serpentine bunchgrass (Table 7-2).

Scrubs and Chaparrals

Scrub habitats tend to be less dry compared to chaparrals, and consist of low-growing shrubs from 2 to 6 feet tall. In general, scrub habitats are distributed at lower elevation than chaparrals. Northern coastal scrub is the most abundant scrub type in the Basin. Common scrub species include: coyote brush (*Baccharis pilularis*), coffeeberry (*Rhamnus californicus*), poison oak (*Toxicodendron diversilobum*), and California blackberry (*Rubus ursinus*). Northern coastal scrub is often distributed as patches within grassland habitat. Coyote brush has a high reproductive rate, and has the potential to convert orchards and grasslands into scrub habitat.

Chaparral plant communities tend to be distributed in dry areas having shallow soil profiles, particularly on south- and west-facing slopes. Typical chaparral species in the Basin include: chamise (*Adenostoma fasciculatum*), buck brush (*Ceanothus cuneatus*), blue blossom/blue brush ceanothus (*Ceanothus thrysiflorus*), scrub oak (*Quercus dumosa*), black sage (*Salvia mellifera*), leather oak (*Quercus durata*), poison oak, mixed chaparral, interior live oak chaparral, and serpentine chaparral. Chaparral plant communities are "characterized by shrubs and shrubby trees from 3 to 10 feet tall with some herbaceous plants growing under them" (Santa Clara County 1993). In general, chaparrals are fire-adapted plant communities, requiring periodic fires for optimum health and stability. For example, chamise is a stump sprouter and depends on fire every 15 to 20 years (Barbour, Burk, and Pitts 1980).

Riparian Habitats

Riparian habitats are distributed along the banks and/or floodplains of rivers and creeks. The plant composition and width of the riparian corridor vary, depending on the steepness of the channel and the hydrologic regime present (e.g., frequency of flooding). Types of riparian plant communities that occur along the rivers and creeks in the Basin include: central coast arroyo willow riparian forest, central coast cottonwood-sycamore riparian forest, white alder riparian forest, sycamore alluvial woodland, central coast live oak riparian forest, and central coast riparian scrub, which is dominated by shrub species (Table 7-2). In some areas where there is frequent flooding, gravel bars with mule fat (*Baccharis salicifolia*) scrub occur as an early seral community. Examples of relatively natural stands of white alder riparian forest occur in Upper Stevens Creek County Park and Grant Ranch County Park. Invasive, nonnative plant species reportedly found in riparian corridor within the Basin include blue gum eucalyptus, acacia, fennel (*Foeniculum vulgare*), periwinkle, English ivy, French broom, black locust, Algerian ivy (*Hedera canariensis*), Cape ivy, Himalaya blackberry, weeds, curly dock (*Rumex cripus*), thistle, backwood acacia (*Acacia melanoxylon*), tree-of-heaven, glossy privet (*Ligustrum lucidum*), fig, poison hemlock, fennel, black mustard, black walnut, almond, and giant cane (*Arundo donax*).

Riparian habitats have been significantly reduced from their historical extent. Due to the limited extent of the remaining riparian habitats and their value for wildlife resources, federal, state, and county government agencies consider them a sensitive and protected resource. Before the Santa Clara Valley was urbanized, riparian forests and woodlands often occurred as continuous bands of dense vegetation along many of the creeks. During the last two centuries, many of the streambanks were altered with artificial bank stabilization, channelization, and/or flood control clearing (Jones and Stokes 1993). Today, small disjunct stands of riparian woodlands and forests occur. Common riparian tree species include: box elder (*Acer negundo*), Fremont cottonwood (*Populus fremontii*), arroyo willow (*Salix lasiolepis*), red willow (*Salix laevigata*), white alder (*Alnus rhombifolia*), western sycamore (*Platanus racemosa*), and coast live oak (*Quercus agrifolia*).

Woodlands

Woodland habitats primarily occur in the foothills, and are typically composed of various species of oak trees. Trees in woodlands are more widely spaced, and tend to be lower in stature compared to forest habitats; therefore, the herbaceous understory may be well-developed in undisturbed areas. Types of woodlands that occur in the Basin include coast live oak woodland, interior live oak (*Quercus wislizenii*) woodland, black oak (*Quercus kelloggii*) woodland, blue oak woodland, valley oak (*Quercus lobata*) woodland, and open gray pine (*Pinus sabiniana*) woodland (Table 7-2). The woodlands found in the Diablo Range are subject to drier conditions and are often dominated by blue oak (*Quercus douglasii*), foothill/gray pine, and interior live oak. In the Santa Cruz Mountains, the woodlands are dominated by coast live oak and tan oak (*Lithocarpus densiflorus*). Woodlands are distributed in a discontinuous band from Crystal Springs southward to Mt. Madonna (Thomas 1961).

Broadleaved Upland Forests

Types of broadleaved forests that occur in the Basin include: mixed evergreen forest, black oak forest, tan oak forest, California bay forest, and coast live oak forest (Table 7-2). Forests are primarily distributed at higher elevations on the north- and east-facing slopes of the Santa Cruz Mountains and west-facing slopes of the Diablo Range. Hardwood forests composed mainly of coast live oak, tan oak, California black oak, madrone (*Arbutus menziesii*), and California bay (*Umbellularia californica*) occur on the east-facing slopes of the Santa Cruz Mountains.

Coniferous Forests

Types of conifer forests that occur in the Basin include: Coulter pine (*Pinus coulteri*) forest, Douglas-fir (*Pseudotsuga menziessi*) forest, knobcone pine (*Pinus attenuata*) forest, upland ponderosa pine (*Pinus ponderosa*) forest, and upland redwood forest (Table 7-2). Coast redwood (*Sequoia sempervirens*) forest is mainly distributed in the Santa Cruz Mountains in ravines, along stream sides, and areas that are moistened by coastal fog (Thomas 1961). Stands of ponderosa pine forest, foothill/gray pine forest, and Coulter pine forest occur in the higher elevations of the Diablo Range. Timber is harvested in the Santa Cruz Mountains.

Agricultural Lands

Agricultural lands include orchards, vineyards, field crops, grazing lands, and irrigated pastures. Orchards were once prevalent throughout the Santa Clara Valley; however, now only remnants of larger orchards remain scattered in residential areas and in the foothill regions that are less subject to development. Common fruit crops include prune, cherry, apricot, walnut, and pear. By 1930, there were 120,000 acres of orchards in production. Due to an increased demand for urban services, there was a one-third reduction in the amount of cultivated lands between 1947 and 1961. Grazing lands still occur, including lands in Grant Ranch County Park and Los Altos Hills and portions of the Stanford University leased lands west of Junipero Serra Boulevard. Since 1961, the amount of agricultural land has continued to decrease.

Urban Habitat

The *CALVEG Mosaic of Existing Vegetation of California* (Matyas and Parker 1979) refers to artificial/human-made vegetation as the urban–agriculture complex. Urban forest primarily refers to landscaped residences, planted street trees (i.e., elm, ash, liquidambar, pine, palm), and parklands. Most of the vegetation is composed of nonnative or cultivated plant species. An invasive nonnative tree, the tree-of-heaven (*Ailanthus altissima*), has become established in yards and vacant lots in the City of San Jose area.

The City of San Jose arborist has performed past inventories of the numbers and species of street trees that have been planted along the sidewalks. Other cities, such as Palo Alto, have also conducted tree inventories. Portions of Palo Alto and San Jose (i.e., Willow Glen) have mature trees that in some areas form contiguous canopies.

7.1.5.6 Special Plant Species

Special plant[5] species are plants that are legally protected under the federal and California Endangered Species Acts or other regulations, or species that are considered to be of concern by the resource agencies and/or the scientific community. Such species are often designated rare, threatened, endangered, or locally unique. The *California Native Plant Society's Inventory of Rare and Endangered Vascular Plants of California* (Skinner and Pavlik 1994) provides information on the laws and acts for endangered species protection.

The Santa Clara County General Plan (Santa Clara County 1993) lists 43 endangered and threatened plants known to occur in Santa Clara County. The list provides information on each species, including its common and scientific name, legal status, and habitat preference. A number of these rare and endangered species are associated with serpentine (also designated ultramafic) soils, including Santa Clara Valley dudleya (*Dudleya setchellii*), coyote ceanothus (*Ceanothus ferrisae*), and Metcalf Canyon jewel-flower (*Streptanthus albidus spp. albidus).*

The endangered coyote ceanothus has been recorded at Anderson Reservoir and in the Morgan Hill area. The Mt. Hamilton Range is known for rare plants such as the Mt. Hamilton thistle (*Cirsium fontinale campylon*), the Mt. Hamilton coreopsis (C*oreopsis hamiltonii*), and the Mt. Hamilton jewelflower (*Streptanthus callistus*) (Corelli and Chandik 1995).

Twenty-nine special-status plant species are known to occur in the Santa Clara Basin. Table 7-3 presents information on special-status plants in the Basin.[6]

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[5] "Special Plants" is a broad term used to refer to all the plant taxa inventoried by the CNDDB, regardless of their legal or protection status. Special Plant taxa are species, subspecies, or varieties that fall into one or more of the following categories:

- Officially listed by California or the federal government as Endangered, Threatened, or Rare
- A candidate for state or federal listing as Endangered, Threatened, or Rare
- Taxa that meet the criteria for listing, even if not currently included on any list, as described in Section 15830 of the California Environmental Quality Act (CEQA) Guidelines
- A Bureau of Land Management, U.S. Fish and Wildlife Service, or U.S. Forest Service Sensitive Species
- Taxa listed in the *California Native Plant Society's Inventory of Rare and Endangered Vascular Plants of California*
- Taxa that are biologically rare, very restricted in distribution, or declining throughout their range but not currently threatened with extirpation
- Population(s) in California that may be peripheral to the major portion of a taxon's range but are threatened with extirpation in California
- Taxa closely associated with a habitat that is declining in California at an alarming rate (e.g., wetlands, riparian, old growth forests, desert aquatic systems, native grasslands, valley shrubland habitats, vernal pools, etc.)

[6] Table 7-3 is based on the Santa Clara Basin Watershed Management Initiative's (WMI's) Technical Memorandum 32: Recommended List of Special-Status Species for RARE Assessment, approved by the Core Group May 4, 2000. Information for the technical memorandum was compiled from various databases including the CNDDB, the California Native Plant Society Inventory, and the Santa Clara Valley Audubon Society Bird Species List for Santa Clara Valley and was reviewed by a number of stakeholders and biologists. The species in Table 7-3 should be considered as the current list of special-status species in the Santa Clara Basin. The reader is referred to the technical memorandum for a description of how this list was developed and the rationale of inclusion and exclusion of species in the list.

Insert Table 7-3 Pages 1-13

7.1.6 Wildlife and Wildlife Habitats

7.1.6.1 Historical Perspective

Excavations of Native American middens in the Coyote Hills of Fremont, dating back from 400 BC to 400 AD, indicate that the following mammals were abundant in this area: sea otters, mule deer (black-tailed deer), canines, elk, pronghorn antelopes, harbor seals, rabbits, raccoons, skunks, squirrels, and badgers. Sea otters and mule deer comprised 62 percent of the total animals identified in midden excavations. The most numerous birds identified from these same sites include (in descending order): snow geese, Ross's geese, canvasbacks, green-winged teals, Canada geese, northern pintails, American widgeons, northern shovelers, ring-necked ducks, marbled godwits, mallards, wood ducks, surf scoters, Brandt's cormorants, and western gulls. Bones of larger birds were also found at these midden sites; tundra swan, great blue heron, and brown pelican bones were used for whistles, and California condors' bones were used in shaman kits (Harvey et al. 1990).

The native inhabitants, the Costanoans, were primarily hunters and gatherers. It is thought that the Costanoans used fire to drive small game and that this practice aided in keeping the grasslands open. The Portola expedition in 1769 reported that tule elk were abundant throughout the Santa Cruz Mountains and on the flats of the East Bay. Herds of thousands of elk, pronghorn and black-tailed deer inhabited the grasslands, marshes, shrub, and chaparral habitats around the South Bay.

The tone of pure amazement given in accounts by early settlers regarding wildlife populations in the South Bay's estuary and wetland habitats is consistent. One account noted that the population of sea otters was so abundant that otters were easily killed by boat oars when paddling through kelp beds. California sea lions and harbor seals hauled out and pupped in extensive rookeries in the South Bay (Skinner 1962 from Harvey et al. 1990). Accounts of waterfowl by settlers and game hunters in the 1800s and early 1900s describe populations so numerous that one could not see the water, and that at times the sky would be so dark with waterfowl that it would "black out" the sun when waterfowl migrated down the Pacific Flyway from Alaska to rest, feed, and nest in the Estuary and wetland habitats of the Basin (Harvey et al. 1990).

> "Andy Burnett reached California in the autumn of 1832…Andy had never seen so many waterfowl; had never imagined there could be so many, anywhere. They covered the surface of the small lakes so thickly that Andy could discern but a gleam of water here and there. On a sudden impulse he extended the long rifle and fired it into the air. A blank instant silence followed….broken a half second later by the crashes of mighty water fall as the birds took wing. It seemed as if the dark earth were lifting to expose the hidden silver of the lake. The air was full of hurtling bodies. The very sky was darkened. And another great roar, and a third, like successive peals of thunder, rolled across to the man's astonishment; and then a smooth high silence made up of the thin whistling of thousands upon thousands of wings…" (White 1947).

Bald eagles were common both along the coast and throughout the Central Valley. Records between 1860 and 1900 indicated that bald eagles nested near La Honda in San Mateo County and were commonly seen forging in all of the counties along the edges of the Bay. California condors were commonly observed on the San Francisco Peninsula and in the South Bay area, often in association with turkey vultures. In San Mateo County, it was estimated that condors occurred at a ratio of 1:20 with turkey vultures. An amateur ornithologist, J.P. Lamson, living in the East Bay redwood forest, reported seeing condors commonly between 1853 and 1855. Mr. Lamson reported seeing more than 50 individual condors within a single hour (Harvey et al. 1990).

California grizzly bears were one of the most frequently mentioned large mammals in historic accounts. Early settlers reported viewing anywhere from 9 to 40 individuals at once from the same observation point and commonly encountered them in groups of 20 (Thompson 1957 from Harvey et al. 1990). Grizzly bears, common in San Mateo County, were roped and taken to the docks at Redwood City and butchered for their meat. (Grinnel et al. 1937 from Harvey et al. 1990). They were recorded as being the most abundant in marshes, dense stands of willows and cottonwoods, and in the coast range chaparral.

7.1.6.2 Changes Due to Human Activity

Throughout the history of human habitation in the Bay Area, the regional wetlands have been impacted by anthropological activities. The earliest impacts caused by Native Americans were relatively minor compared to those caused later by European settlers. At the time of Spanish settlement in the late 1700s, the Bay's natural estuarine system covered 1,300 square miles. Tidal marshes covered over 850 square miles, including the expansive freshwater and brackish marshes of the Sacramento-San Joaquin River Delta (the Delta), Suisun Bay, and the salt marshes of the North and South Bays. Historically, this estuary system contained the largest contiguous tidal marsh system on the Pacific Coast of North America (Harvey et al. 1990).

The trend of altering native habitats for large scale agricultural use began with the arrival of the first missions in the Santa Clara Valley in 1777, and the construction of the Guadalupe River dam (located near Mission Santa Clara) for irrigation of wheat, corn, bean, and other crops. Fruit trees and grapes were also cultivated. Settlers' accounts during 1850 describe the whole plain of Alameda County to San Jose as a vast unfenced field of grain. By 1866, artesian wells could no longer meet water demands. In 1870, Los Gatos Creek was diverted in order to meet the water demands for agriculture and a booming human population. By 1870, wheat production was slightly less than three times the production of oats, barley, rye, and corn combined.

Grazing practices began with the establishment of the missions, occurring primarily in the hills and slopes of the Mt. Hamilton Range, as the valley floor was used for crops. The southernmost end of the Santa Clara Valley was also used for grazing. A large hide and tallow business with New England trading vessels was conducted by ranches in the Basin through the Port of Alviso. By 1845, livestock grazing altered natural grasslands within the entire Santa Clara Basin to such an extent that native perennial grasses were already replaced by European annuals by overgrazing and the spread of nonnative grass associated with cattle feed.

The loss of historical estuarine habitat in the Bay has been attributed to diking for agriculture and salt production, fill from sedimentation caused by intense hydraulic gold mining in the Sierra Nevada, and displacement by fill for residential, industrial and commercial development, garbage dumps, and sewage treatment plants (Eicher 1988). By 1985, the historical 1,300 square miles of contiguous undisturbed wetlands in the Bay Area had declined to patchy habitats totaling a little under 232 square miles, as illustrated on Figures 7-7 and 7-8 (Eicher 1988).

7.1.6.3 Wildlife Habitat Descriptions

The Basin provides a wide variety of habitats for wildlife. Because of the diversity of habitat types and the relatively undeveloped character of portions of the Basin (the upper watershed lands and the Baylands), the Basin has numerous permanent and seasonal populations of wildlife species.

Following are general descriptions of the current wildlife resources in the Basin by habitat type. The terms used for habitat types in the Basin are the same terms used in the preceding vegetation section. There is also a separate terminology used by some wildlife biologists for the characterization of wildlife habitats. This classification system was developed for the California Wildlife-Habitat Relationships (WHR) System by the California Interagency Wildlife Task Group. It was developed to recognize and logically categorize major vegetative complexes at a scale sufficient to predict WHR. The various wildlife habitats that constitute the WHR System are described in *A Guide to Wildlife Habitats of California* (Mayer and Laudenslayer 1988). Table 7-2 presents the relationships between the WHR System, the habitat/vegetation type terminology used in this text, and the plant communities described by Holland (1986).

Lower South San Francisco Bay

The open-water habitat of the lower South Bay provides foraging habitat for harbor seals (*Phoca vitulina richardi*) and California sea lions (*Zalophus californicus*), as well as diving birds such as brown pelicans (*Pelecanus occidentalis californicus*), double-crested cormorants (*Phalacrocorax auritus*), surf scoters (*Melanitta perspicilata*), and terns. Surface water also provides resting habitat for both resident and migratory birds, including western grebes (*Aechmophorus occidentalis*), American wigeons (*Anas americana*), American coots (*Fulica americana*), loons, and seagulls.

The water quality of the South Bay is very different today that it was historically with regard to freshwater inflows. “Diversions of water from local streams have altered the salinity gradients where they flow into the Bay” (Goals Project 1999). Additionally, large inputs of year-round freshwater flow into the South Bay from municipal wastewater treatment plants. These flows have changed the habitat type and function of tidal marshes (Goals Project 1999).

Insert Figure 7-7 (front)

Insert Figure 7-7 (Back)

Insert Figure 7-8 (Front)

Insert Figure 7-8 (Back)

Baylands Habitats – Tidal/Brackish Wetlands

Historically, the San Francisco Bay Delta Estuary (the Estuary) system contained the largest contiguous tidal marsh system on the Pacific coast of the Americas. Although the Estuary system is still the largest on the American west coast, available habitat for wildlife has been significantly reduced into patches – a serious problem for wildlife, especially for terrestrial vertebrates such as the endangered salt marsh harvest mouse (*Reithrodontomys raviventris*) and vagrant shrew (*Sorex vagrans*). The patchwork of tidal habitats available to wildlife in the lower South Bay poses the same problems normally associated with island ecology, with barriers to movement and recolonization, and reduction in genetic flow.

In undisturbed marshes, the transition zone between marsh and upland areas is critical to animals that use the higher areas as refuges during high tides. This transitional habitat has been severely reduced due to development. Dikes have now taken on the ecological role of providing refuge areas for many wetland species (Eicher 1988). While diked marshes act as immigration and emigration filters for many species, they may provide the only linkages for movement corridors between tidal wetlands for many wildlife species. Most importantly, continued habitat fragmentation poses serious threats to the viability of plant and animal species, as genetic flow becomes bottlenecked or reproductively isolated. In addition, fragmentation of habitats increases the edge effect as smaller parcels of land have a greater perimeter in relation to total area.

Salt marshes are rich in animal biodiversity, as terrestrial and aquatic habitats overlap. Although the biodiversity of vascular plants is low in estuarine systems, the abundant amount of available light, nutrients, and water enables this habitat type to be one of the most productive habitat types identified. The combination of vegetation and open water in estuaries provides food, rearing areas, and cover for waterfowl, shorebirds, invertebrates and marine fishes.

The Baylands are an important resting and foraging ("fueling") stop for at least 100 different species of birds that migrate along the Pacific Flyway (Conradson 1996). Seventy-one of these bird species are considered common to the Baylands (Conradson 1996), and 36 are permanent residents.

There are a number of federal and state listed endangered birds in the Bay salt marshes, such as the California clapper rail (*Rallus longirostris obsoletus*), a year-round resident associated with the mid-tide cordgrass zones. Other federal and state listed species are: California brown pelican, American peregrine falcon (*Falco peregrinus anatum*), and California least tern *(Sterna albifrons brownii*). These bird species are not limited to marsh habitats, but all utilize the Bay marshes. The shallower open-water areas may be especially critical to the survival of California least tern young, who learn to forage in these areas.

Roughly 17 terrestrial vertebrates utilize salt marshes for foraging during low tides. Representative species include: raccoon (*Procyon lotor*), vagrant shrew, striped skunk (*Mephitis mephitis*), grey fox (*Urocyon cinereoargenteus*), salt marsh harvest mouse, house mouse (*Mus musculus*), gopher snake (*Pituophis catenifer*), and western terrestrial garter snake (*Thamnophis elegans*). The salt marsh harvest mouse is both a federal and state endangered species, endemic to salt marshes of the Estuary. Salt marsh harvest mice are found in tidal marshes, as well as in diked former tidal marshes, usually in association with dense stands of pickleweed (Eicher 1988).

"Exotic animal species are also of concern, especially those that are effective predators on native species. With many of the Bay Area's natural habitats disturbed or lost, predation by mammalian predators on several endangered species has become a crucial management issue. The red fox is an introduced predator that threatens the survival of the endangered California clapper rail and severely reduces populations of other native ground nesting birds" (Goals Project 1999). "Cats are another especially effective mammalian predator on Baylands wildlife, particularly on the California least tern…." (Goals Project 1999).

Baylands Habitats – Tidal Flats

"Tidal flat habitat includes mudflats, sandflats, and shellflats. It occurs between mean lower low water and mean tide level and supports less that 10 percent cover of vascular vegetation, other than eelgrass. About 90 percent of intertidal flat habitat occurs on the edges of the Bay, and the remainder is associated with tidal channels" (Goals Project 1999).

"During the twice-daily high tides, tidal flats provide foraging habitat for many species of Bay fishes, and during low tides they are the major feeding areas for shorebirds" (Goals Project 1999).

Mudflats comprise the largest area of tidal flat habitat. Mudflats in particular are rich in food items. These areas of fine-grained silts and clays support an extensive community of diatoms, worms, and shellfish, and more complex vegetation including green algae and red algae (Goals Project 1999).

"The South Bay is considered to be the region's most important area for shorebirds, which mainly feed across the tidal flats" (Goals Project 1999).

Baylands Habitats – Salt Ponds, Levees, and Dikes

Salt ponds are artificial ponds created for the production and harvesting of salt. They occur within the historical areas of tidal salt marsh in the South Bay. The process of making salt in the artificial ponds involves pumping Bay water through a series of ponds, known as concentrators or evaporators, over a period of 6 or 7 years, during which time solar evaporation of the water increases its salinity from about 35 parts per thousand (ppt) to more than 180 ppt (Goals Project 1999).

Salt ponds increase in salinity from pond to pond as water evaporates. Salt ponds, especially those with relatively low- to mid-salinities, provide an important habitat for many species of resident and migratory wildlife, particularly birds. They are of primary importance to migratory shorebirds and waterfowl, and they also provide year-round foraging habitat for a number of resident species (Goals Project 1999). Within a certain range of salinity, brine shrimp grow in large numbers and can provide a year-round food source for birds such as black-necked stilts (*Himantopus mexicanus*), grebes, avocets (*Recurvirostra americana*), gulls, and ducks. Salt ponds with lower salinity ranges are utilized by migratory waterfowl as resting and wintering areas. The upland habitats around salt ponds are generally devoid of vegetation and therefore do not provide nesting habitats for waterfowl. The upland areas and islands associated with salt ponds do, however, provide nesting habitats for California gull (*Larus californicus*), western gull (*Larus occidentalis*), Caspian tern (*Sterna caspia*), Foresters tern (*Sterna forsteri*), killdeer (*Charadrius vociferus*) and snowy plovers (*Charadrius alexandrinus nivosus*).

In all, more than 40 species of birds are considered to be common in the salt pond habitat (Goals Project 1999).

"The construction of artificial salt pond habitat in the Bay enabled increased populations of many bird species. These species include eared grebe (*Podeceps nigricollis*), white pelican (*Pelecanus erythrorhynchus*), snowy plover, Caspian tern, Forester's tern, Wilson's phalarope (*Phalaropus tricolor*), California gull, American avocet, and black-necked stilt. The populations of some of these species would be greatly reduced or even extirpated from the Bay if salt ponds or shallow saline ponds were to disappear" (Goals Project 1999).

In undisturbed marshes, the transition zone between marsh and upland areas is critical to animals that use the higher areas as refuges during high tides. This transitional habitat has been severely reduced in the South Bay due to development. Dikes and levees have now taken on the ecological role of providing refuge areas for many wetland wildlife species (Eicher 1988). This "higher ground" is especially important as refuge for small mammals during periods of extreme high tide and storm events or flooding.

During the winter when shallow standing water occurs, lowland areas of diked wetlands are important resting and foraging areas for waterfowl and waterbirds. Some diked wetlands with pickleweed provide important habitat for the endangered salt marsh harvest mouse.

Freshwater (Lentic, i.e., standing water) Habitat (Lacustrine-Pond/Reservoir)

Surface water sources provide wildlife with drinking water and are excellent breeding areas for aquatic amphibians (e.g., tree frogs (*Hyla regilla*), California newts (*Taricha torosa*), California tiger salamanders (*Ambystoma californiense*), California red-legged frogs (*Rana aurora draytonii*), and western toads (*Bufo boreas*)). Barn swallows (*Hirundo rustica*), cliff swallows (*Hirundo pyrrhonota*), tree swallows (*Tachycineta bicolor*), and bats drink from and forage on insects while on the wing over reservoirs, and adjacent to freshwater marsh areas. Raccoons forage for adult and larval amphibians, fish, and crayfish. Other representative species include ruddy ducks (*Oxyura jamaicensis*), Virginia rail (*Rallus limicola*), night herons (*Nycticorax nyticorax*), blue herons (*Ardea herodias*), green-back herons (*Butorides striatus*), blackbirds, marsh wrens, and garter snakes.

The availability of surface water in dry habitats is important for sustaining mammal populations, especially in the drier areas and in the Diablo Range. Ponds enhance all other habitats in terms of value for wildlife; mammals, birds, reptiles, and amphibians from adjacent habitats are likely to use ponds en route to surrounding areas.

There are numerous small ponds that have been constructed for livestock watering (stock ponds) throughout the foothills of the Diablo Range. Depending on the seasonality of these small ponds, they often serve as important breeding habitat for amphibians (e.g., pacific tree frogs, California red-legged frogs, California tiger salamanders, and western toads) and in turn provide foraging habitat for garter snakes, mammals, and birds.

Due to fluctuations in water levels, reservoirs lack the same type of shoreline habitat that occurs around natural lakes and ponds. Shoreline habitat provides important protective cover and foraging areas for wildlife. Percolation ponds, while often seasonally stable in water level, are highly manipulated and different in wildlife habitat value than naturally occurring ponds. While percolation ponds frequently develop emergent vegetation along the shoreline, the buffer zone between these emergent wetlands and human recreational activities and housing limit wildlife access and use of these ponds by mammals, amphibians, and reptiles. While birds maintain access to percolation ponds, human activity and domestic pets around the shoreline limit nesting by waterfowl and other birds.

Freshwater Wetlands (Palustrine Emergent Wetlands)

Freshwater marshes, springs, and seeps provide wildlife with drinking water and are excellent breeding areas for aquatic amphibians such as tree frogs and western toads, if sufficient water is available. If standing water is present, then small mammals drink from marshes, and bats frequently hawk insects over marsh areas.

Native and Nonnative Grasslands

Grasslands provide an important foraging resource for a wide variety of wildlife species. The grasses and forbs produce an abundance of seeds and attract numerous insects, providing food for granivorous and insectivorous wildlife. Sparrows, rabbits, and rodents are commonly found in this habitat. Consequently, grasslands are valuable aerial foraging sites for raptors such as hawks and owls, bats, swallows, American kestrels (*Falco sparverius*), and flycatchers.

In general, the wildlife values of grasslands are highest adjacent to forested or scrub habitats. This mosaic increases wildlife species richness for wildlife that utilize grasslands for feeding, as well as trees and shrubs for cover and/or nest sites. Grasses provide good escape cover, food, nesting material, and nest concealment. Typical reptile species in this habitat are the southern alligator lizard, the western fence lizard, the gopher snake, the common garter snake, and the western terrestrial garter snake. The diversity of amphibians is generally not high in grasslands, but some species such as the California tiger salamander use mammal burrows for aestivation (summer dormant condition) sites.

Passerine birds that commonly occur in grasslands in the Basin include savannah sparrows, house finches, lesser goldfinches, and lark sparrows. Grasshopper sparrows, western bluebirds, western meadowlarks, and American robins forage for invertebrates in the ground and grasses. Say's phoebe and several swallows hawk insects while flying above grasslands. Raptors that feed on small mammals in the grassland habitat include white-tailed kites, golden eagles, northern harriers, American kestrels, red-tailed hawks and common barn owls. Turkey vultures are commonly seen soaring in search of carrion. Birds that breed in grasslands include horned larks, western meadowlarks, and burrowing owls. Grasslands are also an important wintering habitat for foraging geese and egrets.

Grasslands are productive habitats for small mammals, providing abundant food plants and cover. California ground squirrels are one of the most numerous species. Other common species include the black-tailed jackrabbit, Botta's pocket gopher, the western harvest mouse, and the California vole. These small mammals provide a prey base for diurnal and nocturnal raptors – coyotes, gray foxes, badgers, long-tailed weasels, bobcats, skunks, and snakes. Bats forage for insects in this habitat. Black-tailed deer are often seen browsing or grazing in the late evening. Feral pigs typically forage on grasses and bulbs in grasslands.

The value of native grasslands to wildlife is similar to that of nonnative grasslands, but the presence of native grasses increases the habitat value for certain native wildlife species.

Scrub and Chaparral

Coastal scrub habitat provides cover and a plentiful foraging habitat for a large diversity of songbirds, rodents, reptiles, falcons, and hawks. Browsers (e.g., deer) rely on scrub habitats for foraging and cover. The dense habitat, especially at the edges of the grasslands, provides important structural cover for many species, including: the bobcat, raccoon, skunk, mountain lion, coyote, California quail, jackrabbit, and garter snake. Blackberries, twinberries, huckleberries, and elderberries provide an important food and water source for many birds and mammals. Coyote brush also provides cover for deer, which will bed down in the grasses between the shrubs. Coyote brush scrub provides protective cover and perch sites for mammals and birds that forage in the adjacent grasslands.

Coastal scrub plant communities also provide a diversity of flowering plants that are utilized by hummingbirds and butterflies. Buckwheat (*Eriogonum sp*.), plantain, sticky monkey flower, and *Sedum sp*. are particularly noted as beneficial butterfly plants.

Coastal scrub communities can vary greatly in plant density and height. Some areas hold lesser value to wildlife due to the high shrub density and height. This is assumed to be a result of the lack of recent fire or lack of natural browsers (i.e., historic herds of elk). Coastal scrub has the highest wildlife value when there is a matrix of scrub densities or a matrix with other habitats (e.g., grasslands). A recently completed report on the fire history at Stanford's Jasper Ridge Biological Preserve noted that fires were set a least every 4 to 9 years by the Ohlone for vegetation management. Apparently no fires have occirred in the preserve for about 100 years until control burns were recently resumed (Philippe Cohen, Director, Jasper Ridge Biological Reserve, pers. comm., 2000).

Chaparral habitats are found on higher elevation ridges in the Santa Cruz Mountains and Diablo Range. Chaparral habitats are generally drier than scrub habitats. Water for herbivorous wildlife is often obtained by foraging on common chaparral plants that bear fruit, such as manzanita or coffeeberry, or by foraging on green leaves. Representative wildlife species include: the wrentit, California thrasher, Merriam chipmunk, striped racer, woodrat, black-tailed deer, bobcat, coyote, gray fox, raccoon, rabbit, bush mouse, deer mouse, California quail, song sparrow, western rattlesnake, western fence lizard, gopher snake, red-tailed hawk, and ring-necked snake.

Riparian and Bottomland Habitat (Valley Foothill Riparian)

One of the highest levels of wildlife species diversity and abundance in California is associated with riparian habitats. At the state level, riparian plant communities are considered a sensitive habitat and have been identified by the CDFG as a habitat of special concern (Wetlands Resource Policy, CDFG Commission 1987). Riparian habitats are valuable because they support a high density and diversity of wildlife species and because they are a diminishing resource. In the State of California, at least 89 percent of riparian areas existing 140 years ago have been lost (Wetlands Resource Policy, CDFG Commission 1987).

Factors that contribute to the high wildlife habitat value of riparian habitats include the presence of surface water, the variety of niches provided by the high structural complexity of the habitat, and the abundance of plant growth. Riparian habitat is used by wildlife for food, water, escape, cover, nesting, and thermal cover. Riparian corridors along the tributaries and creeks also provide important migration and dispersal corridors for wildlife.

Amphibians are more numerous and diverse in this habitat. Streamside pools and low-flow shallows provide breeding habitat for Pacific tree frogs and California newts. Other species, such as the California slender salamander, seek the moist shelter beneath fallen logs and woodland debris for breeding and refuge. California red-legged frogs may also be observed in the riparian corridors. Common reptile species that utilize aquatic habitat within riparian corridors for foraging or escape cover include western aquatic garter snakes, western skinks, western terrestrial garter snakes, Santa Cruz garter snakes, and possibly, in the northwestern areas of the Basin, San Francisco garter snakes.

Where deciduous trees are prevalent (e.g., willows, cottonwoods, and sycamores) the abundant insects these plants attract create areas especially suitable for neotropical migrants that feed on the numerous insects to replenish their migratory fat reserves. Relatively high use by neotropical migrant birds is expected in willow riparian habitat as well as sycamore habitats. The sycamore trees provide nesting cavities favored by many bird species. Examples of neotropical migrants include: Wilson’s warblers, warbling vireos, olive-sided flycatchers, and American redstart. Resident birds, such as winter wrens, Swainson’s thrushes, and song sparrows, are more abundant in riparian habitats than in adjacent forests. American dippers, herons, belted kingfishers, and waterfowl utilize the open water and banks of rivers and creeks. Northern pygmy owls may be limited to streamside forests. Swifts, swallows, and flycatchers can be found hawking their insect prey over water. Red-shouldered hawks utilize riparian trees for nesting.

Raccoons, skunks, opossums, ringtail cats, long-tailed weasels, gray foxes, mountain lions, and bobcats are likely to drink from the creeks and forage on rodents, amphibians, and insects. Riparian habitats provide movement corridors and water sources for black-tailed deer and birds as well. Bats associated with riparian forests include Townsend's big-eared bats (a federal and state species of concern), California myotis, long-eared myotis, and fringed myotis.

Because Central Coast riparian scrub occurs along intermittent streams, wildlife use is expected to be more seasonal (e.g., during periods of water flow). Since the major vegetative component of this habitat is willow, these areas are also important for neotropical migrants.

Invasive exotic plant species[7] have become established in many urban riparian areas of the Basin. Many of the riparian corridors have scattered occurrences of invasive blue gum eucalyptus, giant reed, fruit trees (orchard escapees), German (Cape) ivy, periwinkle, field bindweed, poison hemlock, bull thistle, Italian thistle, and milk thistle. Because they are often a monoculture, invasive plants do not provide the same habitat value for native wildlife as native habitats.

Woodlands (Oak Woodlands, Blue Oak, Foothill Pine)

Oak woodlands are considered critical habitats for the conservation of many bird and mammal species (Block et al. 1990). Important habitat features of oak woodlands include acorns and the presence of cavity-bearing trees. As a seasonal food, acorns are important for the survival of many species of wildlife in fall and winter. Birds that are dependent on acorns as a seasonal food include acorn woodpeckers, scrub jays, band-tailed pigeons, and California quail.

Mature oak trees bear natural cavities, which are important resources for cavity-nesting birds and small mammals. Also, mature oak forests typically contain snags (standing dead trees). Snags are valuable resources for woodpeckers, who prefer dead trees and limbs for excavation of roost and nest sites (Thomas 1979). Snags receive high levels of use by secondary cavity-nesting birds (e.g., chickadees and wrens) and mammals. Snags also support wood-boring insects that provide food for bark-gleaning insectivorous birds.

Broadleaved Forest and Coniferous Forest

The wildlife value of broadleaved forests, mixed evergreen forest, and coniferous forests varies with the degree of canopy cover, density, and diversity of understory plant species. In general, wildlife species diversity and abundance are highest where vegetation is highly stratified, offering a greater variety of niches for wildlife species. Evergreen forest mixed with scrub communities creates a mosaic that is highly stratified and of high value to wildlife. Bird species richness and abundance is high in the mixed evergreen forest where the understory is stratified and dense.

[7] The definition of an invasive exotic plant is a nonnative plant species that did not occur naturally in California prior to European settlement and that is able to proliferate and aggressively alter or displace indigenous plant communities.

Some of the important food plants for wildlife that occur in these forest types include: California hazelnuts, madrones (only in the mixed evergreen forest), coffeeberries, blackberries, and poison oak. These plants provide seasonal wildlife foods, such as berries and nuts, which are consumed by many bird and mammal species.

Significant habitat features include the presence of cavity-bearing trees. Mature trees bear natural cavities, which are important resources for cavity-nesting birds and small mammals. Also, mature mixed evergreen forests and Douglas fir forests typically contain snags.

Great horned owls, western screech owls, and northern pygmy owls nest in mixed evergreen forests and prey on rodents that are active at night. Diurnal raptors (all of which are State species of special concern) in this habitat include golden eagles, Cooper's hawks, and sharp-shinned hawks. These raptors feed primarily on small mammals or other birds, but golden eagles may take larger prey.

Another important feature of the mixed evergreen forest is the abundance of fallen woody debris (i.e., limbs and logs). Woody debris adds structural complexity to the forest habitat and is important as cover, nesting, roosting, and foraging substrate for wildlife. Downed wood also helps moderate arid conditions, creating micro-climates suitable for amphibians and reptiles.

The mosaic of microclimates resulting from the shade of canopy trees and the presence of downed woody debris offers suitable breeding and cover sites for many amphibians, such as arboreal salamanders, Ensatina salamanders, and California slender salamanders. Aquatic breeding species, such as the California newt typically spend their terrestrial existence in rodent burrows in grasslands, but may also take refuge under woody debris in adjacent forests.

The mixed evergreen forest supports a high diversity of reptiles due to the abundant prey and cover provided by understory vegetation and fallen woody material. Representative species, such as the common king snake, garter snake, and ringneck snake, prefer the moist, wooded drainage bottoms.

Representative mammal species that utilize both habitat types include the broad-footed mole, dusky-footed woodrat, deer mouse, black-tailed deer, Merriam's chipmunk, western gray squirrel, bobcat, gray fox, striped skunk, Virginia opossum, and many bat species. Potential habitat occurs for several species of special concern in the mixed evergreen forest, especially in forested areas of mixed age class. Possible special animal species include the San Francisco dusky-footed woodrat, peregrine falcons, long-eared owls, sharp-shinned hawk, and Cooper's hawk. Foraging, roosting, and nesting habitats for special bats may also occur in this habitat type.

The presence of water within some of the redwood forest enables a variety of species to potentially occur in this habitat. Species such as ringtail cats, brown creepers, nut hatches, estivating red-legged frogs, Pacific giant salamanders, California slender salamanders, California newts, Ensatina salamanders, and rough-skinned newts are expected to occur along redwood-lined creeks within the forest.

Agricultural Land (Cropland, Orchard-Vineyard)

Orchard and vineyard fruits will attract birds (blue jays, scrub jays, starlings, western tanagers), raccoons, foxes, and coyotes. Orchards and vineyards that are not plowed provide foraging, cover, and denning sites for native (gray) and nonnative (red) foxes, burrowing owls, ground squirrels, gophers, mice, and snakes. Insects are important pollinators of blossoms to ensure fruit. Owls and other raptors such as white-tailed kites, red-shouldered hawks, red-tailed hawks, and burrowing owls will feed on rodents and insects of the orchard and vineyards. Old buildings and barns around orchards often provide habitats for bats and owls.

Urban (Urban Forest)

A limited number of mostly nonnative species such as dogs, cats, house mice, Norway brown rats, pigeons, European starlings, and opossums thrive in urbanized habitats. Highly urban areas are often spotted with ornamental fruit-bearing trees or with a few remnant orchard escapees which provide a food source for both native and nonnative wildlife species.

The overall wildlife value of eucalyptus groves is very limited in comparison to the native plant communities that the eucalyptus has replaced. Eucalyptus trees do, however, provide night roosts, foraging perches, and nest sites for a few bird species, particularly raptors. Eucalyptus trees provide little foraging value to birds and mammals compared to native oaks or coastal scrub. Eucalyptus bark peels can create microhabitats for some small vertebrate species, such as alligator lizards and woodrats.

7.1.6.4 Special Wildlife Species

A total of 67 species of mammals, birds, reptiles, insects, and amphibians within the Santa Clara Basin have been designated by federal and state governments as having sufficiently declined in numbers to deserve special protection or monitoring. Seven species of insects once endemic to the Bay are now extinct. Table 7-3 presents information on the current list of special-status species in the Santa Clara Basin (invertebrates, fish, amphibians, reptiles, birds, mammals, and plants).[8]

[8] Table 7-3 is based on WMI's Technical Memorandum No. 32: Recommended List of Special-Status Species for RARE Assessment, approved by the Core Group May 4, 2000. Information for the technical memorandum was compiled from various databases including the CNDDB, the California Native Plant Society Inventory, and the Santa Clara Valley Audubon Society Bird Species List for Santa Clara Valley and was reviewed by a number of stakeholders and biologists. The species in Table 7-3 should be considered as the current list of special-status species in the Santa Clara Basin. The reader is referred to the technical memorandum for a description of how this list was developed and the rationale of inclusion and exclusion of species in the list.

7.1.7 Fish and Aquatic Habitats

7.1.7.1 Historical Perspective

Historically, runs of steelhead trout were prominent in a number of Basin streams – including Guadalupe River, Coyote Creek, San Francisquito Creek, Stevens Creek, and Saratoga Creek. Salmon runs were present in at least the larger drainages such as the Guadalupe River and Coyote Creek. Passage barriers, water diversions, and overall habitat degradation have diminished steelhead and salmon populations not only in Basin streams, but also throughout California and the West. Reproducing populations of steelhead are known to exist in Coyote Creek, Guadalupe River, Stevens Creek, and San Francisquito Creek. In addition, small runs of anadromous Chinook salmon occur in Guadalupe River and Coyote Creek.

Early written documents, dating as far back as the 1700s when the Spanish first settled the area, record the local presence of migrating fish in South Bay streams. Table 7-4a, *Historical Freshwater Fishes of Santa Clara Basin Watersheds* indicates the wide range of fishes that populated local streams.

In the past, the Basin headwater streams may have featured young steelhead trout, salmon, riffle sculpins, and California roach. Aquatic habitat in forested headwater streams provided cool temperatures, high dissolved oxygen, and cover including riparian vegetation, overhanging banks or roots, cobbles, boulders, and pools. Abundant riffles provided spawning areas, cover for young fish, and habitat for aquatic insects that are a primary food resource for young steelhead and other fish. Warmer tributaries that had higher summer temperatures or intermittent summer flow provided habitat for California roach (Leidy 1984).

In the main stem reaches of these streams, historical fish fauna included hitch, Sacramento sucker, California roach, prickly sculpin, Sacramento blackfish, and young steelhead. These reaches also provided habitat for anadromous fishes such as the Pacific lamprey and salmon in the larger streams. Aquatic habitat featured a mix of deeper pools, shallow riffles, and warmer summer temperatures. Some of these fish are adapted to slower stream velocities, lower dissolved oxygen, and higher temperatures. As riffle habitat decreased downstream, fish were often less dependent on aquatic insects for food; instead, they fed on smaller fish and plankton in the water column. In these small systems, the number of fish species tended to increase downstream because fish found in the upper watershed, such as California roach and steelhead, also could be found in suitable habitats in the main stem. Some of the smaller Basin streams were probably dry in the lower reaches during the summer months most years, or were composed of a series of isolated pools. Larger streams such as Coyote Creek were perennial, as indicated by historic fish accounts of Sacramento perch, Tule perch, and splittail.

In the lowest stream reaches, native fish were adapted to a range of freshwater to saltwater conditions. For example, the splittail is tolerant of brackish water. In addition, the juvenile forms of several marine fishes such as the staghorn sculpin and the Pacific herring were found in these lower reaches (Moyle 1976). Most of these fish feed on the abundant crustaceans that live in this zone (Moyle 1976).

Insert Table 7-4a

Past versus Present

Although historical accounts indicate that local streams provided habitat for several species of native fishes, this may not reflect the range of species observed in more recent times. Table 7-4b, *Current Freshwater Fishes Observed in Santa Clara Basin Watersheds* displays fish species that have been collected or observed in local streams over the last 20 years.

Valley residents and fisherman reported the local presence of coho salmon until the 1970s. The Guadalupe-Coyote Resource Conservation District believes that there is a continuing presence of Chinook since the mid-1700s (GCRCD 2001). Adult fall run Chinook have been scientifically documented in the Guadalupe River and Coyote Creek since the mid-1980s. The GCRCD and the Salmon and Steelhead Restoration Group have photographs and video documenting Chinook salmon with spawning colors as early as June in the Guadalupe River in 1995, 1996, and 1997. While these efforts have helped establish a case for the modern presence of Chinook salmon, identification of the specific strains that may be present in the river during the spring and summer months has yet to occur (Larry Johmann and Nancy Bernardi, GCRCD, pers. comms., November 3, 2000). Reproduction of Chinook is occurring in the Guadalupe River and Coyote Creek.

The SCVWD biologists support the hypothesis that Santa Clara Valley chinook slamon are keyed genetically to Central Valley fall run Chinook salmon, and Guadalupe River and Coyote Creek fish are strays from the Central Valley rather than remnants of a native fish stock. The GCRCD consulting biologists support the hypothesis that most fall run Chinook salmon in the Guadalupe River and Coyote Creek are remnants of a native fish stock.

The habitat conditions and needs of steelhead and salmon species in Coyote Creek, Stevens Creek, and Guadalupe River are currently under investigation through the Fisheries and Aquatic Habitat Collaborative Effort (FAHCE), a water rights complaint resolution effort among regulatory agencies (CDFG, U.S. Fish and Wildlife Service, National Marine Fisheries Service, San Francisco Bay Regional Water Quality Control Board [Regional Board]), environmental and fisheries advocates, and the Water District. The FAHCE project is scheduled to be completed in 2001 and should provide additional information regarding steelhead and salmon in these three streams.

7.1.7.2 Changes Due to Human Activity

Native fish populations began to decline in the 1940s, concurrent with a dramatic increase in human population in the Basin. Humans have altered habitat conditions for native fish through water diversions that reduce streamflows, construction of dams that create passage barriers and lake habitat, and increased erosion and sedimentation that reduces the quantity and quality of riffle habitat critical for spawning, rearing, and aquatic insect production. Channelization and flood control measures have reduced habitat complexity and riparian vegetation, contributed to streambank erosion, and increased high velocity flows. The destruction of riparian vegetation reduces pool habitat created by rootwads and woody debris, contributes to higher stream temperatures due to less shade, and lowers the abundance of terrestrial insects for food and terrestrial detritus fed upon by some aquatic insects. Native fish still common in Basin streams are those restricted to headwater streams or those tolerant of a range of environmental conditions. For example, both California roach and Sacramento suckers tolerate higher stream temperatures and lower dissolved oxygen levels than other native fish such as riffle sculpins.

Insert Table 7-4b, Page 1

Insert Table 7-4b, Page 2

Nonnative fish species and their populations have increased dramatically over the past few decades and now outnumber native fish species in most Basin watersheds. Nonnative fish have been introduced for a variety of reasons, such as mosquito control, pet releases, fishing, game-fish prey, and by accident. While the introduction of nonnative fish can lead to the decline of native fish through direct competition, predation or behavior, in most cases, nonnative fish thrive in the altered habitat conditions found in human-impacted streams. For example, nonnative fish that originated in the eastern U.S. (e.g., sunfish) are better able to tolerate higher stream temperatures, higher turbidity, and lower dissolved oxygen levels than native fish. Additionally, nonnative fish such as largemouth bass are aggressive predators and could impact young steelhead abundance in Basin streams.

Humans have altered Bay habitats by filling wetlands, constructing salt ponds that reduce freshwater-saline water mixing areas, and reducing and redirecting freshwater flows from South Bay streams. Toxins are introduced through rural and urban runoff. While untreated sewage is no longer discharged into the Bay, treated sewage consumes oxygen and contributes additional organic materials and pollutants to Bay waters, affecting aquatic habitat. Historically, the Bay supported some of the largest fisheries on the West Coast of Dungeness crabs, starry flounder, oysters, and clams. Bay shrimp and herring roe are the only commercially viable fisheries left in the Bay (Cohen 1990).

7.1.7.3 Aquatic Habitat Descriptions

The native fish fauna of the Basin and the South Bay reflect their connection to the greater Sacramento-San Joaquin watersheds that also flow out through the Bay (Moyle 1976). When ocean levels were lower, the streams tributary to the South Bay were a component of a larger freshwater system that encompassed North Bay streams and the Sacramento and San Joaquin River watersheds. Native freshwater fish common to both the Basin and Sacramento-San Joaquin River watersheds include steelhead/rainbow trout, salmon, California roaches, Sacramento suckers, prickly sculpins and hitches. Today, anadromous (migrating from the ocean to freshwater for reproduction) and marine fish share the Bay waters common to the Delta, North Bay, and South Bay. Following are descriptons of fish and aquatic life in the Basin, organized by habitat type.

Lower South San Francisco Bay (Open Waters) and Baylands Habitats (Tidal [Mud] Flats, Tidal Sloughs, and Salt Ponds)

San Francisco Bay is the largest estuary on the West Coast. Aquatic habitat in the Bay includes marshes, tidal mudflats, sloughs, salt ponds, and open water.

Most marine life in the Bay either depends directly on mudflats and marshes for its sustenance, or indirectly on them by feeding upon detritus or other marine life nourished there. Because most of the Bay bottom is mud, most of its bottom dwellers have muddy lifestyles. The bottom is a place for diggers and burrowers, for worms and clams and oysters and for all the things that feed on them (Cohen 1990).

Native and nonnative invertebrates include two species of mussel (ribbed/horse and bay), three species of oyster (Olympia, Atlantic, and Pacific), seven species of clam (gem, Japanese littleneck, littleneck, soft-shell, bent-nosed, Baltic, and Asian), three species of shrimp (Asian, bay, and blue mud), four species of crab (hermit, mud, Atlantic green), and Chinese mitten crab, snails, worms, brine shrimp, and brine flies (Conradson 1996). Although the diversity of invertebrate species may be low, population densities of invertebrates found in the mud or zooplankton larva and brine shrimp found in the water column are highly productive.

Conradson (1996) lists only 21 common species of invertebrates native to the Bay. The low number of native invertebrate species may be due to the relatively young geologic age of the Bay (10,000 years) in combination with geographic isolation from other salt marsh habitats (Conradson 1996). However, over more than a century, many nonnative species have been introduced intentionally and accidentally into the Bay. Approximately 100 marine invertebrate species have been introduced since 1850 (13 of which are listed as common) as passengers on cargo and other ships entering the Bay (Conradson 1996). These exotic species, which came from as far away as the Orient, South Pacific, and Australia, were often able to fill unestablished niches or outcompete and eliminate the native species because natural controls such as predators, better competitors, and disease did not accompany them.

The Asian clam is a recent introduction that may have a widespread impact on the Bay ecosystem. First observed in Suisun Bay in 1986, the Asian clam (*Potamocorbula amurensis*) most likely arrived travelling as small larvae in the ballast water of a cargo ship from China, Japan, or Korea (Cohen 1990). Since this clam consumes huge quantities of zooplankton, a primary food source for fish larvae, this nonnative may impact fish abundance in future generations (Citizens Alliance to Restore the Estuary 1996).

Since the 1992 discovery of the Chinese mitten crab in the South Bay, their population has expanded into the Sacramento-San Joaquin Delta system and watershed. The juvenile crabs migrate into freshwater areas where they develop into adults. Mitten crabs have already had adverse effects on the estuary system, and fish and water facilities (Tsukimura and Toste 2000). Locally concerns focus on the impact of mitten crab burrowing on streambanks and levees.

The Bay supports nearly 100 species of fish. Some fish spend their entire life cycle in the Bay. Others enter the Bay for a specific life stage (usually reproduction). Typical fish include herring, topsmelt, Jacksmelt, Northern anchovy, starry flounder, staghorn sculpin, shiner, goby, croaker, and perch. Anadromous steelhead, salmon, and lamprey are present in the Bay during their migration from the ocean as adults and to the ocean as young. In addition, many fish migrate seasonally into the mouths of freshwater streams for feeding and reproduction. These migrations depend on changes in salinity, temperature, and food resources.

Detritus from wetlands, phytoplankton (microscopic floating plants) and zooplankton, form the basis of food webs in the Bay. Zooplankton are minute animals that include copepods, opossum shrimp (*Neomysis mercedis)* and the larvae of fish, mollusks, barnacles, crabs, and other organisms. Zooplankton provides food for immature predatory fish such as steelhead, salmon and striped bass, bay shrimp, and filter-feeding fish such as herring and shad. Some bottom-dwelling animals feed by filtering phytoplankton, zooplankton, and other organic materials from Bay waters. These animals include oysters, clams and other bivalves, and amphipod and isopod crustaceans. Other bottom-dwelling (benthic) organisms such as snails and polycheate worms graze on plankton, patches of brown diatoms, and other algae originating on the intertidal flats. (These microscopic diatoms often lend a golden hue to the mudflat's surface). In turn, these benthic invertebrates are fed upon by crabs, carnivorous mollusks, bat rays, leopard sharks, and bottom feeding fish such as starry flounder.

The lower reaches of the Basin streams are a transition zone to the more saline waters of the South Bay. Fish in these lower reaches are generally tolerant of a range of environmental conditions. Furthermore, a number of fish migrate in and out of sloughs for feeding and reproduction as salinity and flow changes with seasons, tides, and runoff. Fish occurrence in these lower reaches has been best documented for Coyote Creek. Fish collected in lower Coyote Creek were dominated by nonnative fish – goldfish, carp, red shiner, yellowfin gobies – but included one native fish, the California roach (Habitat Restoration Group 1995). At the mouth of Coyote Creek, captured fishes were a mix of species adapted to all waters. A collection of 15 species was dominated (97 percent of catch) by five species: the Pacific staghorn sculpin, starry flounder, northern anchovy, yellowfin goby, and shiner perch. Populations of the yellowfin goby have increased dramatically and may result in future competition with native gobies and fish such as the staghorn sculpin.

Fifteen species of fish are common to the salt and brackish marshes of the Bay (Conradson 1996). However, salt marshes provide large amounts of algae and detritus to the base of the food chain, which will ultimately support more than 60 species of fish in the deeper fresh, salt, or brackish waters of the Bay to complete their life cycle (Conradson 1996).

> "Salt ponds support a distinctive and highly specialized salt-tolerant to salt-loving biota consisting of microalgae, photosynthetic bacteria, and invertebrates (e.g., brine fly and brine shrimp), but no vascular plants. The dominant species are single-celled green alga and numerous species of blue-green and other bacteria. Ponds with salinities closer to marine salinities support macroalgae such as sea lettuce and marine plankton…" (Goals Project 1999).

In the less salty ponds, fish and aquatic organisms occur that are common to other shallow waters of the South Bay. For example, topsmelt, which can tolerate salinities up to 90 ppt, inhabit salt ponds. In the saltiest ponds, brine shrimp, brine flies, and the alga *Dunaliella salina* dominate a simple ecosystem.

Freshwater Habitats: Lotic (i.e., Flowing Water) Habitats

At present, the fish fauna in Basin streams includes 14 native species and 18 nonnative species (Table 7-4b). Abundance and distribution of native fish species have been reduced significantly through human settlement, water resource development, and other human impacts, mostly since the early 1900s. While six fish species native to Basin streams are now locally extinct, native fish persist either in certain areas of the watershed or with reduced populations throughout their former range. For example, riffle sculpin have been collected most recently only in the least disturbed, cold tributary streams of the Coyote Creek and Guadalupe River watersheds. Alternatively, a few native fishes are tolerant of environmental conditions in human-altered streams. For example, California roach and Sacramento suckers are the most abundant and widespread native fish in Basin streams. California roach are able to tolerate warmer stream temperatures and lower dissolved oxygen levels than other native fish, while Sacramento suckers are adapted to a range of environmental conditions from cold streams to warm reservoirs. Historical occurrence and subsequent changes in native fish populations are best documented for the larger watersheds: Coyote and San Francisquito Creeks and the Guadalupe River. In the smaller watersheds, an understanding of historical native fish distribution and recent changes to fish fauna is constrained by limited sampling efforts.

Reproducing populations of steelhead are known to exist in Coyote Creek, Guadalupe River, Stevens Creek, and San Francisqito Creek and their tributaries. The presence or absence of steelhead indicate the extent of human alteration in a watershed because steelhead are sensitive to human impacts such as passage barriers, water diversions, sedimentation, and increased stream temperatures. A small run of anadromous Chinook salmon occurs in the Guadalupe River.

In most Basin watersheds, headwater reaches and tributaries remain less disturbed than main stem streams and lower reaches. Quite a few tributaries flow out of protected open spaces or parks. Aquatic habitat in the forested headwater streams provides cool stream temperatures, high dissolved oxygen, and cover including riparian vegetation, overhanging banks or roots, cobbles, boulders, and pools. Abundant riffles (areas of higher gradient with gravel/cobble substrate) provide spawning areas, cover for young fish, and habitat for aquatic insects that are a primary food resource for young steelhead and other fish. Upper watershed streams are usually dominated by native fish, including California roach, Sacramento suckers, and prickly sculpins. Young steelhead and riffle sculpins also occur in headwater streams when present in the watershed. One nonnative fish, the green sunfish, prefers these upper watershed streams with few other species present. Limited information exists regarding upper watershed fish populations for several of the smaller watersheds.

Dam construction has isolated many upper watershed streams in the Basin. While native fish can persist in these streams, migratory fish such as steelhead and lampreys can no longer utilize these tributaries for spawning and rearing since most reservoirs do not have fish ladders. Reduced access to these tributaries is one of the main factors in the decline of steelhead in Coyote Creek and Guadalupe River.

Main stem streams and lower tributary reaches vary considerably among watersheds, but all are altered significantly by human impacts. Human impacts include water diversions, channelization, flood control projects, loss of riparian vegetation, and increased rates of sedimentation. These impacts reduce habitat complexity, the number and quality of pool habitats and gravel and cobble substrate, which are essential for spawning, cover, and insect production. Loss of riparian vegetation results in decreased shading, increased water temperatures, reduced cover and decreased input of nutrients and food (e.g., insects).

Nonnative fish tend to dominate fish abundance and diversity in lower reaches. In general, nonnative fish are better adapted to these human-altered stream conditions than native fish. For example, carp are tolerant of the very warm and turbid water that exists in lower Coyote Creek during much of the year. In Stevens Creek, nonnative fish are more common in the middle and lower reaches, even though native fish are predominant in the upper main stem.

Freshwater Habitats: Lentic (i.e., Standing Water) Habitats

In the Basin, lentic, or lake-like, freshwater habitat occurs predominantly in permanent and seasonal in-channel impoundments. Lentic aquatic habitat tends to have higher stream temperatures and lower dissolved oxygen than adjacent lotic (flowing water) habitat. Lentic habitats feature daily and seasonal patterns of temperature and dissolved oxygen levels that reflect the interaction of solar radiation, light penetration, and phytoplankton photosynthesis and respiration. In addition, water flowing into and out of reservoirs affects temperature and dissolved oxygen between upstream and downstream locations in the reservoirs. Oxygen stratification can occur in lakes and reservoirs, whereby cooler water temperatures towards the bottom have greatly reduced oxygen levels. Stratification can limit suitability for fish requiring higher oxygen levels and lower temperatures. Food resources differ in reservoirs with most fishes feeding on phytoplankton, zooplankton, aquatic insects and other invertebrates such as snails, or preying on fish and other aquatic organisms.

The lentic habitat found in reservoirs and in-channel percolation ponds tends to favor nonnative fish such as bluegills, sunfish, brown bullheads, carp, goldfish and largemouth bass. Reservoirs promote the presence of nonnative fish in the watershed by providing suitable habitat. These nonnative fish can prey on native fish and invade adjacent stream habitat, for example, largemouth bass can prey on juvenile steelhead.

Reservoirs provide habitat for some native fish (such as hitch and Sacramento blackfish) adapted to lentic conditions. Reservoirs can provide suitable rearing habitat for nonmigratory rainbow trout if cool temperatures, dissolved oxygen, and food resources are available. Reservoirs are also suitable for native fish species adapted to a range of environmental conditions, such as the California roach and Sacramento sucker. In-channel percolation ponds have the potential to provide rearing habitat for juvenile steelhead if temperatures, dissolved oxygen, and food resources are suitable, but only a few possible steelhead were captured during a 5-year study monitoring in-channel percolation ponds on Basin streams (Habitat Restoration Group 1995). Since the large, permanent reservoirs in the Basin do not provide passage for steelhead, they would not be expected to occur in these reservoirs, although native rainbow trout may persist in upstream tributaries.

7.1.7.4 Special Fish Species

Steelhead trout (*Oncorhynchus mykiss)* has been federally listed as threatened in Basin streams. Steelhead and rainbow trout, common names for the species *Oncorhynchus mykiss,* have different life histories. Steelhead are anadromous: young steelhead spend from 1 to 2 years in streams before migrating to the ocean, where they mature and return to freshwater streams as adults to reproduce. Unlike salmon, steelhead can return several times to freshwater streams to spawn. Rainbow trout live full-time in freshwater streams and do not migrate to the ocean. Resident rainbow trout populations often develop in streams that had steelhead populations historically, but migration to the ocean (and back) is not possible due to changes such as the natural formation of waterfalls or the human construction of permanent dams and drop structures. However, these rainbow trout have the genetic potential to once again become a steelhead population if migration passage is restored. Both smolts (outmigrating young) and adults depend on adequate streamflows for migration. Adequate streamflows in spring (April to early June) are essential for the successful outmigration of young steelhead.

Success of anadromous fish spawning and rearing depends on several habitat factors, including cool temperatures, high dissolved oxygen levels, and substrates for spawning and rearing. Salmonids of all life stages prefer cool temperatures and well-oxygenated water. As water temperatures increase, salmonid survival is dependent upon high food productivity and high dissolved oxygen levels. Stream temperatures influence the incubation period for Chinook and steelhead eggs. Young steelhead need cover habitat such as undercut banks, pools, overhead vegetation, riffles, and boulders to escape predation and high streamflows.

Fall run Chinook salmon are a CDFG species of special concern. See Table 7-3 for information on special-status species in the Santa Clara Basin.[9]

7.2 Waterbodies of the Santa Clara Basin

The waterbodies of the Basin are highly varied. They include the rivers and creeks that drain the 13 separate watersheds that flow into the South Bay, the southern portion of San Francisco Bay south of the Dumbarton Bridge, and the wetlands surrounding the South Bay. There are nine major lakes/reservoirs and other smaller reservoirs located on creeks at mid-elevations in the watershed. There are also isolated wetlands throughout the Basin, including freshwater marshes and numerous small ponds. Figure 7-9 shows the location of each watershed in the Basin, along with many of the rivers, creeks, and tributaries.

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[9] Table 7-3 is based on WMI's Technical Memorandum No. 32: Recommended List of Special-Status Species for RARE Assessment, approved by the Core Group May 4, 2000. Information for the technical memorandum was compiled from various databases including the CNDDB, the California Native Plant Society Inventory, and the Santa Clara Valley Audubon Society Bird Species List for Santa Clara Valley and was reviewed by a number of WMI stakeholders and biologists. The species in Table 7-3 should be considered as the current list of special-status species in the Santa Clara Basin. The reader is referred to the technical memorandum for a description of how this list was developed and the rationale of inclusion and exclusion of species in the list. Note that dissenting opinion exists among some stakeholders regarding what type of Chinook salmon are present in the Guadalupe River and Coyote Creek. Some stakeholders feel winter run Chinook occur in the Basin as well.

Insert Figure 7-9 (Front)

Insert Figure 7-9 (Back)

7.2.1 Lower South San Francisco Bay [10]

The waterbodies of the lower South Bay and Baylands include the open water (saltwater) of the Estuary south of the Dumbarton Bridge and the wetlands surrounding the South Bay. The term "Baylands" is used to refer to a number of wetland ecosystems found near the Bay, and encompasses many different types of habitat, each of which have unique hydrologic properties and plant and animal associations. Baylands in the northern Santa Clara Basin include tidal mudflats, tidal sloughs, coastal (tidal) salt marshes, diked salt marshes, brackish water marshes, salt ponds, and freshwater marshes. The extensive system of dikes and levees in the Baylands not only alters the distribution of tidal, brackish, and fresh waters but also provides a unique habitat of "higher ground" within the marsh plain. A map of the Baylands is shown on Figure 7-10.

7.2.1.1 Open Waters, Mudflats, and Tidal Sloughs

Although the various components of the Estuary are part of a complex hydrologic mosaic in which each piece depends on all of the other pieces, it is possible to sequentially discuss the various types of waterbodies found in the Basin, beginning with the Bay itself. Hydrologists split the Estuary into two distinct hydrologic systems: a northern reach running from the Delta through Suisun, San Pablo, and Central Bays, where the pattern of water circulation and salinity is largely determined by the flows from the Sacramento and San Joaquin Rivers; and a southern reach consisting of the South Bay, which receives much less water from its tributaries. The Basin includes the southern end of the South Bay. The Estuary as a whole is subject to the mixed semidiurnal tides typical of the West Coast, meaning that there are two unequal high tides and two unequal low tides in each (roughly) 25-hour period. In the nearly enclosed basin of the South Bay, the tides cause the water to slosh back and forth like water in a bathtub, causing the normal tidal range at the extreme southern end to approach 8.5 feet (Cohen 1990).

Tides are raised by the gravitational pull of the moon and the sun, with the tidal range changing in a regular pattern as the moon circles the earth every 28 days. The tides with the greatest range, called spring tides, occur during the full or the new moon, when the moon, sun, and earth are nearly aligned. At this time, the inequalities between the two daily high tides and the two daily low tides are also greatest. Neap tides, with the least tidal range and most similar daily highs and lows, occur during the moon's quarters. The tides also vary on an annual cycle, with extreme high and low tides occurring in May/June and November/December (Cohen 1990).

Since the South Bay only receives about one-tenth as much freshwater from its tributary streams as do the northern portions of the Bay, it does not regularly experience the strong salinity (dissolved salt) gradients or estuarine flows typical of the northern reaches of the Bay. As a result, salinities are generally higher and more uniform in the South Bay (Cohen 1990). Summer

[10] Persons interested in learning more about the ecology of San Francisco Bay may wish to access the Bay Area EcoAtlas managed by the San Francisco Estuary Institute (SFEI 1998). The Bay Area EcoAtlas is a growing assemblage of maps, images, scientific data, and information sources about the ecology of the bays, wetlands, and watersheds of the Bay Area. The EcoAtlas can be visited online at the SFEI website: www.sfei.org. Information on the EcoAtlas can be obtained by contacting the SFEI at 1325 South 46th Street, Richmond, CA 94804.

salinities can be three times higher than winter salinities due to evaporation; and sometimes parts of the South Bay are saltier than the ocean (Conradson 1996). With little freshwater flowing in, the southern portion of the South Bay is relatively stagnant, especially south of the Dumbarton Bridge.

Overall, the residence time (the average length of time it takes for a water molecule or a dissolved contaminant to leave the system) is four times longer in the southern than in the northern reach of the Bay. In wet winters, however, large floods coming down from the Delta can surge through the Central Bay and enter the southern reach, temporarily establishing vertical salinity gradients and two-layered estuarine flows (Cohen 1990). By some calculations, this reduces the residence time from around 5 months in the summer (when water exchange is controlled by less efficient mixing mechanisms such as tidal currents and wind mixing) to two months in the winter (when freshwater flow is largely responsible for mixing) (Conradson 1996). Thus, large flows through the Delta in winter and spring may help to flush pollutants out of the South Bay (Cohen 1990). Areas of the Bay with large discharges and poor water circulation, such as the lower South Bay, which in the summer receive more treated wastewater than river water, are thought to be particularly vulnerable to pollution (Cohen 1990).

Most of the Bay is extremely shallow, and this is especially true of portions of the South Bay. Although in some South Bay shallows the sediments on the Bay floor are mixed with enormous numbers of broken oyster shells, nearly everywhere else the Estuary's bottom is a slick, sticky ooze of fine silts and clays, commonly referred to as bay mud.

Tidal (mud) flats are generally understood to be the zones of apparently barren mud, muck, or sand exposed at low tide. Their upper boundary is indicated by the edge of emergent vegetation or wave-cut bank. The acreage of a typical tidal (mud) flat varies not only within the 25-hour tidal cycle, but also with the monthly or seasonal tidal cycles and floods. Within the South Bay itself, the present extent of mudflats is slightly smaller than in presettlement times. Generally, the levees and fills of the Baylands have been located along higher boundaries, above the mudflats (Tudor Engineering Company 1973).

7.2.1.2 Historical Perspective

The Baylands of the Basin are an ecologically fragile area that have undergone dynamic structural and environmental changes over the past 100 years. As illustrated on Figures 7-7 and 7-8, in the Bay ecosystem as a whole, marshlands bordering the Bay now total about 75 square miles. In 1850, before diking and filling of these lands had begun, marshlands covered some 300 square miles. The prehistoric broad salt marshes dissected by the meandering brackish tidal sloughs of Coyote, Alviso, Guadalupe, and other, lesser drainages have long been trapped behind earth levees and shaped by dredgers and bulldozers. Much of the tidal wetlands and the floodplains have been modified. They were converted first to stock pasturage and hay farms, then to truck gardens and orchards, and most recently to factory and business sites, suburban housing, military installations, and aerospace industries (Tudor Engineering Company 1973).

Insert Figure 7-10 (Front)

Insert Figure 7-10 (Back)

The loss of these wetlands has come at a steep price. Wetlands are increasingly recognized as among the most productive ecosystems on Earth, but they are more than just food factories for wildlife. Wetlands serve an important role for flood control and act as filters and cleansing agents for water flowing into the Bay. By intercepting surface runoff, marshes are able to remove and retain nutrients, process chemical and organic wastes, and reduce sediment loads before the water reaches the Bay. Through their enormous absorptive capacity, wetlands are able to store floodwater that would otherwise destroy cropland or residential areas. They help control sedimentation and erosion. Given their importance to wildlife, water quality and flood protection, wetlands are an extremely valuable natural resource (Citizens Alliance to Restore the Estuary 1996).

The Bayfront cities of Palo Alto, Menlo Park, East Palo Alto, Mountain View, Sunnyvale, San Jose, and Fremont have each played their role in the environmental history of the Baylands, although the impacts to Bayfront lands at the northern edge of the Basin have been less severe than those at the extreme southern reach of the Estuary. Saltwater intrusion, land subsidence, falling water tables and destructive floods have been less severe in these northern Baylands than they have in the floodplains of Coyote Creek, Alviso Slough, and Guadalupe Slough (Tudor Engineering Company 1973).

The major, direct impact on the Baylands in the Basin during the past 75 years, and the one that has modified the Baylands environment most drastically, was brought about by the development of the salt industry (Tudor Engineering Company 1973). The tidal marshes of the South Bay had saline soils, lacked readily available irrigation water, and experienced high evaporation rates during the summer – all of which made agriculture less feasible than in the northern portions of the Estuary. Extensive, natural crystallizing ponds suggested another use: salt production (Josselyn 1983). Salt ponds of the South Bay were diked beginning in 1854 (Bay Institute of San Francisco 1987). By the late 1800s, extensive lands were diked by small companies to produce salt in evaporation ponds. By the 1930s, over 99 square miles had been diked in the South Bay for salt production, a use that continues to this day, although diking and filling in the South Bay have slowed greatly during the past 30 years, since the passage of the Clean Water Act.

The discharge of freshwater from wastewater treatment plants into the South Bay presents another ongoing problem. Over the last 20 years, approximately 270 acres of tidal salt marsh dominated by pickleweed and cordgrass in the South Bay have been converted to brackish marsh dominated by alkali bulrush in areas of freshwater discharge from wastewater treatment.

A number of marsh-dependent plants and animals have become rare or endangered, largely as a result of habitat loss and fragmentation of the Estuary. A total of 90 taxa of mammals, birds, reptiles, insects, and amphibians within the Bay was designated by federal and state governments as having sufficiently declined in numbers to deserve special protection or monitoring.

The "Baylands Ecosystem Habitat Goals" report (Goals Project 1999) distinguishes three separate segments within that portion of the South Bay Subregion that is south of Dumbarton Bridge: Segment O – Mountain View Area; Segment P – Coyote Creek Area; and Segment Q –

Mowry Slough Area. Descriptions of the historical distribution of Baylands habitats in each of these areas are contained in this report.

7.2.2 Santa Clara Basin Watersheds

A watershed is defined as "a hydrologic unit that drains to tidal waters of the Bay, including tributaries and land areas above reservoirs" (WMI Work Group C). This discussion of the hydrologic features in the Basin describes each of the stream systems that flow to the South Bay.

The Basin encompasses 13 distinct watersheds that drain to the southern portion of the South Bay. Seven of these watersheds (San Francisquito Creek, Matadero/Barron Creeks, Adobe Creek, Permanente Creek, Stevens Creek, Calabazas Creek, and San Tomas Aquino/Saratoga Creek watersheds) drain the northeast and east-facing slopes of the Santa Cruz Mountains, originating on the east side of Skyline Boulevard (State Highway 35). Each of these creeks flows across the western portion of the Santa Clara Valley to the Baylands bordering the west and southwest sides of the South Bay. Two small drainage basins (Sunnyvale West and Sunnyvale East Channel watersheds) drain lowland areas on the southwest side of the South Bay. Guadalupe River watershed drains the north-facing slopes of the Santa Cruz Mountains at the southern end of the Santa Clara Valley. Guadalupe River flows north through the Santa Clara Valley to the south end of the Bay.

The west-facing slopes of the Diablo Range in the southern and southeastern portions of the Basin are drained primarily by Coyote Creek. Coyote Creek watershed is the largest watershed in the Basin. Guadalupe River watershed is the second largest. Coyote Creek flows the full length of the Santa Clara Valley from south to north at the base of the Diablo Range before entering the eastern side of the South Bay. The foothills of the Diablo Range in the northeastern portion of the Basin are drained by Lower Penitencia Creek watershed. Finally, the lowland areas in the northeasternmost portion of the Basin are drained by the Arroyo la Laguna watershed that flows to the Baylands at the northeastern side of the South Bay via several slough systems.

Table 7-5 (Rivers and Creeks in the Basin) presents the relationship between each of the watercourses within each watershed. Table 7-6 provides information on the drainage area and channel length of many of the rivers and creeks in the Basin.

Each of the watersheds in the Basin is discussed in detail below. The purpose of these watershed descriptions is to provide the reader with a general understanding of the location and character of each watershed, along with a feeling for the resource values associated with each stream system and the perturbations that have affected the health of these stream and riparian ecosystems.

Each watershed is discussed in sequence starting with the San Francisquito Creek watershed on the west side of the Basin, and moving through the Basin in a counter-clockwise direction (as viewed from the Dumbarton Bridge), ending with the Arroyo la Laguna watershed on the east side of the Basin.

Table 7-5
Rivers and Creeks in the Santa Clara Basin

Watercourses Entering the South Bay	Major Rivers and Creeks	Major Tributaries and Reservoirs	Tributaries to Tributaries and Reservoirs	Additional Tributaries	Additional Tributaries
San Francisquito Creek Watershed					
San Francisquito Creek discharges into the South Bay south of the Dumbarton Bridge and north of the Palo Alto Flood Basin.	San Francisquito Creek	Los Trancos Creek (An unnamed diversion occurs to Felt Lake with a return.)	Buckeye (East Fork)		
		Bear Creek	Bear Gulch		
			West Union Creek	McGarvey Gulch	
				Squealer Gulch	
				Tripp Gulch	
				Appletree Gulch	
			Dry Creek		
		Searsville Lake	Alambique Creek		
			Sausal Creek	Bozzo Gulch	
				Neils Gulch	
				Bull Run Creek	
				Dennis Martin Creek	
			Corte Madera Creek	Coal Creek	
				Rengstorff Gulch	
				Damiani Creek	
				Jones Gulch	
				Hamms Gulch	
			Westridge Creek		
Matadero and Barron Creek Watershed					
Matadero and Barron Creeks discharge into the Palo Alto Flood Basin.	Matadero Creek	Stanford Channel			
		Deer Creek			
		Arastradero Creek			
	Barron Creek				
Adobe Creek Watershed					
Adobe Creek discharges into the Palo Alto Flood Basin.	Adobe Creek	Robleda Drain			
		Purissima Creek			
		Moody Creek			
		North Fork			
		West Fork			
		Middle Fork			
Permanente Creek Watershed					
Permanente Creek discharges to the South Bay via Mountain View Slough.	Permanente Creek	Hale Creek	Loyola Creek		
			Magdalena Creek		
		West Branch Permanente	Ohlone Creek	Big Green Moose Creek	

Table 7-5 (continued)
Rivers and Creeks in the Santa Clara Basin

Watercourses Entering the South Bay	Major Rivers and Creeks	Major Tributaries and Reservoirs	Tributaries to Tributaries and Reservoirs	Additional Tributaries	Additional Tributaries
Stevens Creek Watershed					
Stevens Creek discharges into the South Bay east of Permanente Creek and west of Guadalupe Slough.	Stevens Creek	Permanente Diversion			
		Heney Creek			
		Stevens Creek Reservoir	Swiss Creek	Montebello Creek	
				North Swiss Creek	
			Stevens Creek	Gold Mine Creek	
				Indian Cabin Creek	
				Bay Creek	
				Indian Creek	
Sunnyvale West Channel Watershed					
Sunnyvale West Channel discharges into Moffett Channel and thence into Guadalupe Slough.	Sunnyvale West Channel				
Sunnyvale East Channel Watershed					
Sunnyvale East Channel discharges into Guadalupe Slough.	Sunnyvale East Channel				
Calabazas Creek Watershed					
Calabazas Creek discharges to the South Bay via Guadalupe Slough.	Calabazas Creek	Prospect Creek			
		Rodeo Creek			
		Regnart Creek			
		Junipero Serra Channel			
		El Camino Storm Drain			
San Tomas Aquino/Saratoga Creek Watershed					
San Tomas Aquino Creek discharges to the South Bay via Guadalupe Slough.	San Tomas Aquino Creek	Smith Creek	Page Ditch		
		Wildcat Creek	Vasona Creek	Vasona Creek	
				Sobey Creek	
		Saratoga Creek	Congress Springs Canyon		
			Bonjetti Creek	San Andreas Creek	Sanborn Creek
				Todd Creek	
				McElroy Creek	
			Booker Creek		

Table 7-5 (continued)
Rivers and Creeks in the Santa Clara Basin

Watercourses Entering the South Bay	Major Rivers and Creeks	Major Tributaries and Reservoirs	Tributaries to Tributaries and Reservoirs	Additional Tributaries	Additional Tributaries
Guadalupe River Watershed					
Guadalupe River discharges to the South Bay via Alviso Slough.	Guadalupe River	Los Gatos Creek	Dry Creek		
			Daves Creek		
			Vasona Reservoir	Los Gatos Creek	Almendra Creek
					Trout Creek
			Lexington Reservoir	Limekiln Creek	
				Lyndon Canyon Creek	Lake Ranch Reservoir
				Soda Springs Creek	
				Aldercroft Creek	
				Black Creek	
				Briggs Creek	Dyer Creek
				Hendrys Creek	
				Los Gatos Creek	Moody Gulch
					Hooker Gulch Creek
					Lake Elsman Austrian Gulch Williams Reservoir Los Gatos Creek
		Canoas Creek			
		Ross Creek	Short Creek		
			Lone Hill Creek		
			East Ross Creek		
		Guadalupe Creek	Shannon Creek		
			Pheasant Creek		
			Reynolds Creek *(Exact Location Unclear)*		
			Hicks Creek *(Exact Location Unclear)*		
			Guadalupe Reservoir	Los Capitancillos Creek	
				Upper Guadalupe Creek	Rincon Creek
		Lake Almaden	Alamitos Creek	Golf Creek	McAbee Creek
				Greystone Creek	
				Randol Creek	West Branch Randol Ck.
				Arroyo Calero Creek	Santa Teresa Creek
					Calero Reservoir Cherry Canyon Creek Pine Tree Canyon Creek
				Chilanian Gulch	
				Deep Gulch	
				Almaden Reservoir	Larabee Gulch
					Jacques Gulch
					Alamitos Creek
					Barrett Canyon Creek
					Herbert Creek

Table 7-5 (continued)
Rivers and Creeks in the Santa Clara Basin

Watercourses Entering the South Bay	Major Rivers and Creeks	Major Tributaries and Reservoirs	Tributaries to Tributaries and Reservoirs	Additional Tributaries	Additional Tributaries
Coyote Creek Watershed					
Coyote Creek discharges to South Bay via Lower Coyote Creek.	Coyote Creek	Upper Penitencia Creek	Arroyo Aquague Creek	Papa Saca Creek	
			Dutard Creek		
			Cherry Flat Reservoir	Upper Penitencia Creek	
		Lower Silver Creek	Miguelita Creek		
			North Babb Creek		
			South Babb Creek		
			Flint Creek	Ruby Creek	
			Norwood Creek		
			Thompson Creek	Quimby Creek	
				Fowler Creek	
				Evergreen Creek	
				Yerba Buena Creek	
				Cribari Creek	
				Misery Creek	
				Hawk Creek	
				Dry Creek	
		Upper Silver Creek			
		Coyote Canal			
		Fisher Creek	Willow Springs Creek		
		Anderson Reservoir	San Felipe Creek	Shingle Valley Creek	
				Las Animas Creek	
				Carlin Canyon Creek	Brushy Creek
				Cow Creek	
			Packwood Creek	Hoover Creek	Star Canyon Creek
			Coyote Creek	Otis Canyon Creek	South Fork
					North Fork
				Coyote Reservoir	Larios Canyon Creek
					Coyote Creek
					Bear Creek
					Canada de los Osos
					Hunting Hollow Creek
					Big Canyon Creek
					Soda Springs Canyon
					Middle Fk Coyote Creek
					Little Coyote Creek
					Sulpher Creek
					East Fk Coyote Creek
					Kelly Cabin Canyon
					Water Gulch
					Grizzly Creek

Table 7-5 (concluded)
Rivers and Creeks in the Santa Clara Basin

Watercourses Entering the South Bay	Major Rivers and Creeks	Major Tributaries and Reservoirs	Tributaries to Tributaries and Reservoirs	Additional Tributaries	Additional Tributaries
Lower Penitencia Creek Watershed					
Lower Penitencia Creek Discharges to the South Bay via the tidal portion of Lower Coyote Creek. Lower Penitencia Creek flows to lower Coyote Creek on the west side of Interstate 880 at Dixon Landing Road.	Lower Penitencia Creek	Berryessa Creek	Calera Creek		
			Tularcitos Creek	South Branch	
			Arroyo de los Coches		
			Piedmont Creek	North Branch	
			Sierra Creek		
			Crosley Creek		
			Sweigert Creek		
			Los Buellis Creek		
		East Penitencia Channel			
Arroyo la Laguna					
Line A discharges into the tidally influenced section of Lower Coyote Creek, north of the old Fremont Airport.	Lower Coyote Creek	Line A	Scott Creek (Line A)		
			Unnamed Line B	Unnamed Line B-1	
				Line C	Toroges Creek (Line C)
					Agua Fria Creek (Line D)
					Agua Caliente Creek (Line F)
Mud Slough discharges into lower Coyote Creek within the Baylands.	Mud Slough	Laguna Creek (Line E)	Unnamed (Line G)		
			Unnamed (Line H)		
			Canada del Aliso (Line J)		
			Unnamed (Line I)		
			Sabercat Creek (Line K)	Unnamed (Line K-1)	
			Mission Creek (Line L)	Lake Elizabeth	
				Stivers Lagoon	
			Morrison Creek (Line M)		
Mowry Slough discharges into the lower South Bay south of Newark Slough and north of Coyote Creek.	Mowry Slough				
Plummer Creek and Newark Slough discharge into the lower South Bay just southeast of Dumbarton Point.	Plummer Creek				
	Newark Slough				

Table 7-6 Drainage Area and Channel Length of Rivers and Creeks in the Santa Clara Basin[1]		
River or Creek	**Drainage Area (Square Miles)**	**Channel Length (Miles)**
San Francisquito Creek Watershed		
Alambique Creek	n/a	n/a
Appletree Gulch	n/a	n/a
Bear Creek	***n/a***	***n/a***
Bear Gulch	n/a	n/a
Bozzo Gulch	n/a	n/a
Buckeye Creek	n/a	n/a
Bull Run Creek	n/a	n/a
Coal Creek	n/a	n/a
Corte Madera Creek	n/a	n/a
Damiani Creek	n/a	n/a
Dennis Martin Creek	n/a	n/a
Dry Creek	n/a	n/a
Hamms Gulch	n/a	n/a
Jones Gulch	n/a	n/a
Los Trancos Creek	7.25	6.58
McGarvey Gulch	n/a	n/a
Neils Gulch	n/a	n/a
Rengstorff Gulch	n/a	n/a
San Francisquito Creek	42.04	8.77
Sausal Creek	n/a	n/a
Squealer Gulch	n/a	n/a
Tripp Gulch	n/a	n/a
West Union Creek	n/a	n/a
Westridge Creek	n/a	n/a
Matadero/Barron Creeks Watershed		
Arastradero Creek	1.13	0.95
Barron Creek	3.09	4.92
Deer Creek	1.60	2.46
Matadero Creek	13.57	7.97
Stanford Channel	1.08	1.60
Adobe Creek Watershed		
Adobe Creek	10.84	14.01
Middle Fork	n/a	n/a
Moody Creek	n/a	n/a
North Fork	n/a	n/a
Purissima Creek	1.25	0.37
Robleda Drain	n/a	n/a
West Fork	n/a	n/a

Table 7-6 (continued) Drainage Area and Channel Length of Rivers and Creeks in the Santa Clara Basin[1]		
River or Creek	**Drainage Area (Square Miles)**	**Channel Length (Miles)**
Permanente Creek Watershed		
Big Green Moose Creek	n/a	n/a
Hale Creek	4.80	3.16
Loyola Creek	n/a	0.74
Magdalena Creek	1.28	0.63
Ohlone Creek	n/a	1.04
Permanente Creek	8.11	12.97
West Branch Permanente	n/a	2.84
Stevens Creek Watershed		
Bay Creek	n/a	n/a
Gold Mine Creek	n/a	n/a
Heney Creek	0.64	0.72
Indian Cabin Creek	n/a	n/a
Indian Creek	n/a	n/a
Montebello Creek	n/a	1.54
North Swiss Creek	n/a	n/a
Permanente Diversion	8.96	1.35
Stevens Creek	38.04	20.22
Swiss Creek	n/a	1.67
Sunnyvale West Channel Watershed		
Sunnyvale West Channel	4.10	3.20
Sunnyvale East Channel Watershed		
Sunnyvale East Channel	6.35	6.40
Calabazas Creek Watershed		
Calabazas Creek	20.67	13.30
El Camino Storm Drain	3.23	2.31
Junipero Serra Channel	1.25	2.51
Prospect Creek	1.44	1.38
Regnart Creek	3.41	2.94
Rodeo Creek	1.43	1.90
San Tomas Aquino-Saratoga Creek Watershed		
Bonjetti Creek	n/a	0.14
Booker Creek	0.50	0.66
Congress Springs Canyon	n/a	n/a
Guadalupe Slough	- -	6.32
McElroy Creek	n/a	n/a
Page Ditch	0.38	0.86
San Andreas Creek	n/a	n/a
San Tomas Aquino Creek	39.06	16.55
Sanborn Creek	1.02	0.34
Saratoga Creek	16.56	15.44

Table 7-6 (continued) Drainage Area and Channel Length of Rivers and Creeks in the Santa Clara Basin[1]		
River or Creek	**Drainage Area (Square Miles)**	**Channel Length (Miles)**
Smith Creek	2.65	3.41
Sobey Creek	0.63	0.01
Todd Creek	n/a	n/a
Vasona Creek	1.43	0.51
Wildcat Creek	4.12	3.84
Guadalupe River Watershed		
Alamitos Creek	37.96	8.93
Aldercroft Creek	n/a	1.39
Almendra Creek	1.08	1.88
Arroyo Calero Creek	12.40	6.08
Austrian Gulch	n/a	1.41
Barrett Canyon Creek	n/a	2.55
Black Creek	n/a	n/a
Briggs Creek	n/a	1.12
Canoas Creek	18.62	7.39
Cherry Canyon Creek	n/a	n/a
Chilanian Gulch	n/a	n/a
Daves Creek	0.61	1.62
Deep Gulch	n/a	n/a
Dry Creek	n/a	n/a
Dyer Creek	n/a	n/a
East Ross Creek	0.80	0.90
Golf Creek	3.08	2.27
Greystone Creek	1.38	1.56
Guadalupe Creek	15.24	28.03
Guadalupe River	170.64	19.78
Hendrys Creek	n/a	0.76
Herbert Creek	n/a	2.27
Hicks Creek	n/a	1.8
Hooker Gulch Creek	n/a	1.98
Jacques Gulch	n/a	0.93
Larrabee Gulch	n/a	0.96
Limekiln Creek	n/a	1.8
Lone Hill Creek	1.29	0.91
Los Capitancillos Creek	n/a	0.58
Los Gatos Creek	54.83	24.05
Lyndon Canyon Creek	1.90	3.13
McAbee Creek	0.50	0.47
Moody Gulch	n/a	4.36
Pheasant Creek	1.40	1.00
Pine Tree Canyon Creek	n/a	n/a

Table 7-6 (continued)
Drainage Area and Channel Length of Rivers and Creeks in the Santa Clara Basin[1]

River or Creek	Drainage Area (Square Miles)	Channel Length (Miles)
Randol Creek	2.28	1.93
Reynolds Creek	n/a	n/a
Rincon Creek	2.57	1.93
Ross Creek	9.96	6.16
Santa Teresa Creek	1.99	1.89
Shannon Creek	1.20	1.14
Short Creek	0.50	0.52
Soda Springs Creek	n/a	0.66
Trout Creek	n/a	0.28
Upper Guadalupe Creek	n/a	n/a
West Branch Randol Creek	n/a	3.63
Coyote Creek Watershed		
Arroyo Aquague Creek	9.00	15.15
Bear Creek	n/a	n/a
Big Canyon Creek	n/a	n/a
Brushy Creek	n/a	n/a
Canada de los Osos	n/a	n/a
Carlin Canyon Creek	n/a	n/a
Cow Creek	n/a	n/a
Coyote Canal	n/a	n/a
Coyote Creek	321.62	42.14
Cribari Creek	1.53	0.34
Dry Creek	n/a	n/a
Dutard Creek	n/a	n/a
East Fork Coyote Creek	n/a	n/a
Evergreen Creek	1.98	2.86
Fisher Creek	15.78	7.99
Flint Creek	1.98	1.52
Fowler Creek	2.78	2.85
Grizzly Creek	n/a	n/a
Hawk Creek	0.60	0.40
Hoover Creek	n/a	n/a
Hunting Hollow Creek	n/a	n/a
Kelly Cabin Canyon	n/a	n/a
Larios Canyon Creek	n/a	n/a
Las Animas Creek	12.10	4.66
Little Coyote Creek	n/a	n/a
Lower Silver Creek	43.50	7.15
Middle Fork Coyote Creek	n/a	n/a
Miguelita Creek	4.49	4.05
Misery Creek	0.90	1.46

Table 7-6 (continued) Drainage Area and Channel Length of Rivers and Creeks in the Santa Clara Basin[1]		
River or Creek	**Drainage Area (Square Miles)**	**Channel Length (Miles)**
North Babb Creek	2.57	1.29
North Fork - Otis Canyon Creek	n/a	n/a
Norwood Creek	2.18	3.13
Otis Creek	n/a	n/a
Packwood Creek	10.10	10.89
Papa Saca Creek	n/a	n/a
Quimby Creek	2.17	2.05
Ruby Creek	1.55	1.61
San Felipe Creek	8.00	29.17
Shingle Valley Creek	3.40	6.06
Soda Springs Canyon	n/a	n/a
South Babb Creek	4.00	3.61
South Fork - Otis Canyon Creek	n/a	n/a
Star Canyon Creek	n/a	n/a
Sulpher Creek	n/a	n/a
Thompson Creek	17.99	8.81
Upper Penitencia Creek	23.91	11.04
Upper Silver Creek	5.96	7.24
Water Gulch	n/a	n/a
Willow Springs Creek	n/a	n/a
Yerba Buena Creek	2.58	1.52
Lower Penitencia Creek Watershed		
Arroyo de los Coches	4.02	3.41
Berryessa Creek	22.05	9.66
Calera Creek	2.93	3.13
Crosley Creek	0.93	1.28
East Penitencia Creek	1.70	0.68
Los Buellis Creek	n/a	0.73
Lower Penitencia Creek	27.20	4.13
Piedmont Creek	n/a	n/a
Piedmont Creek – North Branch	1.93	1.46
Sierra Creek	0.77	2.10
Sweigert Creek	0.94	0.36
Tularcitos Creek	n/a	n/a
Tularcitos Creek – South Branch	1.96	0.86
Arroyo la Laguna Watershed		
Agua Caliente (Line F)	n/a	n/a
Aqua Fria Creek (Line D)	n/a	n/a

Table 7-6 (concluded) Drainage Area and Channel Length of Rivers and Creeks in the Santa Clara Basin[1]		
River or Creek	**Drainage Area (Square Miles)**	**Channel Length (Miles)**
Canada del Aliso (Line J)	n/a	n/a
Laguna Creek (Line E)	n/a	n/a
Lower Coyote Creek	n/a	n/a
Mission Creek (Line L)	n/a	n/a
Morrison Creek (Line M)	n/a	n/a
Mowry Slough	n/a	n/a
Mud Slough	n/a	n/a
Newark Slough	n/a	n/a
Plummer Creek	n/a	n/a
Scott Creek (Line A)	1.01	3.75
Sabercat Creek (Line K)	n/a	n/a
Toroges Creek (Line C)	n/a	n/a
Unnamed Channel (Line B)	n/a	n/a
Unnamed Channel (Line B-1)	n/a	n/a
Unnamed Tributary to Laguna Creek (Line G)	n/a	n/a
Unnamed Tributary to Laguna Creek (Line H)	n/a	n/a
Unnamed Tributary to Laguna Creek (Line I)	n/a	n/a
Unnamed Tributary to Sabercat Creek (Line K-1)	n/a	n/a

[1] Not all of the creeks in the Santa Clara Basin are included in this table; channel lengths only include those areas within Santa Clara Valley Water District jurisdiction.

n/a = Data not readily available.

- - = Not applicable.

Source: Santa Clara Valley Water District

7.2.2.1 San Francisquito Creek Watershed

The San Francisquito Creek watershed is located in the northwesternmost portion of Santa Clara County and the most southeastern portion of San Mateo County. The creek's drainage basin is approximately 45 square miles. The uppermost portion of the watershed along Skyline Boulevard (State Highway 35) in the Santa Cruz Mountains is approximately 2,200 feet in elevation. A map of the watershed is shown on Figure 7-11.

San Francisquito Creek begins at the outlet of Searsville Dam located on Stanford University lands in San Mateo County. The creek is approximately 12.5 miles long – extending from the base of Searsville Dam to the Bay. Tributaries in the upper watershed that feed into Searsville Lake include Alambique Creek, Martin Creek, Sausal Creek, and Corte Madera Creek. Tributaries that enter San Francisquito Creek downstream of Searsville Dam include Bear Creek and Los Trancos Creek.

Downstream of the confluence with Los Trancos Creek, San Francisquito Creek forms the boundary between San Mateo County and Santa Clara County. Bordering the creek on the north are the cities of Menlo Park and East Palo Alto, and on the south is the city of Palo Alto. San Francisquito Creek runs through Stanford University lands. The towns of Woodside and Portola Valley are in the upper portion of the watershed.

As late as 1912, San Francisquito Creek flowed year-round as far east as El Camino Real (State Highway 82) (Wels et al., undated). It still flows past El Camino in wet years (Doug Padley, pers. comm., 1998).

San Francisquito Creek lies within the Water District's Lower Peninsula (Northwest) Flood Control Zone and San Mateo County's San Francisquito Creek Flood Control Zone. Recent flood events have occurred in 1955, 1958, 1982, 1995, and 1998. In an attempt to control flooding and bank erosion in portions of the lower channel, areas between University Avenue Bridge and U.S. Highway 101 have been lined with sacked concrete and protected with berms or low floodwalls. The reach between U.S. Highway 101 and the Bay has been widened and leveed.

Prior to 1998, the largest flood on record for San Francisquito Creek occurred in December of 1955. The magnitude of this flood, which has a 4 percent chance of occurring in any given year, was sufficient to inundate 1,200 acres of commercial and residential property and about 70 acres of agricultural property. Before the 1955 flood, the creek overtopped its banks six times between 1910 and 1955. Because development in the area was sparse before the 1950s, only light damage resulted from these earlier floods. A flood event that occurred in April 1958 caused a levee failure downstream of the Bayshore Freeway (U.S. Highway 101) and resulted in the subsequent flooding of the Palo Alto Airport, city landfill, and golf course to depths of up to 4 feet.

After the floods of 1955 and 1958, interim flood protection measures were implemented on the creek in the reaches upstream and downstream of the Bayshore Freeway. The creek flooded

Figure 7-11 (front)
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Figure 7-11 (back) Page 7-98

again in 1998, when streamflows exceeded the highest on record and resulted in substantial flooding, causing over $28 million in property damage in Santa Clara County alone.

The severity of flooding has been increased due to sedimentation. Sedimentation occurs in the reach of the creek downstream of U.S. Highway 101 due to tidal action, as well as due to deposition of sediment from upstream sources. Sediment that is transported from the headwaters of the creek is deposited when water slows down as the gradient of the stream changes in the flatter parts of the watershed. Once deposited, sediment occupies space in the channel that is no longer available to transport floodwaters. In 1996, sediment occupied at least one-third of the flow area in the channel beneath the U.S. Highway 101 crossing. Sediment can also interfere with local drainage outfalls by blocking pipes and culverts. Recent studies in the headwaters of San Francisquito Creek indicate that erosion rates are currently quite high. Since the forested headwaters have not been extensively burned for more than 100 years, the high rate of erosion cannot be attributed to fire (Kittleson and Hecht 1996).

A Coordinated Resources Management and Planning (CRMP) process has been under way since 1993 in the San Francisquito Creek watershed. In January 1997, the San Francisquito CRMP (now called the San Francisquito Creek Watershed Council, or "Watershed Council") produced a *Draft Watershed Management Plan*. The Flood and Erosion Control Task Force of the San Francisquito Creek Watershed Council produced a *Reconnaissance Investigation Report of San Francisquito Creek* addressing alternative solutions for flooding and erosion problems. Over 30 organizations are signatories to the process of preserving the resources of the San Francisquito Creek watershed. Most recently, the San Francisquito Joint Powers Authority ("JPA") has been formed as a coalition of local government agencies to plan and implement flood management and watershed protection plans in the San Francisquito Creek Watershed.

The upper portion of the watershed is vegetated with scattered oak and madrone woodlands that are intermingled with grassland habitat, in some areas forming a savanna. A grove of upland redwood forest occurs along San Francisquito Creek just below Searsville Lake. Native tree species that occur in the riparian corridor include valley oak, coast live oak, willows and California buckeyes. Common native riparian shrubs include coffeeberry (*Rhamnus californicus*), ocean spray (*Holodiscus discolor*), and creeping snowberry (*Symphoricarpos mollis*).

A section of both banks of San Francisquito Creek lies within the Jasper Ridge Biological Preserve, and here one finds isolated second-generation stands of coast redwood. Other common woody species along the creek banks include the yellow-flowering box elder, big-leaved maple, willows of several species, white alder, California bay and California hazelnut (Wels et al., undated).

Invasive, nonnative plant species are a significant component of the riparian corridor along San Francisquito Creek, and include blue gum eucalyptus, acacia, fennel (*Foeniculum vulgare*), periwinkle, English ivy, French broom, black locust, Algerian ivy (*Hedera canariensis*) and Cape ivy (Cities of Menlo Park and Palo Alto 1998; Lee Ellis, pers. comm., 1998). The San Francisquito Watershed Council has produced a *Streamside Planting Guide for San Mateo and Santa Clara County Streams* as a means of educating landowners adjacent to the creek about beneficial plants they can use in their landscaping that are compatible with the riparian habitat.

California red-legged frogs, a federal threatened species, are present along San Francisquito Creek (Keith Anderson, pers. comm., 1998).

The upland portion of the watershed consists of low-density residential development. The relatively flat valley floor has been extensively developed.

San Francisquito Creek watershed supports a healthy and stable steelhead population. Much of the watershed lies in a steep, mountainous area of the Santa Cruz Mountains and includes open space, Stanford University's Jasper Ridge Biological Preserve, and rural residential housing. This mix of land uses has preserved areas of high quality steelhead habitat in the upper tributaries of Los Trancos and Bear Creeks. Good steelhead habitat also exists in main stem reaches just downstream of Searsville Dam to the Lagunita Diversion (Alan Launer, pers. comm., 1998). Downstream of the Stanford golf course, steelhead habitat is fair to poor.

The Lake Lagunita Diversion Dam (owned by Stanford University) was a significant passage barrier until 1978, when the fish ladder was replaced with a Denil-style fishway. Also, a fish ladder was placed on the Felt Lake Diversion Dam on Los Trancos Creek in 1995 (Keith Anderson, pers. comm., 1998). Since then, the fishway has been further modified to improve passage (Margaret Roper, pers. comm., 1998). Searsville Dam, built in the late 1800s and located within Stanford's Jasper Ridge Biological Preserve, is a terminal barrier on San Francisquito Creek for all upstream migrating fish. While the primary passage barriers on the main stem San Francisquito have been laddered, other passage obstructions and barriers may exist on the main stem and in the tributaries (Alan Launer, pers. comm., 1998). The San Francisquito Creek Joint Powers Authority and the San Francisquito Watershed Council are working to remove identified barriers in the watershed.

In the San Francisquito watershed, extremely high natural sediment rates coupled with erosion associated with human settlement are constraints for steelhead spawning and rearing. Future development on Stanford property and addressing flood control problems in the lower main stem will need to preserve existing passage for both downmigrating young and upmigrating adult steelhead.

Fish collected in San Francisquito watershed include six other native species and seven nonnative species. Other native fish captured are the California roach, Sacramento sucker, hitch, speckled dace, threespine stickleback, and prickly sculpin. Three additional species of native fish were present historically: Sacramento perch, last collected in 1960; squawfish, last collected in 1905; and while prickly sculpin have not been collected recently, they may still be present in the upper tributaries.

7.2.2.2 Matadero/Barron Creeks Watershed

The upper Matadero Creek and Barron Creek watersheds are located on the lower-elevation northeast-facing slopes of the Santa Cruz Mountains. The Matadero Creek watershed drains an area south of the San Francisquito Creek watershed. Barron Creek is parallel to, and south of Matadero Creek. The Barron Creek watershed lies to the north of the Adobe Creek watershed.

The Matadero Creek and Barron Creek watersheds are often discussed as a single hydrologic unit since high flows from the upper Barron Creek watershed are transferred to Matadero Creek via a diversion constructed by the Water District. A map of the watershed is shown on Figure 7-12.

Matadero Creek

Matadero Creek originates near the town of Los Altos Hills and flows in a northeasterly direction through the residential, commercial, and industrial areas of the City of Palo Alto and unincorporated areas of Santa Clara County. Downstream of the Bayshore Freeway (U.S. Highway 101), Matadero Creek discharges into the Palo Alto Flood Basin, which outfalls into the Bay. Matadero Creek has a total watershed area of about 14 square miles, of which approximately 11 square miles are mountainous land, and 3 square miles are gently sloping valley floor (Water District 1988).

Prior to the turn of the century, Matadero Creek was a well-defined channel that meandered down a gently sloping alluvial fan on the eastern side of the Santa Cruz Mountains. The stream channel lost definition as the land surface flattened out. Historic streamflows spread out as shallow overland flow in a broad floodplain that stretched east toward the Baylands.[11] Streamflows eventually discharged into the South Bay through Mayfield Slough. By the turn of the century, diking off of wetlands and the construction of salt ponds eliminated much of the original broad floodplain and forced the use of outfall channels to carry freshwater streamflow to the South Bay (Water District 1988).

In the late 1930s, the City of Palo Alto purchased land from Leslie Salt Company for what is today known as the Palo Alto Flood Basin: a 600-acre tidal basin immediately northeast of the Bayshore Freeway (U.S. Highway 101). In the early 1940s, the City made various modifications to the flood basin, and Matadero Creek was extended as an earth ditch out to the Bay. Following the flood of 1955, the Matadero Creek stream channel was lined with concrete to increase its capacity and prevent erosion. Downstream of Alma Street, Matadero Creek is entirely a human-made channel, and never existed as a natural watercourse (Water District 1988).

Flooding occurred along Matadero and Barron Creeks in 1941, 1952, 1955, 1958, 1973, and 1983. The Water District constructed improvements on Matadero Creek in 1958, consisting of an earth channel with sacked concrete side slopes from Bayshore Freeway to Greer Road and varying sizes of concrete-lined channel between Greer Road and El Camino Real (Water District 1988). In 1959, the Water District constructed the Stanford Channel. The channel has a drainage area of about 1 square mile and flows into Matadero Creek under El Camino Real. In 1971, the Water District raised the existing levees and constructed a retaining wall on the outside of the levees from Bayshore Freeway to just upstream of Greer Road. Sacked concrete streambank protection was installed through Bol Park by Santa Clara County in 1972.

[11] Originally, Matadero Creek did not flow all the way to the Bay, but discharged into the wetlands on the floodplain east of Alma Avenue (Bob Moss, pers. comm., 1998).

The Water District prepared a *Matadero and Barron Creeks Planning Study* in 1988 (Water District 1988). Subsequently, one of the alternatives for flood control channel improvements between the Palo Alto Flood Basin and Foothill Expressway was selected and constructed.

The upper reaches of Matadero Creek traverse through oak woodlands and grassland savanna. The portion of the riparian corridor adjacent to the Veterans' Administration Hospital (downstream of Hillview Avenue) is composed of yellow willow – coast live oak riparian forest (Habitat Restoration Group 1994c). Native tree species that occur in the riparian corridor include valley oak, coast live oak, willows, and California buckeye. The riparian corridors along the urbanized sections of both Matadero and Barron Creeks are small and fragmented due to portions of the creek banks protected with bank stabilization and flood control structures. Due to the proximity to many residences, garden escapees, including the invasive nonnatives Himalaya blackberry, Algerian ivy and English ivy, are common. California red-legged frogs are present in the headwaters.

Limited historical and recent fishery information is available for Matadero and Barron Creeks. Most likely, these streams were intermittent in the lower reaches during summer, but probably supported native species such as California roach, prickly sculpin, and Sacramento sucker in the upper reaches. Four fish species have been collected in Matadero Creek: native threespine stickleback and prickly sculpin, and nonnative rainwater killifish and mosquitofish. Local residents have seen steelhead in Matadero Creek (Alan Launer, pers. comm., 1998). Additional native and nonnative fish would possibly be collected with more thorough sampling in all reaches. Channelization, flood control, and barriers such as culverts have drastically reduced fish habitat.

Barron Creek

Barron Creek originates in the residential areas of Los Altos Hills west of Interstate 280. Barron Creek flows in a northeasterly direction through the City of Palo Alto and joins with Adobe Creek just upstream of the Bayshore Freeway (Water District 1988). Adobe Creek then flows beneath the Bayshore Freeway into the Palo Alto Flood Basin.

Originally (i.e., prior to the 1920s) Barron Creek did not flow all the way to the Bay. It turned northeast to join Matadero Creek near the present intersection of Matadero Avenue and Tippawingo Drive (Bob Moss, pers. comm., 1998). In the late 1920s or early 1930s, a channel was dug all the way to the Bay; thus, the downstream portion of Barron Creek is an artificial alignment from Amaranta Avenue to the Bayshore Freeway.

Barron Creek is primarily an urban watershed with a drainage area of about 3 square miles. Many modifications were made to the creek channel in the late 1950s (Water District 1988). Barron Creek flooded seven times between 1956 and 1983 (Bob Moss, pers. comm., 1998).

Insert Figure 7-12 (Front)

Insert Figure 7-12 (back)

7.2.2.3 Adobe Creek Watershed

The Adobe Creek watershed is located in northwestern Santa Clara County. Adobe Creek originates on the northeasterly facing slopes of the Santa Cruz Mountains near Montebello Ridge, which is greater than 2,600 feet in elevation. Adobe Creek drains an area of approximately 10 square miles, of which roughly 7½ miles are mountainous, and 2½ square miles are on the valley floor. The main stem of Adobe Creek is joined by three forks: the middle, west, and north forks. Other major tributaries in the upper watershed are Moody Creek and Purissima Creek. A map of the watershed is shown on Figure 7-13.

Much of the upper Adobe Creek watershed is open-space land owned by the Mid-Peninsula Regional Open Space District and the Trust for Hidden Villa. The remainder of the mountainous portion of the watershed is occupied by low-density residential development. No reservoirs have been built on Adobe Creek. The valley floor portion of Adobe Creek flows through residential areas of Los Altos Hills, Los Altos, Palo Alto, and Mountain View. Robleda Drain flows into Adobe Creek west of Foothill Expressway. Adobe Creek is joined by Barron Creek just to the west of the Bayshore Freeway. Adobe Creek does not discharge directly into the South Bay. Adobe Creek (along with Barron and Matadero Creeks) flows into the Palo Alto Flood Basin.

The majority of the flow in Adobe Creek is produced by rainfall that occurs in the higher elevations within the watershed. The steep nature of the upper watershed results in short duration and high intensity runoff for most major storms. "Adobe Creek has a long history of flooding. Prior to the turn of the century, the creek was a well-defined channel that meandered down a gently sloping alluvial fan flattening out and losing definition as it approached San Francisco Bay." Historic floods resulting in flood damage have occurred in 1952, 1955, 1983, 1986, and 1995.

There have been many places where changes have been made in the creek channel alignment. In all cases, the creek was moved from a meandering alignment across a historic floodplain to a straightened channel at the edge of a development. In 1959, the Water District constructed a trapezoidal concrete channel along the reach of Adobe Creek between Alma Street and El Camino Real. In 1975, an 8-foot pipe bypass intended to prevent flooding of properties along Adobe Creek was constructed starting near the intersection of Moody and El Monte Roads (on the Foothill College Campus) going upstream approximately 2,200 feet, ending just upstream of Tepa Way.

In 1988, the City of Los Altos, the Town of Los Altos Hills, and the Hidden Villa Trust received an Urban Stream Restoration Program Grant from the California Department of Water Resources for the development of a comprehensive stream restoration plan for Adobe Creek from El Camino Real to the headwaters. The Adobe Creek Restoration Plan contains specific measures for the restoration and enhancement of riparian habitat (and other biological values) and the control of streambank erosion along upper Adobe Creek.

In 1996, the Water District prepared the Adobe Creek Watershed Planning Study addressing alternatives for resolving existing and potential flooding, erosion, and sedimentation problems on

Adobe Creek upstream of El Camino Real to the Hidden Villa Trust Property on Moody Road, a distance of approximately 7½ miles.

The upper, less developed portion of the watershed is located in the Los Altos Hills, and is primarily chaparral and broadleaved upland forest dominated by madrone and oak species. To a lesser extent there are also grassland areas. According to the *Adobe Creek Restoration Plan* (Habitat Restoration Group 1989), the riparian vegetation along Adobe Creek (from Montebello Ridge to the El Camino Real) forms an almost continuous riparian corridor of trees and shrubs along both banks. Along the upper creek bank, coast live oak, California buckeye, blue elderberry, California bay, and valley oak occur. The mid-bank vegetation is typically composed of box elder, California dogwood (*Cornus californica*), big leaf maple, and California black walnut (*Juglans hindsii*) (Habitat Restoration Group 1989). Nonnative plant species are abundant along the banks and include the following invasive nonnative species: blue gum eucalyptus, fennel (*Foeniculum vulgare*), periwinkle, English ivy, French broom, and Algerian ivy (Habitat Restoration Group 1989). From El Camino Real to the Bay (City of Palo Alto), there is no riparian vegetation due to the channelization of Adobe Creek.

Fire plays an important role in long-term sediment production in the headwaters of Adobe Creek. Following an intense fire, surface soil material creeps or ravels from hill slopes into small drainages, often when the soils are dry. Rainfall that occurs in the first years following a fire entrains large amounts of debris that are transported downstream. Streamside landsliding also contributes sediment directly to the channel of Adobe Creek. Fires and debris flows are both highly episodic.

A catastrophic fire has not occurred in the Adobe Creek watershed in the last 150 to 200 years, based on the age of Douglas-fir trees in the upper watershed. The complete absence of fire in recent years, combined with relatively high rainfall, suggests that Adobe Creek has the capacity to carry far more sediment than its current supply. Because streams self-adjust sediment loads by depositing or eroding sediment, the result of this recent (and probably temporary) imbalance has been an increase in the erosion of the bed and banks of the creek.

Limited historical and recent fishery information is available for Adobe Creek. Most likely, Adobe Creek was intermittent in the lower reaches during summer, but probably supported native species such as California roach, prickly sculpin, and Sacramento sucker in the upper perennial reaches. In Adobe Creek, collected fish include four native species (California roach, Sacramento sucker, threespine stickleback, and prickly sculpin) and two nonnative species (rainwater killifish and carp). Additional native and nonnative fish would possibly be collected with more thorough sampling in all reaches. Channelization, flood control, and physical barriers such as culverts have drastically reduced fish habitat.

7.2.2.4 Permanente Creek Watershed

The Permanente Creek watershed is located to the south of the Adobe Creek watershed and north of the Stevens Creek watershed. Permanente Creek drains an area of approximately 17 miles on the northeast-facing slopes of the Santa Cruz Mountains. The headwaters of Permanente Creek

Insert Figure 7-13 (Front)

Insert Figure 7-13 (Back)

lie just to the east of Black Mountain (elevation 2,800 feet) on Montebello Ridge. A map of the watershed is shown on Figure 7-14.

Permanente Creek is approximately 13 miles in length. Permanente Creek flows through the cities of Los Altos and Mountain View and discharges into the South Bay via the Mountain View Slough. Flows of up to 1,500 cubic feet per second (cfs) are diverted to Stevens Creek via the Permanente Creek Diversion, a diversion constructed in 1959.

The upper, less developed portion of the watershed is located in the southern Los Altos Hills, and is dominated by chaparral and upland broadleaved forest dominated by madrone, tan oak, coast live oak, big leaf maple, and black oak. To a lesser extent, there are also grassland areas.

Much of Permanente Creek's streambank within the City of Mountain View has been treated with artificial materials for bank stabilization and flood control. Limited historical and recent fishery information is available for Permanente Creek. Most likely, Permanente Creek was intermittent in the lower reaches during summer, but probably supported native species such as California roach, prickly sculpin, and Sacramento sucker in the upper reaches. In Permanente Creek, only two species have been collected: nonnative rainwater killifish and mosquitofish.

The Hanson Permanente Cement Company, Inc. (formally Kaiser) owns and operates a cement plant and rock quarry adjacent to Permanente Creek in the city of Cupertino. In September 1998, the Regional Board issued Hanson a Notice of Violation for discharges of sediment-laden stormwater into Permanente Creek. Hanson has implemented interim measures as required by the Notice, and submitted two reports to the Regional Board that document the progress made to date. Some of these measures include stabilizing all disturbed slopes at the facility that are not being mined actively and are contributing to sediment discharges, intercepting all sediment laden stormwater in excess of 50 mg/L total suspeneded solids before the stormwater enters the creek, and cleaning out all sediment from existing permitted sedimentation basins to achieve adequate retention volume (Regional Board 1999).

7.2.2.5 Stevens Creek Watershed

Stevens Creek originates on the northeast-facing slopes of the Santa Cruz Mountains. Upper Stevens Creek lies just to the east of Skyline Boulevard north of Saratoga Gap. The Stevens Creek watershed is bound on the northwest by the Permanente Creek watershed and on the southeast by the Calabazas Creek watershed. The Stevens Creek watershed drains an area of approximately 38 square miles. This includes almost 9 miles of the Permanente Creek watershed, whose peak flows were diverted to Stevens Creek in 1959 (Water District 1980). A map of the watershed is shown on Figure 7-15.

The headwaters of the Stevens Creek watershed are bisected by the northwesterly trending San Andreas fault, through which Stevens Canyon has formed. The southwest side of the San Andreas fault, up to the county line, is underlain by sediments. On the northeast side of the fault, most of the watershed is underlain by the Franciscan Group and its serpentine members. The types of minerals dissolved in the waters of Stevens Creek are consistent with the geology of the watershed. The presence of serpentine results in magnesium-rich groundwater, which feeds the creek during drier periods. Rainfall brings surface waters into the creek, and these waters tend to be high in calcium and tend to greatly dilute the influence of groundwater during wet periods (Iwamura 1999).

From its headwaters at Russian Ridge in the Santa Cruz Mountains (elevation 2,500 feet), Stevens Creek flows southeasterly along the San Andreas Fault Zone for 5½ miles before swinging to the northeast and then north to Stevens Creek Reservoir. From Stevens Creek Dam, the creek flows northward to the South Bay, a distance of approximately 13 miles (Water District 1980).

Much of the upper watershed of Stevens Creek is in Upper Stevens Creek Park owned by Santa Clara County. Upper Stevens Creek flows southeast along the San Andreas Rift Zone and then turns to the northeast before flowing into Stevens Creek Reservoir. From the Stevens Creek Reservoir, the creek continues northward onto the valley floor. Stevens Creek flows in a defined channel through the Cities of Cupertino, Los Altos, Sunnyvale and Mountain View. Stevens Creek flows into the South Bay near Long Point, north of Moffett Field Naval Air Station. Salt ponds are located on both sides of Stevens Creek where it meets the Bay.

Two tributary channels flow into Stevens Creek downstream of Stevens Creek Dam. Heney Creek, with a total watershed area of 0.64 square mile is an improved facility constructed in 1965. It outfalls into Stevens Creek just downstream of Interstate 280. Permanente Creek Diversion diverts a maximum flow of 1,550 cfs from Permanente Creek into Stevens Creek. The Permanente Creek Diversion outfalls into Stevens Creek between Bryan Avenue and Levin Avenue in Mountain View, and constitutes the major tributary to Stevens Creek on the valley floor (Water District 1980). The Water District uses the streambed between Stevens Creek Reservoir and El Camino Real for recharging the groundwater basin (Water District 1980).

The predominant plant community in the highest elevations is broadleaved upland forest with patches of chaparral and nonnative grassland. Common tree species include tan oak, black oak, big leaf maple, California bay, Douglas fir, California buckeye and madrone. In the mountainous areas along Stevens Creek, common riparian tree species are white alder, big leaf maple and California bay. Downstream from Stevens Creek Reservoir, the stream gradient becomes less steep, and the riparian corridor is wider compared to the upper canyons. Typical riparian tree species include box elder, arroyo willow, red willow, cottonwood, western sycamore, valley oak, and coast live oak. As Stevens Creek crosses the City of Mountain View, much of its streambank is channelized and covered/treated with artificial materials for bank stabilization and flood control.

Stevens Creek supports a native fish fauna in the upper reaches and includes resident rainbow trout, California roach, and Sacramento sucker. The Creek is also thought to support a reproducing population of steelhead. Fish ladders at U.S. Highway 101 and Central Expressway were barriers under low-flow conditions; however, these problems were corrected in 1998. The drop structure at L'Avenida is a passage barrier during low-flow; the drop structure will be modified in 2000. Native

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hitch, squawfish, and threespine stickleback have been collected in Stevens Creek. Nonnative fish are more common in the middle and lower reaches of Stevens Creek, and include channel catfish, goldfish, carp, mosquitofish, and green sunfish.

7.2.2.6 Sunnyvale West and Sunnyvale East Channels Watersheds

The Sunnyvale West and Sunnyvale East Channels are two artificial channels that were constructed by the Water District to provide drainage for a large area in Sunnyvale between Calabazas Creek and Stevens Creek (California History Center, De Anza College 1981). The Sunnyvale West Channel watershed is located to the east of Stevens Creek. The Sunnyvale East Channel watershed is located to the west of Calabazas Creek. Maps of the watersheds are shown on Figures 7-16 and 7-17.

Sunnyvale East Channel empties into Guadalupe Slough (California History Center, De Anza College 1981). Sunnyvale West Channel drains into Moffett Channel (California History Center, De Anza College 1981) and thence into Guadalupe Slough.

7.2.2.7 Calabazas Creek Watershed

Calabazas Creek drains approximately 20 square miles in the northwestern portion of the Basin (Water District 1989). Situated on the northeast-facing slopes of the Santa Cruz Mountains, the Calabazas Creek watershed is located south of the Stevens Creek Watershed and north of the Saratoga Creek watershed. A map of the watershed is shown on Figure 7-18.

Calabazas Creek is 13.3 miles in length and flows in a northeasterly direction. Beginning at an elevation of approximately 2,000 feet above sea level, Calabazas Creek is steep in the mountainous areas, then flattens to a gentle slope as it crosses the valley floor. Major tributary streams to Calabazas Creek include Prospect Creek, Rodeo Creek, and Regnart Creek. Drainage facilities entering Calabazas Creek include Junipero Serra Channel and the El Camino Storm Drain. Calabazas Creek flows into Guadalupe Slough. The valley floor portions of the watershed are extensively urbanized (Water District 1989).

Mean annual precipitation ranges from about 37 inches in the upper watershed to 16 inches on the lower valley floor. The steep nature of the upper portion of the watershed results in short-duration, high-intensity runoff for most major storms (Water District 1989).

Calabazas Creek has a history of chronic flooding. One of the largest floods reported on the creek occurred on December 22, 1955. In Sunnyvale alone, over 160 homes were inundated to a depth of up to 3 feet during this event. More recently, flooding has occurred in 1978, 1980, 1983, 1986, 1995, and 1998. The majority of this recent flooding is attributed to inadequate culverts, which are easily blocked by debris or overwhelmed by floodflow (Water District 1989).

Both sedimentation and erosion have been problematic in various reaches of Calabazas Creek. The most significant sediment problems occur between State Highway 237 and U.S. Highway 101. The sediments come from both the Bay and the upstream watershed. Suspended silts from the Bay are carried up the channel by tidal currents where they mix with freshwater streamflows. In this mixing zone, a chemical process occurs that causes the suspended silts to coagulate and to settle along the banks of the creek where water velocities are low. The receding tide draws water back into the Bay, eroding and transporting only a portion of its original sediment load. Over time, benches are formed along the channel sides. Vegetation that becomes established on these benches secures them and protects them from erosion. High volumes of fluvial (stream transported) sediments are also deposited in sections of Calabazas Creek. The Calabazas Creek watershed has a moderately high sediment yield that can be attributed to both cultural activities in the upper watershed and to active channel erosion (Water District 1989).

The northernmost portion of Calabazas Creek from El Camino Real to Guadalupe Slough was relocated by farmers along straight property lines prior to the turn of the century, and has been relocated or modified three times since 1900. Following the 1955 flood, the Water District realigned Calabazas Creek (in 1958) to its original outfall in Guadalupe Slough along the "farmers' alignment."

The section of Calabazas Creek between El Camino Real and Lawrence Expressway was concrete-lined in the late 1960s and early 1970s. In 1979, a trapezoidal, concrete-lined channel was constructed between U.S. Highway 101 and El Camino Real. Also in 1979, commercial developers realigned the creek between Stevens Creek Boulevard and Vallco Parkway in a double-cell reinforced concrete box culvert, and between Interstate 280 and Vallco Parkway in a trapezoidal earth channel. In 1980, Calabazas Creek from Guadalupe Slough to U.S. Highway 101 was enlarged by constructing an earth channel with levees (Water District 1989).

In 1989, the Water District prepared the *Calabazas Creek Planning Study and Draft Environmental Report* (Water District 1989). Subsequently, one of the alternatives for flood control channel improvements between the Guadalupe Slough and Miller Avenue was selected and constructed.

Portions of Calabazas Creek are used to recharge imported water. Since 1967, when the Stevens Creek Pipeline was completed, the Water District has had the capability to release water into Calabazas Creek for artificial recharge.

Calabazas Creek has a degraded riparian corridor dominated by nonnative species integrated with remnants of natives. The uppermost portion of Calabazas Creek watershed is composed of chaparral and broadleaved upland forest; however, the majority of Calabazas Creek travels through urban areas. Lower reaches of the riparian corridor from the Guadalupe Slough to U. S. Highway 101 are composed of riparian scrub.

Native tree species in the lower reaches include sandbar willow, Fremont cottonwood, arroyo willow, and yellow willow. Farther upstream, between Lawrence Expressway and Miller Avenue, typical riparian tree species include coast live oak, willow, valley oak, and blue elderberry. Native shrub species include poison oak, coyote brush, native California rose, and buckeye. Nonnative plants include introduced weeds, garden cultivars/ornamentals, and invasive

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species such as curly dock (*Rumex crispus*), thistles, eucalyptus, and blackwood acacia (*Acacia melanoxylon*). A number of fruit and nut trees have been introduced into the riparian corridor. Black walnut and almond trees are common (Water District 1989).

Calabazas Creek has limited fishery resources due to a lack of natural summer flow. Mosquitofish are the only recorded fish collected in Calabazas Creek.

7.2.2.8 San Tomas Aquino/Saratoga Creek Watershed

The San Tomas Aquino/Saratoga Creek watershed drains an area of 45 square miles. Saratoga Creek joins San Tomas Aquino Creek in the City of Santa Clara just south of Monroe Street, which is north of El Camino Real and south of Central Expressway in Santa Clara. A map of the watershed is shown on Figure 7-19.

San Tomas Aquino Creek

San Tomas Aquino Creek begins in the foothills of the Santa Cruz Mountains and flows north through the cities of Campbell and Santa Clara. San Tomas Aquino Creek flows into the upper (southern) end of Guadalupe Slough. A levee-raising project was completed on San Tomas Aquino Creek from the Bayshore Highway to Guadalupe Slough in the early 1980s (Water District 1983b). Major portions of the creek have been channelized for flood control, particularly in the lower reaches. As a result, segments of the creek are lacking riparian vegetation.

In addition to incoming flows from Saratoga Creek, San Tomas Aquino Creek also receives water from Vasona Creek and its tributaries that drain portions of Saratoga and Campbell.
In San Tomas Aquino Creek, hitch is the only native fish that has been captured during limited sampling efforts. Nonnative fish collected have been rainwater killifish, golden shiner, goldfish, and carp.

An impassable barrier at the confluence of San Tomas Aquino and Saratoga Creeks prevents anadromous fish passage to both creeks.

Saratoga Creek

The Saratoga Creek watershed drains an area of approximately 17 square miles on the northeast-facing slope of the Santa Cruz Mountains. The Saratoga Creek watershed begins at an elevation of approximately 3,100 feet above sea level along Skyline Boulevard at the crest of the Santa Cruz Mountains. The upper portion of the watershed is a bowl-shaped area that is about 4½ miles across at the widest point. The lower portion of the watershed between the City of Saratoga and its confluence with San Tomas Aquino Creek varies between ¼ and 1 mile wide (Water District 1983b).

Saratoga Creek is a little over 15 miles in length. The creek is steep in the mountainous areas and flattens to a minimal slope as it crosses the valley floor. The elevation at the point where Saratoga Creek joins San Tomas Aquino Creek is about 40 feet above msl.

The earliest floods of record on Saratoga Creek date to the year 1861. Other floods have occurred in the years 1892, 1910, 1940, 1943, 1955, and 1958. The largest flood recorded on Saratoga Creek occurred on December 22, 1955. On that day, the peak flow recorded at the USGS Gaging Station No. 1695 (located in the City of Saratoga) was 2,730 cfs (Water District 1983b).

Construction of flood control channel improvements was completed on the lowermost reach of Saratoga Creek between Cabrillo Avenue and the confluence with San Tomas Aquino Creek in 1980. Between 1984 and 1986, the 3-mile section of the Saratoga Creek channel between Pruneridge Avenue and Cabrillo Avenue was modified to increase channel capacity. The channel was excavated and a gabion lining was installed. Native vegetation has been planted within and above the gabions.

Some of the native riparian vegetation found along the lower portion of Saratoga Creek during preparation of the Saratoga Creek Planning Study included coast live oak, willow, cottonwood, blue elderberry, California sycamore and California buckeye. Some of the more common shrubs and vines in the riparian corridor include poison oak, coyote brush, mule fat, California coffeeberry, and blackberry (Water District 1983b).

The upper portions of the Saratoga Creek watershed are vegetated with broadleaved upland forest, especially mixed evergreen forest, including redwood and Douglas fir, and chaparral. The riparian corridor in the mountainous portion of the watershed is narrow as it courses through steep canyons. Common riparian tree species along the upper reaches of Saratoga Creek include white alder, big leaf maple, and California bay. Scattered Douglas fir and coast redwoods also occur along some of the drainage courses. Native riparian plant species occurring along the lower portions of Saratoga Creek (from Monroe Street to Lawrence Expressway) include arroyo willow, box elder, Fremont cottonwood, western sycamore, red willow, yellow willow, blue elderberry, coffeeberry, coyote brush, and mule fat (Water District 1983b). Nonnative weedy species are common. Invasive nonnative species in the riparian corridor include prickly wild lettuce (*Lactuca serriola*), Italian thistle, bristly ox-tongue, French broom, curly dock, arundo/giant reed, pampas grass, cocklebur (*Xanthium strumarium*) and periwinkle (Water District 1983b). Fruit and nut trees have become established in the riparian corridor including fig, prune, almond, black walnut, olive (*Olea europaea*) and quince (*Cydonia oblonga*) (Water District 1983b).

Three native fish species (resident rainbow trout, hitch and Sacramento sucker) and two nonnative species (rainwater killifish and mosquitofish) have been collected in Saratoga Creek. Saratoga Creek is a historic steelhead stream, and the rainbow trout are of steelhead origin (Keith Anderson, pers. comm., 1998).

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7.2.2.9 Guadalupe River Watershed

The headwaters of the Guadalupe River are located in the eastern Santa Cruz Mountains near the summit of Loma Prieta, elevation 3,790 feet. A map of the watershed is shown on Figure 7-20.

Guadalupe River

The Guadalupe River begins at the confluence of Alamitos Creek and Guadalupe Creek, which is just downstream of Coleman Road in San Jose. From this point, the Guadalupe River flows north approximately 14 miles through heavily urbanized portions of the City of San Jose, eventually discharging to the South Bay via the Alviso Slough near the community of Alviso. South of State Highway 237, the Guadalupe River watershed has a total drainage area of approximately 170 square miles.

Three tributary creeks join the Guadalupe River as it flows north towards the San Francisco Bay: Ross, Canoas and Los Gatos creeks. Ross Creek drains an area of about 10 square miles before it joins the Guadalupe River just downstream of Branham Lane. Canoas Creek drains an area of about 19 square miles before joining the Guadalupe River just upstream of Curtner Avenue. Los Gatos Creek, with a drainage area of about 55 square miles, joins the Guadalupe River in downtown San Jose.

The Guadalupe River played an important role in the settlement of San Jose. As a result, it has been subject to considerable modification. The first major modification of the stream channel occurred in 1866 when a canal was dug to alleviate flooding and to improve conditions for rapidly expanding orchards. More recently, in the early 1960s, Canoas Creek and Ross Creek were realigned. As part of the 1975 Almaden Expressway construction project, about 3,000 feet of the Guadalupe channel were widened and moved eastward. The original stream channel was filled to allow the construction of the northbound expressway (Jones & Stokes 1997).

The written history of flooding in the Basin begins with the founding of the Mission Santa Clara and the Pueblo San Jose de Guadalupe in 1777. Floods during the first few years forced both to move to higher ground. Historic accounts of flooding were recorded in 1779, 1862, 1867, 1869 and 1911. The storm of December 1955 (known as the “Christmas Storm”) caused widespread flooding throughout the Basin. The Guadalupe River inundated some 5,200 acres. Although extensive flooding occurred as a result of this storm, it would have been more severe if the upstream storage reservoirs had not been nearly empty prior to the storm event. Major flooding also occurred on the Guadalupe River on April 2, 1958, when floodwaters covered portions of downtown San Jose to a depth of up to 4 feet. Flooding also occurred downstream, inundating 2,700 acres of agricultural land, as well as the town of Alviso, for 17 days. The discharge of the Guadalupe River in 1958 was nearly twice the discharge recorded for the December 1955 storm, even though it rained a lot more in 1955; this was because the upstream storage reservoirs were full when the 1958 storm occurred. In recent years, the Guadalupe River has flooded San Jose communities during the winters of 1980, 1982, 1983, and 1995.

The Guadalupe watershed has been identified as a significant mercury source to the Bay, owing to prior mining of mercury ore within the watershed. Most of the mining activities occurred within what was once known as the New Almaden Mining District and is now the present location of the Almaden Quicksilver County Park. Mercury mining within the Park began in 1845 and occurred up to 1975, when the area was purchased by Santa Clara County for use as a recreational park. The park occupies approximately 3,750 acres in the foothills of the Santa Cruz Mountains, on Los Capitancillos Ridge. Seventy-five percent of the total park area drains into the Guadalupe River via intermittent creeks and perennial streams. The remaining area drains into the Guadalupe and Almaden reservoirs.

Inactive mercury mines in the New Almaden area include Guadalupe, Senator, San Mateo, San Antonio, Enriquita, San Francisco, Providencia, American, and New Almaden. The principal mercury ore in the area is cinnabar (mercury sulfide), which is situated within a host silica-carbonate rock. The cinnabar is processed by crushing the ore and reducing the ore to elemental mercury in retorts or furnaces. The burned rocks, referred to as calcines, typically were dumped in piles near the processing areas or used as road base material. Generally, the calcines are sandy or silty gravel materials. The calcine piles still remain at the site and vary in area, steepness, mercury concentration, and particle size distribution. Erosion and runoff from calcine piles, waste rockpiles (unprocessed rock), and road material cause mercury-laden sediment to be transported into nearby surface waterbodies.

There are six major reservoirs in the Guadalupe River watershed: Calero Reservoir on Calero Creek, Guadalupe Reservoir on Guadalupe Creek, Almaden Reservoir on Alamitos Creek, and Vasona Reservoir, Lexington Reservoir, and Lake Elsman on Los Gatos Creek. All of these reservoirs were constructed for water conservation and storage purposes, but can provide flood control benefits depending on the size of the upstream drainage areas and the available water storage capacities.

During the drier months, the Water District augments the natural recharge of groundwater along the Guadalupe River and its tributaries through an artificial recharge program. Offstream recharge occurs in percolation ponds that are fed by water diverted from tributary creeks or by imported water pipelines. Prior to 1995, the District used temporary dams to enhance instream recharge. In 1995 the Water District’s permits for the operation of these recharge facilities expired. The Water District has an active project to reevaluate its recharge operations and determine which facilities are critical to the County’s water supply.

Riparian areas along the Guadalupe River on the valley floor include the following native species: arroyo willow, Fremont cottonwood, box elder (*Acer negundo*), western sycamore, red willow and sandbar willow (*Salix exigua*). Garden/orchard escapees and invasive nonnative species are prevalent in the urban riparian corridors. According to a tree survey conducted along reaches of the Guadalupe River between Blossom Hill Road and Interstate 280, the relative abundance of black locust (an invasive nonnative tree) was 20 percent, while the relative abundance of the native species, Fremont cottonwood was 15 percent. The following invasive nonnative plant species are known to occur along the lower Guadalupe River riparian corridor

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Insert Figure 7-20 (Back)

(from Interstate 880 to Hedding Street): arundo/giant reed (*Arundo donax*), fennel, black locust, tree-of-heaven, Himalayan blackberry, prickly wild lettuce, white sweet clover, and bristly ox-tongue (*Picris echioides*) (Habitat Restoration Group 1998).

The valley floor reaches of the Guadalupe River provide important habitat for birds. Bird species using the riparian forest habitat along the Guadalupe River include: mourning doves, downy woodpeckers, Nuttall's woodpeckers, red-shouldered hawks, Pacific-slope flycatchers, chestnut-backed chickadees, and northern orioles. The diversity of nesting birds is reduced along the more urbanized sections of the Guadalupe River where the riparian corridor is narrow and native understory vegetation is absent or localized, or where natural habitats adjacent to the river are largely absent. Mammals known or expected to exist in the riparian habitat include the Virginia opossum, raccoon, Trowbridge shrew, broad-footed mole, fox squirrel, Botta's pocket gopher, and feral house cat.

Aquatic habitat in the Guadalupe River and its tributaries, including Los Gatos Creek, has been altered significantly by reservoirs, passage barriers, flood control projects, and other channel modifications. While many of the native fish that occurred historically in Guadalupe River still occur in the watershed, nonnative fish dominate the system (see Tables 7-4a and 7-4b). Sixteen nonnative species have been collected in Guadalupe River and include golden shiner, threadfin shad, catfish, goldfish, carp, sunfish, largemouth bass, and black crappie. Nine native fish regularly occur in the Guadalupe River watershed: Pacific lamprey, Chinook salmon, hitch, California roach, Sacramento sucker, steelhead, threespine stickleback, riffle sculpin, and prickly sculpin. Sacramento pikeminnow was last collected in 1922 (Leidy 1984).

The Guadalupe River supports a reproducing steelhead population. The steelhead population had declined significantly by 1962 following the construction of reservoirs on all main tributaries (Los Gatos, Guadalupe, Alamitos, and Arroyo Calero creeks) and the construction of a drop structure upstream of Blossom Hill Road. From the time dams were installed in the river up until 1999, steelhead were confined to the main stem of the Guadalupe River and lower Los Gatos Creek, where limited spawning and rearing habitat occur. In these stream reaches, habitat is restricted by high-velocity winter flows that can destroy eggs and young, and by high summer stream temperatures and minimal cover habitat that provide marginal rearing conditions. Downstream tributaries such as Canoas and Ross creeks have less suitable habitat and streamflow for steelhead.

A small run of Chinook salmon occurs in the Guadalupe River. Early written documents record the local presence of migrating salmon in the "Rio Guadalupe" dating as far back as the 1700s when the Spanish first settled the area. Valley residents and fisherman reported the local presence of coho salmon until the 1970s. The GCRCD (2001) believes that there is a continuing presence of Chinook since the mid-1700s. The SCVWD biologists support the hypothesis that Santa Clara Valley chinook slamon are keyed genetically to Central Valley fall run Chinook salmon, and Guadalupe River and Coyote Creek fish are strays from the Central Valley rather than remnants of a native fish stock. The GCRCD consulting biologists support the hypothesis that most fall run Chinook salmon in the Guadalupe River and Coyote Creek are remnants of a native fish stock.

Adult fall run Chinook have been scientifically documented in the Guadalupe River watershed since the mid-1980s. Reproduction of Chinook is occurring in this watershed.

Over the past few years, passage conditions have been improved at several locations. A stream gage (23B at Foxworthy Road) has been modified and a crossing (at Branham Lane) has been removed. Although the Hillsdale Road weir has been modified, it remains a passage barrier under low flow conditions (David Salsbery, Jerry Smith, pers. comms., 1998). In addition, the Water District recently modified the Alamitos drop structure and installed a fish ladder in 1999. Removal of this terminal barrier on Guadalupe River and installation of a fish ladder at Masson Diversion Dam on lower Guadalupe Creek in 2000 has provided potential access to over 16 miles of steelhead spawning and rearing habitat in Guadalupe and Alamitos creeks. In order to realize this potential fully, it will be necessary to address smaller barriers and passage obstructions that occur on Guadalupe and Alamitos creeks.

Los Gatos Creek

The Los Gatos Creek watershed is located on the north-facing slopes of the Santa Cruz Mountains and varies in elevation from 3,483 feet at the peak of Mt. Thayer to about 90 feet at the Creek's confluence with the Guadalupe River. The drainage area of the Los Gatos Creek watershed is approximately 55 square miles. The watershed above Vasona Dam encompasses about 44 square miles.

Lexington Reservoir is located on Los Gatos Creek about 11 miles upstream of its confluence with the Guadalupe River. Lake Elsman is located upstream of Lexington Reservoir.

Just upstream of Lexington Reservoir, the San Andreas fault cuts northwest across the watershed of Los Gatos Creek. The upper reaches of the watershed, on the southwestern side of the San Andreas fault to the Santa Clara County line, are underlain by sedimentary formations. Lexington Reservoir and areas to the east and northwest are underlain by the Franciscan Group and related serpentine beds. In some areas along stream channels beneath the reservoir, there are ribbons of old alluvium, stream deposits that have since been dissected by erosion and now have the appearance of terraces above today's creek (Iwamura 1999).

The water chemistry of the drainage is dominated by calcium, in the form of calcium bicarbonate. The amount of magnesium present is relatively low because only a small portion of the watershed is underlain by the Franciscan Formation and its magnesium-rich serpentine beds (Iwamura 1999).

The vegetation in the upper watershed is composed of broadleaved upland forest (especially mixed evergreen forest) and chaparral. The broadleaved forest intergrades with oak woodlands at lower elevations. In the upper watershed, the creek's course is through steep terrain and the width of the riparian corridor is narrow. Common riparian tree species include white alder, California buckeye, big-leaf maple (*Acer macrophyllum*), coast live oak, and California bay.

In the lower watershed, Los Gatos Creek passes through urban areas (Cities of Los Gatos, Campbell, and San Jose), and much of the riparian corridor has been fragmented by bank stabilization for flood control purposes. Upstream of Lark Avenue, the Los Gatos Creek riparian corridor is relatively lush and diverse; whereas downstream of Lark Avenue, the riparian vegetation is reduced to low-growing willow clumps and isolated western sycamore trees with blackberry vines (EIP 1976), with the exception of the Willow Glen area where the creek is again shaded. Drop structures are barriers to steelhead migration on this historic steelhead stream (Keith Anderson, pers. comm., 1998).

Alamitos Creek, Arroyo Calero, and Santa Teresa Creek

Alamitos Creek and its major tributary—Arroyo Calero (often referred to as Calero Creek)—are located in the Almaden Valley, a northwest-trending valley located within the larger Santa Clara Valley. Alamitos Creek originates in the Santa Cruz Mountains at an elevation of around 3,800 feet. From its source, Alamitos Creek first flows northwesterly to Almaden Reservoir. The Alamitos Creek watershed (including the Calero Creek watershed) is approximately 38 square miles.

From Almaden Reservoir, Alamitos Creek flows in a northeast direction to its confluence with Calero Creek. Along this stretch, the stream gradient is moderately steep. At the Calero Creek confluence, Alamitos Creek turns slightly more westward and continues along a moderately steep gradient to the point of confluence with Guadalupe Creek, where the resultant stream becomes known as the Guadalupe River.

There have been several major floods in the Alamitos and Calero Creek watersheds, some of which have caused significant damage. These floods occurred in 1931, 1937, 1940, 1941, 1943, 1945, 1952, 1955, 1958, 1962, 1967, and 1968. The flood that resulted in the heaviest damages occurred just before Christmas in 1955. This flood, which resulted from heavy rains over a number of days, would have resulted in even greater damages except for the fact that the upstream reservoirs were not full and were therefore able to store a great deal of the runoff. The continuous and heavy rainfall persisted over a period of several days before the flood also loosened and scoured out large trees, which floated downstream along with other accumulated debris. These trees and debris became lodged under bridges and in culverts, obstructing the channel and resulting in severe local flooding (Water District, undated [b]).

Alamitos Creek was widened and levees were constructed from Bertram Road bridge downstream to its confluence with Guadalupe Creek (a distance of approximately 33,000 feet) in the late 1970s.

Randol Creek, Greystone Creek, and Golf Creek enter Alamitos Creek downstream of Calero Creek. The lower reaches of each of these streams were modified by flood protection projects constructed in the mid-1970s.

Of the 12½ square miles comprising the Calero Creek Watershed, 7 are located in the hills above Calero Reservoir. From Calero Reservoir, Calero Creek flows northwest to its confluence with Alamitos Creek.

Santa Teresa Creek begins in the Santa Teresa Hills and flows northwest, parallel to and about 1,000 feet north of Calero Creek. Santa Teresa Creek outfalls into Calero Creek just below Harry Road. A section of Santa Teresa Creek was also widened in the late 1970s.

Guadalupe Creek

Nearly the entire Guadalupe Creek watershed above Guadalupe Reservoir is underlain by the Franciscan Formation and its related serpentine beds. Only a small portion of the southwestern edge of the headwaters of the watershed is underlain by sedimentary formations. It is interesting to note that limited chemical sampling of water in the drainage indicates a predominance of calcium rather than magnesium ions, a surprising result, considering the large percentage of the watershed composed of magnesium-rich serpentine rocks (Iwamura 1999).

The Masson Dam diversion is currently being installed with a fish ladder and screens on the diversion.

7.2.2.10   Coyote Creek Watershed

Coyote Creek originates in the mountains of the Diablo Range northeast of Morgan Hill. Coyote Creek drains an area of approximately 320 square miles. The Coyote Creek watershed is the largest watershed in the Basin. Coyote Creek drains most of the west-facing slope of the Diablo Range. Coyote Creek flows in a northwesterly direction for approximately 42 miles before entering the South Bay. A map of the watershed is shown on Figure 7-21.

There are two major reservoirs in the upper watershed: Anderson and Coyote. The upper reservoir, Coyote Reservoir, was constructed in 1936. Anderson Reservoir was constructed in 1950.

Water released from Coyote Reservoir flows into Anderson Reservoir. There are nine major tributaries to Coyote Creek within the drainage area to these two reservoirs. Canada de los Osos, Hunting Hollow, Dexter Canyon, and Larios Canyon Creeks are within the Coyote Reservoir drainage area. Otis Canyon, Packwood, San Felipe, Las Animas, and Shingle Valley Creeks are tributaries to Anderson Reservoir. Runoff above the Coyote Dam accounts for about 75 percent of the total runoff for the entire Anderson/Coyote watershed (Iwamura 1999).

The northeastern half of the headwaters of Coyote Creek is underlain by the ancient volcanic seafloor of the Franciscan Formation, with its characteristic serpentine beds. The remainder of the watershed is composed of sand, gravel, silt, and clay deposits of varying ages, some of which contain beds of volcanic ash. In the upper reaches of the watershed, the occurrence of serpentine beds has consequences for water quality in the drainage. During low-flow periods, when

Insert Figure 7-21 (Front)

Insert Figure 7-21 (Back)

groundwater accounts for a relatively high percentage of streamflow, there is an elevated amount of magnesium present in the waters of Coyote Creek that has been dissolved from serpentine rocks. During storms, when the amount of surface runoff is high, calcium is more prevalent than magnesium in the creek waters, reflecting the decreased importance of groundwater during high-flow events (Iwamura 1999).

Three notable mineral springs occur within the drainage. These springs are all along or in proximity to the Madrone Springs fault. All of these springs are tributaries to upper Coyote Creek, well upstream of Coyote Reservoir. These springs include Gilroy Hot Springs, Madrone Springs, and Coe Springs (Iwamura 1999).

> "Two minor mining prospects are noted in the watershed. The first manganese prospect known as the Pine Ridge Mine, located atop of Pine Ridge near the entrance of Henry Coe State Park, off Steeley Road. This little worked prospect is located within the Franciscan Group. It is within the Hoover Valley Creek drainage, which drains into Anderson Reservoir via Packwood Creek. The second is a copper prospect known as the Masson Ranch located within the Huntington Hollow tributary of Coyote Creek, just upstream from the confluence of Canada De los Osos. This prospect is also located in the Franciscan Group. Both of these are minor and should have no effect upon the watershed. There are neither ongoing commercial rock quarrying nor gravel quarrying operations at this time within the watershed" (Iwamura 1999).

After leaving the mountains, Coyote Creek flows northwest along the floor of the Santa Clara Valley to the South Bay, a distance of about 30 miles. Major tributaries entering Coyote Creek downstream of Anderson Dam include Fisher Creek, Upper Silver Creek, Lower Silver Creek, and Upper Penitencia Creek. The boundary between the mountains of the Diablo Range and the alluvial plain that forms the valley floor is quite sharply defined. Tributary creeks flowing out of the mountains must cross this alluvial plain to reach Coyote Creek.

Coyote Creek flows through unincorporated, predominately agricultural (but rapidly urbanizing) land between the cities of Morgan Hill and San Jose. Coyote Creek then flows through the urbanized areas of San Jose close to the Bay. Coyote Creek is bordered on the east by the City of Milpitas and on the west by the City of San Jose.

The lower reaches of Coyote Creek have been partially modified for flood protection. Setback levees and high-flow bypass channels have been constructed in the section of lower Coyote Creek between Montague Expressway and Dixon Landing Road. Many acres of young riparian forest habitat have been planted along this section of lower Coyote Creek by the Water District as mitigation plantings for habitat loss resulting from construction of the flood control project. The overall result of the flood control project is that there is a wider, more diverse riparian corridor along this section of Coyote Creek than existed when the adjoining lands were farmed up to the edge of the streambanks.

As Coyote Creek nears the South Bay a transition occurs from a freshwater environment to an estuarine environment where the channel and adjacent Baylands contain many acres of brackish marsh, salt marsh, and mudflats. The Water District had been installing a seasonal dam (Standish Dam) on lower Coyote Creek just upstream of Dixon Landing Road annually until 1998. The dam was intended to prevent saltier water from moving upstream during the summer months, where it could impact potential steelhead habitat. Substantial debate has taken place regarding the value of installing this seasonal dam. A negotiated agreement between Water District and the CDFG resulted in the removal of the dam and an impact study to verify that there is no need to continue installation.

Lower Coyote Creek flows past the City of San Jose's sludge-drying lagoons located immediately to the west of the channel upstream of Dixon Landing Road and around the north side of the Newby Island Land Disposal Site located just downstream of Dixon Landing Road.

Salt evaporation ponds bordered by levees are located on both sides of lower Coyote Creek at its confluence with the South Bay. There are also several important salt and brackish water marshes along the lowermost section of Coyote Creek.

Coyote Creek receives freshwater discharged from the San Jose-Santa Clara Water Pollution Control Plant just upstream from its confluence with the South Bay. Some of this freshwater is "pushed" back upstream by incoming tides with the result that, during low flow periods, tidal water in the lower Coyote Creek is less saline than would otherwise be the case. Over the years, this has resulted in changes in the composition of the wetland vegetation in some former salt marsh areas (i.e., conversion of salt marsh habitat to brackish water marsh habitat).

Flooding occurred along portions of Coyote Creek in 1911, 1917, 1931, 1958, 1969, 1982, 1983, and 1997.

The plant communities in the upper Coyote Creek Watershed in the Diablo Range are typically composed of grassland, scrub, or chaparral habitat on the tops of the hills and oak woodlands in the steep valleys and canyons.

The following types of riparian plant communities have been documented along mid-Coyote Creek extending from East Santa Clara Street downstream to the Montague Expressway: central coast cottonwood/willow riparian forest, riparian scrub and eucalyptus/cottonwood/willow riparian forest. Native riparian plant species recorded along mid-Coyote Creek include: box elder, white alder, Fremont cottonwood, coast live oak, California bay, valley oak, willow species, western sycamore, blue elderberry, and coyote brush. Invasive nonnative plant species include eucalyptus, black locust, tree-of-heaven, acacia, glossy privet (*Ligustrum lucidum*), and fig (Habitat Restoration Group 1995).

In the lower reaches of Coyote Creek a significant corridor of riparian vegetation flanks both sides of the channel. The original vegetation is believed to have been situated on a high, naturally occurring terrace. Alteration of Coyote Creek began taking place prior to 1900, resulting in the high-terrace riparian vegetation being replaced by orchards and farmlands. A middle terrace has managed to survive, with cottonwoods dominating the riparian corridor. Only a relatively small number of oak and sycamore remain along lower Coyote Creek. In spite of alterations to the riparian habitat that have taken place for nearly a century, lower Coyote Creek is considered the highest quality riparian corridor remaining in the South Bay region (ACOE 1986).

Among the Basin watersheds, Coyote Creek has the most diverse native fish fauna, both historically and in the present (see Tables 7-4a and 7-4b). Native fish species found in the Coyote Creek drainage are steelhead/rainbow trout, Chinook salmon, Pacific lamprey, California roach, hitch, Sacramento blackfish, Sacramento sucker, threespine stickleback, prickly sculpin, riffle sculpin, Sacramento pikeminnow, Tule perch, and Sacramento perch. Steelhead are rare in Coyote Creek watershed. While less common than in Guadalupe River, Chinook salmon have been observed in Coyote Creek since the mid-1900s and reproduction has been documented. Some coho salmon occurred in Coyote Creek as late as the 1950s (Smith 1998). Four species of native fish, Pacific Brook lamprey, coho salmon, splittail, and speckled dace, were present historically in the Coyote Creek watershed, but are now locally extinct (Leidy 1984; Smith 1998). Thicktail chub is considered extinct throughout its range (Moyle 1976). Twenty-two nonnative fish species have been collected in the Coyote drainage, including golden shiner, fathead minnow, threadfin shad, goldfish, carp, mosquitofish, sunfish (bluegill, green, pumpkinseed, redear), largemouth bass, smallmouth bass, striped bass, catfish, black crappie, and inland silversides.

Native freshwater clams have been recently found in Coyote Creek, above Anderson Reservoir (Palassou Ridge). They were identified as the rare California floater (*Anodonta californiesis*). (Larry Serpa, pers. comm., 2000)

Numerous migration barriers for steelhead and salmon exist on Coyote Creek and its tributaries. These barriers include permanent dams, seasonal dams, drop structures, and dry stream reaches. Anderson Dam is the impassable terminal barrier on the main stem of Coyote Creek. Downstream of Anderson Dam, Coyote Steel (Percolation) Dam (Metcalf Dam) is laddered. Downstream, fish ladders on three year-round gravel dams for the Ford Road percolation ponds[13] can pose migration barriers during low-flow periods and when ladders are clogged during storm events. Further downstream along the main stem are drop structures that can be migration barriers under certain flow conditions. Also, low-flow vehicle crossings at stream miles 12.8 and 15.5 are partial barriers to steelhead migration (Keith Anderson, pers. comm., 1998).

Streamflows are regulated extensively in Coyote Creek. Downstream of Anderson Reservoir, water is diverted into a 6-mile canal that parallels the stream channel. This water is discharged for groundwater recharge in Metcalf Pond and the Ford Road ponds; consequently, the reach between the canal intake and Metcalf Pond runs dry in all but the wettest years. Downstream of the percolation ponds, the stream channel often runs dry, or only intermittently during most summers. Lower reaches are fed by groundwater and urban runoff, but water quantity and

[13] The Ford Road "gravel dams" are not currently being installed by the Water District (Doug Padley, pers. comm., 1998).

quality are low. As a result of these flow alterations, summer rearing habitat for young steelhead is limited, and spring and early summer streamflows are often inadequate for outmigrating smolts (Smith 1998).

Much of the main stem Coyote Creek provides marginal aquatic habitat for native fish, other aquatic organisms, and aquatic invertebrates. Results of a habitat survey found that nine reaches of mid-Coyote Creek were dominated by poor instream habitat conditions with slow-moving pool habitat, minimal instream cover, and fine substrates (Habitat Restoration Group 1989). Isolated patches exist that provide fair rearing and spawning habitat for salmonids, but overall, instream habitat conditions were poor. Habitat conditions were also marginal for other native fish, but were more conducive to nonnative fishes in the system. Riffle habitat, important to salmonid spawning and rearing, was located in limited areas. Riffle habitats did occur, but had very low abundance and diversity of aquatic invertebrates and often had fine sediments that reduced oxygen levels available in the substrate.

Native fish collected in mid-Coyote Creek – California roach, Sacramento sucker, hitch, and Sacramento blackfish – can tolerate warmer water temperatures and do not depend exclusively on aquatic insects as their primary food source. Nonnative fish collected in main stem Coyote Creek include fathead minnow, red shiner, mosquitofish, bluegill, and goldfish.

Upper Penitencia Creek

Upper Penitencia Creek joins Coyote Creek about 10 miles from the Bay. The total area of the Upper Penitencia Creek watershed is about 24 square miles. The upper watershed, upstream of Dorel Drive, occupies about 21 square miles and includes Upper Penitencia Creek and its principal tributary, Arroyo Aguague. The topography is rugged; the slopes are steep and the canyons are deep and narrow, with little or no flat land along their bottoms. The elevation of the upper watershed ranges from nearly 3,000 feet to 280 feet at Dorel Drive near the base of the mountains. A small reservoir, Cherry Flat Reservoir, is located in the Upper Penitencia Creek watershed.

After leaving the Los Buellis Hills, Upper Penitencia Creek flows westward across the alluvial plain for a distance of about 3½ miles before joining Coyote Creek.[14] The elevation at the junction of Upper Penitencia and Coyote Creeks is 80 feet.

Much of the riparian habitat along the Upper Penitencia Creek has been preserved (interrupted in only a few places), and represents one of the few remaining contiguous riparian corridors that connects the Diablo Range to Coyote Creek. Native riparian species observed upstream of the confluence with Coyote Creek and downstream of Dorel Drive include: western sycamore, box elder, Fremont cottonwood, blue elderberry, coast live oak, and willow species.

[14] Upper Penitencia Creek was diverted along Berryessa Road into Coyote Creek by farmers in 1875, separating Upper Penitencia Creek from Lower Penitencia Creek (Water District 1982).

Currently, the best habitat for steelhead is in the Upper Penitencia Creek (Jerry Smith, pers. comm., 1998). Flowing out of Alum Rock Park, the upper stream reaches are less disturbed and provide cool stream temperatures, riffle habitats, and riparian vegetation necessary for successful steelhead spawning and rearing. Resident rainbow trout occur in these reaches. Passage has been improved recently at the Noble Avenue diversion, a frequent passage barrier in past years.

Lower Silver Creek

Lower Silver Creek originates in the low foothills southeast of San Jose in the general vicinity of Metcalf Road. Starting at about 1,200 feet in elevation, Lower Silver Creek drains a watershed of 43.5 square miles. The creek flows in a north-northwesterly direction until it meets Coyote Creek near the Bayshore Freeway.

7.2.2.11 Lower Penitencia Creek Watershed

The Lower Penitencia Creek watershed lies in the unincorporated area of Santa Clara County and in the cities of Milpitas and San Jose. The total watershed area is about 30 square miles, with about 16 square miles lying on the valley floor and the remainder in the hills of the Diablo Range (Water District 1982). The only two major creeks in the watershed are Lower Penitencia Creek and Berryessa Creek. A map of the watershed is shown on Figure 7-22.

Lower Penitencia Creek

Lower Penitencia Creek is located in the northeasterly sector of Santa Clara County and is bounded by Berryessa Creek to its east and Coyote Creek to its west. It flows northerly from Montague Expressway to its confluence with Coyote Creek near the intersection of Interstate 880 and Dixon Landing Road (Water District 1982).

Major tributaries to Lower Penitencia Creek are Berryessa Creek and the East Penitencia Channel. Berryessa Creek is the major drainage channel for the mountainous portion of the Lower Penitencia Creek Watershed (Water District 1982).

As farming became more intensive in the valley, Penitencia Creek became an important source of irrigation water. One farmer plowed a channel to divert the water to his fields south of the creek. This split Penitencia Creek into two streams: Upper Penitencia, which now flows from the hills above Alum Rock Park to Coyote Creek near the San Jose flea market, and Lower Penitencia Creek which flows from the neighborhoods north of Berryessa Creek through Milpitas to Coyote Creek near Dixon Landing Road (Water District, undated [b]).

In 1955, the Water District designed and constructed the portion of Lower Penitencia Creek from the confluence with Coyote Creek to Spence Avenue (Water District 1982). The earth channel between Spence Avenue and Sylvia Avenue was constructed by the Water District in 1962. In 1965, the Water District constructed the channel from Sylvia Avenue to Old Oakland Highway (Water District 1982).

> "Prior to 1965, Lower Penitencia Creek extended about 3,000 feet south of Montague Expressway. In March of 1965, the [Water District] Board of Directors approved a new flood control facility known as East Penitencia Channel. It was to be constructed in lieu of that portion of Lower Penitencia Creek south of Montague Expressway. The East Penitencia Channel and the portion of Lower Penitencia Creek from Capitol Avenue to Montague Expressway were built by the County as part of the Montague Expressway project in 1973" (Water District 1982).

In 1982, the Water District conducted a study of Lower Penitencia Creek between Coyote Creek and Montague Expressway in order to resolve flooding, erosion, sedimentation and channel maintenance problems (Water District 1982). The proposed project consisted of various channel modifications to the creek to increase its capacity. In the reaches downstream of the confluence with Berryessa Creek, the District proposed that the existing channel be widened and levees be constructed to provide adequate capacity and freeboard. The District also proposed that portions of the channel be concrete-lined. Upstream of Berryessa Creek, flood control measures were proposed to extend to the entrance of Elmwood Rehabilitation Center. These measures consisted of a combination of earth levees, floodwalls, culvert enlargement, and concrete lining (Water District 1982). It is assumed that this project was constructed as designed.

Berryessa Creek

The Berryessa Creek drainage basin covers about 22 square miles in the northeastern portion of the Basin. Berryessa Creek flows westerly from its headwaters in the Diablo Range, at approximately 2,000 feet above msl. Below the foothills, it continues in a westerly direction through the cities of San Jose and Milpitas, and turns north before flowing into Lower Penitencia Creek (ACOE 1986).

Berryessa Creek is an intermittent stream with water flow occurring primarily during the wet winter and spring months. The stream is usually dry during the summer months (ACOE 1986).

The upper portion of the watershed is located in the foothills of the Diablo Range and generally consists of grassland habitat with patches of upland broadleaved forest dominated by oak, madrone, and California bay trees (Water District, undated [a]), which tend to be distributed in ravines and drainages. Patches of chaparral habitat occur to the west of Calaveras Reservoir. Most of the upper reaches of Berryessa Creek occur within oak woodland habitat, whereas the lower reaches are surrounded by grasslands, agricultural lands, or urban habitat. Native riparian trees that occur along Berryessa and Calaveras Creeks include California bay, big leaf maple, and coast live oak. Invasive nonnative plant species known to occur in the riparian corridors of Calaveras and Calera Creeks in Ed Levin County Park include poison hemlock, fennel, milk thistle, star thistle, and black mustard (Brady and Associates 1995).

Insert Figure 7-22 (Front)

Insert Figure 7-22 (Back)

7.2.2.12 Arroyo la Laguna Watershed

The Arroyo la Laguna watershed is a composite of several small watersheds in southern Alameda County. These "subwatersheds" drain the west-facing slopes of the Diablo Range in the area south of the Alameda Creek watershed and north of the Alameda County/Santa Clara County line. The lower portions of these watercourses have been modified for flood control and drainage purposes. They are located in the Alameda County Public Works Agency Zone 6. Some of these watercourses have names and some do not. Many no longer follow their original alignments. Once these streams flow onto the Bay plain they are most often referred to by the line numbers used for reference by the Agency. A map of this watershed is shown on Figure 7-23.

All of the watercourses in the Arroyo la Laguna watershed discharge into the lower South Bay north of Dixon Landing Road and south of the Dumbarton Bridge. The major creeks and sloughs in the Baylands portion of the watershed that receive these waters include lower Coyote Creek (downstream of Dixon Landing Road), Mud Slough, Mowry Slough, Plummer Creek, and Newark Slough.

The southernmost of the watercourses in the Arroyo la Laguna watershed is Scott Creek (also referred to as Line A). The Scott Creek subwatershed lies due north of the Calera Creek (tributary to Lower Penitencia Creek) subwatershed. North of the Scott Creek subwatershed are Lines B and B-1. Line B is a small creek to the north of Scott Creek and south of Toroges Creek. The Toroges Creek subwatershed (also referred to as Line C) lies directly to the south of the Agua Fria watershed. Agua Fria Creek (Line D) is due south of Agua Caliente Creek, which lies within the Laguna Creek Basin. Lines D, C, and B empty into an approximately 2-mile-long outfall channel that flows in a southerly direction paralleling the west side of Interstate 880. North of the old Fremont Airport, this channel turns to the west to empty into Lower Coyote Creek. Scott Creek (Line A) flows into this outfall channel before it empties into Lower Coyote Creek (Gary Shawley, pers. comm., 1998).

Laguna Creek Basin is the term used to describe an area within the City of Fremont that is drained by Laguna Creek and the network of channels within the "Basin." The Laguna Creek Basin discharges to Mud Slough, which then discharges into Lower Coyote Creek. The creeks and/or "lines" within the Laguna Creek Basin are described below. The Laguna Creek Basin is described in detail in the Laguna Creek Basin Reconnaissance Study and Water Quality Enhancement Plan prepared for the City of Fremont by Jones & Stokes Associates, Inc. (Jones & Stokes 1999).

Portions of the City of Newark that lie south of Dumbarton Road and Thornton Avenue also drain to the Baylands. Drainage from this area west of the Laguna Creek Basin enters the lower South Bay via Mowry Slough, Plummer Creek, and Newark Slough.

Laguna Creek Basin

The Laguna Creek Basin covers approximately one-third of Fremont's land area. Mission, Morrison, Cañada del Aliso, and Agua Caliente Creeks, as well as City stormdrains throughout the Irvington District, all drain into Laguna Creek. Not all the creeks in the Laguna Creek watershed are officially named. Most of Laguna Creek and its tributaries are maintained flood control channels managed by the Alameda County Flood Control and Water Conservation District (Jones & Stokes 1999). Each watercourse has been assigned a letter designation by the District.

> "According to the District, the Laguna Creek channel begins west of Paseo Padre Parkway. Historically, this seasonal creek drained overbank flows from Stivers Lagoon, a geographic low spot where Central Park and Lake Elizabeth are currently. A historic remnant of Laguna Creek begins west of Paseo Padre Parkway and meanders through the older Irvington District neighborhoods, crosses the commercial district near Five Corners, and more or less follows Fremont Boulevard until it reaches Auto Mall Parkway. This historic Laguna Creek currently collects all drainages in the watershed south of Mission Creek and does not carry flow from Central Park except during very large storms" (Jones & Stokes 1999).
>
> "Mission and Morrison Creeks drain the steep hills that form the eastern limit of development in the City. From the confluence with Morrison Creek, Mission Creek flows southward adjacent to Lake Elizabeth. At Paseo Padre Parkway, Mission Creek is split into Lines E and G. Line E follows the historic Laguna Creek channel. Most of the flow from Mission and Morrison Creeks draining through Central Park is carried by a flood control channel designated as Flood Zone 6 Line G. Line G begins at Paseo Padre Parkway and generally follows Grimmer Boulevard. It meanders for a short distance through the Rix Park neighborhood south of Blacow Road" (Jones & Stokes 1999).
>
> "Lines E and G flow generally southward through the City until they are combined near Interstate 880. Line E picks up significant runoff from other creeks that drain the Hills Planning Area of the City. Line G picks up only local runoff. The two channels, Laguna Creek and Line G, meet again near Interstate 880 and flow into the San Francisco Bay via Mud Slough" (Jones & Stokes 1999).
>
> "Significant erosion and sedimentation problems have been identified at several locations within the Laguna Creek watershed: Morrison Canyon; Mission Creek downstream of Palm Avenue; new developments north of Mission Boulevard; Lake Elizabeth; and Laguna Creek adjacent to Fremont Boulevard. Near the origins of Cañada Del Aliso in the Diablo Range, a substantial landslide has

Insert Figure 7-23 (Front)

Insert Figure 7-23 (Back)

occurred that threatens homes in the area and contributes significant quantities of sediment to the creek and its receiving waters, Laguna Creek" (Jones & Stokes 1999).

7.2.3 Lakes and Reservoirs

There are numerous lakes, reservoirs, and ponds in the Basin. Most of the lakes are really reservoirs in that they were created by dams constructed for water conservation purposes. Stevens Creek, Almaden, Calero, Guadalupe, Vasona, and Coyote reservoirs were constructed in the mid-1930s to store water for the recharge of the groundwater basin during the summer months.

There are two small reservoirs in the San Francisquito watershed, one major reservoir in the Stevens Creek watershed, seven reservoirs in the Guadalupe River watershed, and three reservoirs in the Coyote Creek watershed. There are no reservoirs of any consequence in the Matadero/Barron Creeks, Adobe Creek, Permanente Creek, Sunnyvale East/West, Calabazas Creek, San Tomas Aquino/Saratoga Creek, Lower Penitencia, or Arroyo la Laguna watersheds. Data on the lakes and reservoirs in the Basin are presented in Table 7-7.

The lakes and reservoirs in the Basin have other important attributes aside from their water conservation function. They are used extensively for recreation, provide some flood protection, and have significant wildlife habitat value. All of the reservoirs owned by the Water District are leased to the Santa Clara County Department of Parks and Recreation. Depending on the reservoir, permitted activities include powerboating, sailing, fishing, swimming, and picnicking.

Permanent reservoirs not only block upstream migration of fish but also replace lotic (flowing water) habitat with lentic (lake) habitat for fish and aquatic organisms. These altered environments support the presence of nonnative fish that are adapted to these lentic environments with calm water, moderate to low oxygen levels, and warmer temperatures. For example, inland silversides and threadfin shad are found almost exclusively in reservoirs. Other nonnative fish such as carp, catfish, and centrarchids (sunfish family) that thrive in reservoirs populate adjacent stream channels.

Reservoirs provide habitat for some native fish adapted to lentic conditions such as hitch and Sacramento blackfish. Reservoirs are also suitable for native fish species adapted to a range of environmental conditions such as California roach and Sacramento sucker. Since the large, permanent reservoirs in the Basin do not provide passage for steelhead, they would not be expected to occur in these reservoirs. Reservoirs can provide suitable rearing habitat for rainbow trout if appropriate temperatures, dissolved oxygen, habitat cover, substrate, and adequate food resources are available.

The CDFG maintains a "put-and-take" trout fishery in several urban lakes in addition to Coyote Reservoir, Lexington Reservoir, Stevens Creek Reservoir, and in Coyote Creek downstream of Anderson Dam (Margaret Roper, pers. comm., 1998).

The largest single source of nickel to the Bay appears to be the natural erosion of nickel-containing soils. (Natural erosion refers to erosion caused by factors unrealted to human activity.) Nickel is derived from recently disturbed serpentine geologic formations. Pyrrhotite is an iron sulfide mineral that contains small amounts of nickel and is reported to occur in the County (Woodward Clyde Consultants and EOA 1997).

Basin reservoirs have been identified as a major source of nickel to the Bay. Erosion causes metal-laden sediment to be transported into nearby streams then to Basin reservoirs and eventually to the Bay. Thus, natural erosion, and not reservoirs themselves, should be considered a source of the nickel to the Bay (Woodward Clyde Consultants and EOA 1997).

7.2.3.1 Almaden Reservoir

Almaden Reservoir is located on Alamitos Road south of the City of San Jose in west central Santa Clara County. The southeastern end of Almaden Quicksilver County Park is opposite Almaden Reservoir on the north side of Alamitos Road. Almaden Reservoir was completed in 1935. It has an average surface area of 59 acres and a capacity of 1,586 acre-feet. The reservoir extends roughly west-to-east in Almaden Canyon at the foot of the east-facing slopes of Sierra Azul, a principal northwest/southeast-trending ridge of the Santa Cruz Mountains (Water District 1995).

The Almaden Reservoir is located in a 12-square-mile drainage area of hilly terrain covered with range grass, low bushes, and trees. Almaden Reservoir collects runoff from the surrounding watershed that includes Herbert and Barrett Creeks flowing into the southwest end of the reservoir near the small community of Twin Creeks. Barrett Canyon Creek and Herbert Creek flow all year. Jacques Gulch Creek flows most of the year and Larabee Gulch Creek contributes during high peak flows, then drops off quickly (Iwamura 1999). The reservoir releases water to Alamitos Creek for groundwater recharge. During the rainy season, storms or long wet periods, often produce more runoff than the reservoir can contain. Excess runoff is directed to Calero Reservoir via the Almaden-Calero Canal. The Water District operates this reservoir for water conservation purposes only; however, there some incidental flood control benefits (Water District 1995).

Reservoir waters range from a calcium bicarbonate type to the more frequent calcium-magnesium bicarbonate type. This is consistent with the geology of the watershed (Iwamura 1999).

Beneficial uses established by the Regional Board include groundwater recharge, municipal and domestic water supply, wildlife habitat, warm and cold freshwater habitat, fish spawning, water contact recreation (fishing from shore), and noncontact water recreation. Bacteriological contamination from nearby residential septic systems has been a water quality concern for the reservoir. Petroleum product use associated with boating has historically been considered a potential water quality concern (Water District 1995).

Table 7-7
Page 1

Table 7-7
Page 2

The now inactive New Almaden Mine atop Mine Hill is located northwest of Almaden Reservoir and a portion of the mine area is located within the reservoir watershed (Iwamura 1999). Studies have found that fish caught at Almaden Reservoir have had levels of methyl mercury that exceed U.S. Food and Drug Administration thresholds (Water District 1995). It is suspected that the problem of accumulated mercury in the flesh of fishes has a significant part of its origin from mine wastes washed into streams and into the reservoir from the mercury mining activities at the New Almaden Mine, largely via Jacques Gulch (Iwamura 1999).

7.2.3.2 Anderson Reservoir

Anderson Reservoir is located within Anderson Lake County Park in the southern portion of Santa Clara County approximately 2 miles northeast of the City of Morgan Hill. Anderson Reservoir was completed in 1950. It has an average surface area of 1,245 acres and a capacity of 89,073 acre-feet (Water District 1995).

Anderson Reservoir impounds water from several creeks: Coyote Creek flows into the reservoir at the southern end; Otis Creek joins Coyote Creek near the southern end of the lake; Packwood Creek drains into the reservoir roughly midway; and San Felipe, Las Animas, and Shingle Valley Creeks flow into the northern end. The reservoir is approximately 7 miles long, and ½ mile at maximum width. The northwest/southeast-trending valley flooded by Anderson Reservoir was the juncture at which the northern creeks joined Coyote Creek before a descent from the western foothills of the Diablo (Mt. Hamilton) Range foothills to the Santa Clara Valley. The drainage area upstream from Anderson Reservoir is approximately 193 square miles (Water District 1995).

The principal purpose of Anderson Reservoir is to impound the flows of several creeks and the stormwater runoff from the surrounding watershed for controlled release during the drier months of the year to aid in aquifer recharge. Coyote Reservoir and Anderson Reservoir are a reservoir series impounding the same principal water source, Coyote Creek. Coyote Reservoir releases water downstream via Coyote Creek to Anderson Reservoir. Anderson Reservoir then releases water to the Santa Clara Valley portion of Coyote Creek, where it recharges the Santa Clara Groundwater Subbasin through a series of percolation ponds that have been constructed along the north-flowing path of Coyote Creek (Water District 1995).

The general mineral quality of the waters from the Coyote Creek watershed above Anderson Dam is dominated by calcium, magnesium, and bicarbonate. Contribution of calcium and bicarbonate comes from all the geologic formations, while a large contribution of magnesium comes from the Franciscan Group, particularly from the serpentine member (Iwamura 1999).

> "Housing developments are located along the southwest side of Anderson Reservoir. Most are sewered to a publicly owned treatment plant but some are not. In the past and to the present, certain accidental incidents of sewage spills into the reservoirs had been noted. Septic tank systems are also associated with the limited recreational developments on the west side of Coyote Reservoir." (Iwamura 1999).

An industrial development occurs in two small tributaries to the northern arm of Anderson Reservoir. The development is the Coyote Unit, Chemical Systems Division of United Technologies Corporation and is located in Shingle Valley and in the adjacent valley referred to as Mixer Valley. The operations consist of the manufacturing and testing of solid fuel rocket propellant. Volatile organic solvents have locally contaminated soils and groundwater. With remedial action activities implemented by United Technologies Corporation, the contamination is confined to the property itself (Iwamura 1999).

Recreational motorized boating occurs at Anderson Reservoir. Methyl tert-butyl ether (MTBE) and oil film are present in the reservoir waters at trace levels. The Water District is monitoring MTBE levels within the reservoir, and as a means of controlling its level, the District and County Parks and Recreation Department started to regulate motorized boating activities on the reservoir (Iwamura 1999).

7.2.3.3 Calero Reservoir

Calero Reservoir is located in the central area of southern Santa Clara County just south of the Santa Teresa Hills section of San Jose and east of the community of New Almaden and Almaden Reservoir. Calero Reservoir was completed in 1935. It has a surface area of 347 acres and a capacity of 10,050 acre-feet (Water District 1995).

Calero Reservoir dam impounds Calero Creek on the west end, flooding a section of the broad Calero Creek Valley of the eastern foothills of the Santa Cruz Mountains. A smaller saddle dam was constructed along McKean Road north of the main dam. The U-shaped Calero Reservoir is approximately 5½ miles long and 2 miles wide at the western end, its widest point. Calero Reservoir collects runoff from a 7-square-mile drainage area and also receives surplus surface water from Almaden Reservoir via the Almaden-Calero Canal. Excess runoff from Almaden is transferred to Calero Reservoir, which has a storage capacity five times greater than that of Almaden. The area surrounding the reservoir is predominantly grasslands and oak savannah (Water District 1995).

The inflows into Calero Reservoir include Arroyo Calero and Cherry Creek, which flow most of the year at low volume. Cow Creek also contributes part of the year (Iwamura 1999).

The primary purpose for Calero Reservoir is controlled release of surface runoff for downstream groundwater recharge. Recharge waters are released either directly to Calero Creek or to the Almaden Valley Pipeline that delivers raw water to the Vasona Pumping Station, approximately 1 mile north of Vasona Reservoir. Water District operates Vasona Reservoir for water conservation purposes; however, there may be some incidental flood control benefits.

Reservoir water represents a mix of indigenous waters from within the watershed and additional waters diverted into the reservoir from Almaden Reservoir via the Almaden-Calero Canal. It should be noted that the Almaden-Calero Canal water transfer is a source of mercury transfer to Calero Reservoir (Keith Anderson, pers. comm., 1998). At times, imported waters from the San Felipe Project could be discharged into the reservoir; therefore, the reservoir water quality could vary with the scheme of reservoir operation. The mix of waters in the reservoir should produce a calcium bicarbonate to a calcium-magnesuim type water, a lot like the mineral quality of Almaden Reservoir water (Iwamura 1999).

Beneficial uses established by the Regional Board include groundwater recharge, municipal and domestic water supply, wildlife habitat, warm freshwater habitat, fish spawning, water contact recreation, and noncontact water recreation. Water quality in the reservoir is influenced by many sources, including cattle grazing, stables, and water originating in the Almaden watershed. Historical water quality issues of concern have been elevated levels of bacteriological contamination (coliforms), iron and manganese, mercury, and algae. Petroleum product use associated with boating has historically been considered a potential water quality concern. No mercury mining historically took place in the Calero Reservoir watershed, but naturally occurring mercury deposits are present in the watershed. Sampling of the tissue of fish caught in Calero Reservoir has determined that mercury levels exceed those set by the U.S. Food and Drug Administration (Water District 1995).

The Arroyo Calero watershed above Calero Reservoir is devoid of mercury mining or any other type of mining activity (Iwamura 1999).

7.2.3.4 Cherry Flat Reservoir

Cherry Flat Reservoir is located in the Upper Penitencia Creek watershed upstream from Alum Rock Park. Cherry Flat Reservoir was constructed in 1932 as a means of solving the constant problem of reoccurring floods and drought in Alum Rock Park. Cherry Flat Reservoir has a storage capacity of 100 acre-feet. The San Jose Conventions, Arts, and Entertainment Department owns and operates the reservoir.

7.2.3.5 Coyote Reservoir

Coyote Reservoir is within Coyote Lake County Park situated in the southern portion of Santa Clara County approximately 4½ miles east of the City of Gilroy. Coyote Reservoir was completed in 1936. It has an average surface area of 648 acres and a capacity of 22,925 acre-feet. The reservoir is approximately 3.2 miles in length and 1,800 feet at its widest point (Water District 1995).

Coyote Reservoir has a 121-square-mile drainage area. The Reservoir collects runoff from the ridges to the east and west of the Coyote Creek drainage basin in addition to the flow of Coyote Creek. Coyote Reservoir releases water into Coyote Creek that flows north approximately 2 miles to Anderson Reservoir (Water District 1995).

Coyote Reservoir is located in a northwest-trending narrow valley in the Mt. Hamilton foothills west of Timber Ridge. The prominent geologic feature of the western front range foothills is the northwest-trending seismically active Calaveras fault that underlies the creek channel of Coyote Creek north of the reservoir, as well as underlying nearly the entire length of the reservoir (Water District 1995).

The Regional Board has established the following beneficial uses: municipal and domestic water supply, agricultural supply, wildlife habitat, warm and cold freshwater habitat, fish spawning, water contact recreation, and noncontact water recreation. Parameters of concern include bacteriological and pathogenic contaminants that could originate from cattle grazing and park facility leach fields.

7.2.3.6 Guadalupe Reservoir

Guadalupe Reservoir is located on the southern boundary of Almaden Quicksilver County Park on Hicks Road in unincorporated central Santa Clara County south of the City of San Jose. The Guadalupe Reservoir dam is located on Guadalupe Creek approximately 2 miles south of the Almaden Valley area of San Jose. Guadalupe Reservoir was completed in 1935. It has an average surface area of 79 acres and a capacity of 3228 acre-feet (Water District 1995).

Guadalupe Reservoir impounds the channel of Guadalupe Creek in a narrow, northwest-trending valley. The valley is in the northern foothills of the Sierra Azul, a massive ridge complex in the northern Santa Cruz Mountains. At the south end of the Reservoir, Los Capitancillos Creek from the west and Rincon Creek from the east join Guadalupe Creek. The ridge north of the Reservoir, rising to 849 feet, is part of Almaden Quicksilver County Park and was the site of the Enriquita Mine and Providencia Mine, former cinnabar (mercuric sulfide) mines. Numerous unnamed intermittent streams drain from this ridge into the reservoir. The drainage area upstream from Guadalupe Reservoir is approximately 6 square miles (Water District 1995).

> "The primary inflows into the reservoir are Guadalupe Creek which runs all year at a low volume, Rincon Creek which confluences with Guadalupe Creek and can run all year, and Los Capitancillos Creek. Los Capitancillos Creek contributes water mainly during flooding events and is considered 'flashy.' Rincon Creek, although it can flow all year, is also considered to be 'flashy'" (Iwamura 1999).

The principal purpose of Guadalupe Reservoir is to provide staged releases of impounded water to the Alamitos Percolation Pond system downstream on Guadalupe Creek. Water District operates this reservoir for water conservation purposes; however, there may be some incidental flood control benefits (Water District 1995).

Beneficial uses established for Guadalupe Reservoir include groundwater recharge, municipal and domestic water supply, wildlife habitat, warm and cold freshwater habitat, fish spawning, water contact recreation (fishing from shore/boat), and noncontact water recreation (Water District 1995).

The limited number of complete mineral analyses available indicates the waters to be a consistent calcium-magnesium bicarbonate type. It is surprising that the magnesium equivalent percentage is not higher, since the watershed drainage is almost entirely underlain by the Franciscan Group and its related serpentine member (Iwamura 1999).

Adjacent to the north and east side of the reservoir are old mine workings of the San Antonio Mine and the Enriqueta Mine. Just upstream of the reservoir occurs the old workings of the Providencia Mine, and further upstream on the Los Capitancillos tributary are the American Mine and the New Almaden Mine atop Mine Hill. Downstream of the reservoir is the San Mateo Mine on the north side of Guadalupe Creek at the toe of the dam, and the Senator Mine a little further downstream. None of these old mercury mines is active (Iwamura 1999).

7.2.3.7 Lake Elizabeth and Stivers Lagoon

> "Stivers Lagoon is one of a number of freshwater marshes along the east side of the Hayward fault. The marsh was formed as a sag pond (i.e., an accumulation of groundwater that fills a depression formed by the fault). This movement created a shallow depression of approximately 200 acres. The marsh is primarily fed by Mission Creek" (Jones & Stokes 1999).
>
> Stivers Lagoon "historically included both areas of deep open water and freshwater marsh. Hydrologically, the lagoon functioned similarly to a lake, with the creeks discharging into a broad open area with a well-defined outlet channel downstream known as Laguna Creek. As a result, the water depth and inundated areas would have varied both seasonally and annually. Levees were constructed around the marsh in the mid-1900s to limit the extent of flooding and to reduce soil saturation. In the mid-1930s, a channel was excavated through the marsh for flood control and indirectly dried the marsh soils, particularly in the summer months. Continued excavation and dredging of this channel up to the present time has allowed the encroachment of upland plant species into the former lagoon. Stivers Lagoon now comprises approximately 40 acres and is fed by both Mission and Morrison Creeks." (Jones & Stokes 1999).

Lake Elizabeth was created in 1968 by excavating a portion of Stivers Lagoon. The lake was expanded to its current 82-acre area in 1986. Lake Elizabeth is owned and operated by the Alameda County Flood Control and Water District (ACFCWD) as an integral part of the Mission Creek flood control system. A realigned channel was created for Mission Creek.

> "High flows in Mission Creek backup at the Paseo Padre culverts and flow over a weir into Lake Elizabeth. When flows recede, Lake Elizabeth drains back into Mission Creek via the same weir. During the summer months, the City installs flash boards in the weir to regulate the lake level for recreation. Under its lease agreement with the [ACFCWD], the City must maintain 931 acre-feet of storage within the lake at an elevation of 55.6 feet above mean sea level".
>
> "Lake Elizabeth, Stivers Lagoon, and Mission Creek adjacent to the lake are sediment sinks. Materials transported from Morrison Canyon and Mission Creek settle out in these areas because of the abrupt change in slope, which reduces creek velocity and the creek's ability to carry sediment" (Jones & Stokes 1999).

> "In 1968, a sediment basin with a 25,000 cubic yard capacity was also created to trap sediments before they entered Lake Elizabeth in large flood events. Analysis of aerial photos showed that by 1983 the sediment basin was filled and wetland vegetation had become established" (Jones & Stokes 1999).
>
> "The [ACFCWD] has dredged the Mission Creek channel to remove excessive sediment and restore channel capacity. This action has caused adjacent marsh lands of Stivers Lagoon to become disconnected from the creek during low summer flows".
>
> "Lake Elizabeth has slowly filled with sediment to the extent that water levels are critically low in summer months and do not adequately support water sports such as sailing".

7.2.3.8 Lake Elsman

Lake Elsman is located upstream of Lexington Reservoir in the Los Gatos Creek watershed. Lake Elsman has a storage capacity of 6,200 acre-feet. Water released from Lake Elsman flows to Lexington Reservoir.

7.2.3.9 Lake Williams

Lake Williams is a small impoundment on Los Gatos Creek immediately upstream of Lexington Reservoir.

7.2.3.10 Lexington Reservoir

Lexington Reservoir is located adjacent to State Highway 17 in unincorporated western Santa Clara County approximately 1 mile south of the Town of Los Gatos. Lexington Reservoir was completed in 1952. It has an average surface area of 475 acres and a capacity of 19,044 acre-feet (Water District 1995).

The James J. Lenihan Dam impounds Los Gatos Creek and numerous other drainages within the surrounding watershed. Los Gatos Creek enters the south end of the reservoir, while Lime Kiln Creek and Soda Springs Creek drain into the reservoir from the east, Aldercroft Creek, Black Creek and Briggs Creek from the west, and Moody Gulch and Hendrys Creek from the south. Hendrys Creek, Los Gatos Creek (with Lake Elsman), and Aldercroft Creek contribute water most of the year. Briggs Creek, Black Creek, and Beardsley Creek contribute water only part of the year during the wet season (Iwamura 1999). The drainage area upstream of Lexington Reservoir is 369 square miles. The principal geologic feature of the Lexington Reservoir vicinity is the San Andreas Fault zone that trends northwest/southeast through the extreme southern end of the reservoir (Water District 1995).

Lexington Reservoir discharges to the north to the Los Gatos Creek channel at the base of Sierra Azul. Lexington Reservoir is roughly 2½ miles long and 3,000 feet wide at the northern end near the dam. The reservoir also includes several deep sloughs where reservoir waters have backed into the creek channels of Soda Springs Canyon Creek, Aldercroft Creek, and Briggs Creek (Water District 1995).

The primary purpose of the Lexington Reservoir is to store water for scheduled releases to replenish groundwater at recharge facilities further downstream on Los Gatos Creek (Water District 1995).

The mineral quality of the reservoir waters ranges from calcium bicarbonate to calcium-magnesium bicarbonate type. This is consistent with the geologic character of the watershed (Iwamura 1999).

Several insignificant mercury prospects occur within the Los Gatos Creek watershed. Perhaps the only significant metals prospect is the Hooker Creek copper prospect located at Aldercroft Heights. The limited mining activity continued intermittently from 1917 to 1929. A small production of gold and silver was reported from 1936 to 1938, and since then the prospects have been inactive. They pose no adverse effect upon the overall water quality of the reservoir waters (Iwamura 1999).

> "Quarrying activities have been in the form of limestone at two sites up the Lime Kiln Canyon tributary of Lexington Reservoir. These are the Douglas Ranch and the Lyndon quarries. Small stone quarrying operations occurred at various locations within the watershed but perhaps most notably at the Alma Fire Station area. These quarries are inactive and generally pose little effect on the overall quality of reservoir areas" (Iwamura 1999).

A once active, very small oil field is located 2½ miles upstream (south) of Lenihan (Lexington) Dam in the Moody Gulch area. The oil field was discovered in 1879 and had its greatest production before 1912. It had produced intermittently to the 1950s, but by then it was producing only a couple of barrels per day. Today, most of the wells are buried beneath State Highway 17 fill at Moody Gulch (Iwamura 1999).

Of the reservoir watersheds in the county, Los Gatos Creek above Lexington is the most highly developed. Aldercroft Heights, Chemeketa Park, Holy City, Redwood Estates, and a development above Lexington Reservoir on the Monte Vina arm are clusters of development within the watershed above Lexington Reservoir. In addition, there are individual houses and estates outside the relatively densely populated areas, and also schools and recreational camps. These developments have the potential to cause nutrient loading due to septic tanks. Short-term sediment yield from construction and longer-term yields from roads could also pose reservoir water quality problems. According to the analyses of reservoir waters, nutrient load does not appear to be a problem thus far for the reservoir (Iwamura 1999).

7.2.3.11 Searsville Lake

Searsville Lake is located in the San Francisquito Creek watershed. San Francisquito Creek begins at the outlet of Searsville Dam. The reservoir is approximately 12.5 miles upstream from the Bay. Searsville Lake has a surface area of approximately 35 acres. Tributaries in the upper watershed that feed into Searsville Lake include Alambique Creek, Martin Creek, Sausal Creek, and Corte Madera Creek.

In 1879, the United States District Court condemned the mill town of Searsville for a new reservoir that would extend San Francisco's domestic water collection system. Most houses were moved away, and by the time the first classes were taught at Stanford University in 1891, Searsville Lake was filling with water for the first time (Wels et al., undated).

First dammed in 1892, the lake once covered 90 acres in a "Y" shape, with arms reaching through swamp and marshlands. Today, the swamp is drying out, and the lake itself covers less than 23 acres. More than 45 feet of silt have gathered on the bottom, reducing the lake's depth to only 22 feet at the center (Wels et al., undated).

7.2.3.12 Stevens Creek Reservoir

Stevens Creek Reservoir is located in Stevens Creek Park on Stevens Canyon Road just south of the city limits of Cupertino in western Santa Clara County. Stevens Creek Reservoir was completed in 1935. It has an average surface area of 197 acres and a capacity of 3,465 acre-feet (Water District 1995). The dam is located downstream of the confluence of Stevens Creek and Swiss Creek (Iwamura 1999).

Stevens Creek has cut a narrow canyon along the base of Montebello Ridge on the north and Table Mountain to the south. Montebello Ridge, a northwest-trending ridge, is adjacent to and east of the San Andreas Fault zone that crosses within 500 feet of the southern end of Stevens Creek County Park. The reservoir impounds the creek at the point where the canyon begins to widen as it descends from the northeastern foothills of the Santa Cruz Mountains. Stevens Creek Reservoir is located in a 17-square-mile drainage basin (Water District 1995).

> "There are three primary inflows into the reservoir: Stevens Creek, Swiss Creek, and Firehouse Creek. Stevens Creek and Swiss Creek typically run all year. Firehouse Creek does not run all year and contributes mostly in the rainy season. Stevens Creek is supplemented by four main tributaries: Indian Creek, Bay Creek, Indian Cabin Creek, and Gold Mine Creek. There are numerous springs located on the southwest side of Montebello Ridge which feed the tributaries." (Iwamura 1999).

Mineral analyses indicate the waters to be calcium bicarbonate and magnesium-calcium bicarbonate types. These mineral types are consistent with the geology of the watershed; the calcium bicarbonate types are suspected to predominate at times of high runoffs; magnesium-calcium bicarbonate are suspected to predominate at times of lower flows (Iwamura 1999).

The primary purpose of Stevens Creek Reservoir is to impound the water of Stevens Creek for percolation to recharge the Santa Clara Groundwater Subbasin. The Water District operates this reservoir for water conservation purposes; however, there may be some incidental flood control benefits (Water District 1995).

Beneficial uses established by the Regional Board include groundwater recharge, municipal and domestic water supply, wildlife habitat, warm and cold freshwater habitat, fish spawning and migration, and noncontact water recreation (Water District 1995).

“There are no known active or inactive mining activities in the watershed. In the past, gravel quarrying operations occurred in the area of Stevens Creek Dam and upstream on one of the northern tributaries close to the dam. These operations involved the quarry of gravels from the conglomerate of the Santa Clara formation” (Iwamura 1999).

Limited recreational activities occur in the reservoir area and in the watershed, including a recreation camp. The limited amount of sampling of reservoir water has not indicated any potential nutrient problem (Iwamura 1999).

7.2.3.13 Vasona Lake/Reservoir

Vasona Reservoir is located within Vasona Lake County Park in the Town of Los Gatos near the intersection of State Highway 17 and State Highway 85. Vasona Dam is located on Los Gatos Creek approximately 2 miles downstream (northeast) of Lenihan Dam. The watershed drainage area downstream of Lexington Reservoir is approximately 6.46 square miles. Vasona Reservoir was completed in 1935. It has an average surface area of 58 acres and a capacity of 400 acre-feet (Water District 1995).

“The Los Gatos Creek watershed between Vasona Dam and Lexington Reservoir is a relatively small watershed with a little more than one-half its area in the mountains and foothills of the Santa Cruz Mountains, and the remainder on the valley floor of Santa Clara Valley” (Iwamura 1999). The upper part of the watershed is located on the eastern slopes of El Sereno and the northern slopes of St. Joseph’s Hill. The lower part of the watershed consists of the mainly flat Los Gatos area north of the upper part of the watershed. The lower part of the watershed is well developed and urbanized. The upper part is less urbanized in the steeper portions (Iwamura 1999). The town of Los Gatos and City of Monte Sereno lie within the lower portion of the watershed.

Vasona Reservoir is located in the alluvial floodplain formed by Los Gatos Creek prior to its channelization. The Water District uses the reservoir to store and release recharge waters to percolation ponds further downstream on Los Gatos Creek (Water District 1995).

> “Inflow into Vasona is mainly from Lexington Reservoir and smaller amounts from urban runoff through stormdrains and surface runoff. There is also contribution from Trout Creek, which runs all year and empties into Los Gatos Creek. Almendra Creek contributes only during storm flash flooding” (Iwamura 1999).

Beneficial uses established by the Regional Board for Vasona Reservoir include industrial process supply, navigation, ocean commercial and sport fishing, warm freshwater habitat, fish migration, water contact recreation, and areas of special biological significance (Water District 1995).

Park visitors actively use the reservoir and surrounding parklands. One water quality concern related to recreation is the concentration of waterfowl in and around the reservoir. Waste matter from waterfowl has the potential to result in reduced dissolved oxygen levels, and an increase of suspended materials, biostimulatory substances, and unpleasant odors (Water District 1995).

Since the capacity of Vasona Reservoir is small, water released from Lexington Reservoir is just momentarily detained in Vasona Reservoir before passing through. However, as the flows from Lexington passes through urban areas, landscaped urban recreational parks, and Vasona Reservoir, itself a refuge for ducks, geese, and other birds, subtle differences in quality are noted from Lexington Reservoir discharge to Vasona Reservoir. In most instances, the nitrate, total phosphorus, total organic carbon, dissolved organic carbon, and heavy metals content are slightly higher at Vasona as compared to Lexington waters, although the concentrations of these constituents are still considered to be extremely low (Iwamura 1999).

7.2.4 Groundwater Basins

The groundwater resources of the Basin are considerable. Although very little water is found in the hard bedrock formations that underlie the mountainous and foothill areas, groundwater is abundant in the valley. The geologic materials that have filled the Santa Clara Valley over millions of years are comprised of gravels, sands, and silty sands. These types of deposits are very permeable (transmit water easily) and constitute good aquifers[15] (water-bearing units), which have the capability to yield large flows to wells (Wilson and Iwamura 1989). In most areas of the Basin, groundwater quality is good to excellent and is suitable for most beneficial uses (Wilson and Iwamura 1989). Groundwater wells contribute about half the potable water supply in Santa Clara County.

The Basin groundwater system is composed of a large valley filled with sediment that has been divided into four interconnected subbasins, as shown on Figure 7-24. The largest of these subbasins, and the most important with respect to local water supply, is the Santa Clara groundwater subbasin. The southern groundwater basin is the Coyote Basin, located south of the Coyote Narrows, while the Niles Cone and San Mateo Bayside Plains groundwater subbasins are located adjacent to the east and west shores of the Bay, respectively. Like the other groundwater subbasins, the Santa Clara subbasin is composed of silt, sand, clay, and gravels that have been washed down from the Diablo Range and Santa Cruz Mountains and deposited by rivers and streams in the low foothills and in the valley between the two mountain ranges (Iwamura 1995).

[15] Aquifers are typically composed of varying layers of sand and loose, porous soils containing small voids in which water can reside and flow (Water District 1998).

Insert Figure 7-24 (Front)

Insert Figure 7-24 (Back)

At the edge of the subbasins, in the low foothills, the geologic materials that compose the aquifers are exposed at the ground surface. These zones are collectively known as the “forebay” of the aquifer. In these exposed areas, rainfall, streamflow, and other surface water is able to infiltrate and to seep into the aquifer (Iwamura 1995). The infiltration of new water into the aquifer is a process called “recharge,” and is critical to continued use of the aquifer. The Water District is active in promoting recharge to the aquifer, and uses local and imported water to recharge the subbasin with 393 acres of percolation ponds located throughout Santa Clara County. Seasonal dams on creeks and rivers are also used to encourage instream recharge (Water District 1998).

From the recharge areas at the margins of the subbasins, groundwater flows downgradient towards the valley flat. Outside of the recharge areas, the Santa Clara subbasin becomes divided vertically into two major water-bearing zones. These two zones are located above and below a very thick layer of clay, or aquiclude, which prevents groundwater movement and exchange between the two zones. Throughout most of the subbasin, the clay layer is encountered at a depth of approximately 150 feet (Iwamura 1995). Water-bearing units beneath this clay layer are called confined aquifers, and have slightly different hydraulic properties than the unconfined aquifers above them. The unconfined aquifers in the subbasin are little used now, but still represent an important resource that could be used in the future or under emergency conditions[16].

Like the Santa Clara subbasin, the Coyote Valley subbasin is filled with alluvial (river deposited) sediments and is interconnected with the Santa Clara subbasin to the north through the Coyote Narrows. The bulk of the water-bearing alluvial deposits emanated from Coyote Creek as it entered the valley floor from the east side of the Diablo Range. Groundwater occurs in the alluvial fill and is essentially unconfined as it moves in a general northwesterly direction down the valley. Depths to groundwater in the subbasin range from about 40 feet to less than 10 feet. As the subbasin becomes restricted at the Coyote Narrows, groundwater rises so as to discharge into Coyote Creek just upstream of the Coyote Narrows (Wilson and Iwamura 1989).

The Santa Clara Valley subbasin is a managed groundwater system. The Water District recharges the subbasin with water to counterbalance water pumped from the aquifer. In addition to helping maintain groundwater supplies, recharge ameliorates problems related to land subsidence. Subsidence is a broad sagging of the land surface over many miles as a result of decreased water pressure in the underlying aquifers, and is a phenomenon that has occurred extensively in the Santa Clara subbasin during the 20th century (Water District 1998). The broad sag of the land surface had centers of subsidence centered near downtown San Jose and in the Mountain View-Sunnyvale area, and extending into Alviso and Palo Alto (Figure 7-25) (Iwamura 1995).

The recharge program uses storm runoff caught in the local reservoirs and Sacramento-San Joaquin River waters imported through the Central Valley Project.

[16] Small portions of the upper aquifers have become contaminated from industrial and fueling operations. These are under investigation and most of the plumes are being remediated (Tom Iwamura, pers. comm., 1998).

The Alameda County Water District operates a similar recharge program throughout the Fremont area, using a combination of waters from local reservoirs and from the Delta to recharge the Niles Cone groundwater subbasin. Although most of the Alameda Creek alluvial deposits are just beyond the northern boundary of the Basin, some of the Alameda Creek recharge does enter portions of the northeastern corner of the Basin, and also flows at depths of several hundred feet beneath the Bay, sustaining the groundwater pumped along the bayfront in Palo Alto, Menlo Park, East Palo Alto and Mountain View.

Smaller groundwater basins are found along streams in the foothills of the Santa Cruz Mountains from Morgan Hill northward to Atherton. Groundwater that percolates through fractured bedrock and through fault zones plays locally important roles in sustaining summer streamflow, which is needed by streamside vegetation, fish, and other wildlife. Groundwater pumped from local wells is used by Stanford for irrigation and as a backup potable water supply for Palo Alto.

7.2.4.1 Land Subsidence

The decrease in water pressure that led to land subsidence in the Santa Clara subbasin was due largely to overpumping of the aquifer. Prior to the turn of the century, very little water was pumped from wells in the lowlying interior portion of the subbasin, and what little was pumped was for domestic use. With the development of the deep well turbine pump and the availability of cheap electrical power, pumping from wells for agricultural irrigation became popular. In 1912, only about 30 percent of the valley land was irrigated, but by 1920, 67 percent was irrigated. Nearly all of this water was pumped from wells. The period from 1920 to 1936 was abnormally dry, and as a result, more and more wells were drilled to meet increasing demands for water (Roll 1964). The effects of groundwater overdraft were dramatic.

In the Basin, one serious consequence of subsidence was that lands near the Bay sank below sea level. Land subsidence started around 1920 and continued until 1969, enabling saltwater to intrude upstream through the mouths of rivers, dramatically affecting the riparian (stream channel) habitat of those rivers (Water District 1998). Land subsidence also altered the gradients of streams, affected streamflow capacity, and cost taxpayers millions of dollars in levees (Tom Iwamura, pers. comm., 1998). The most serious cases of saltwater intrusion occurred in the Guadalupe River area from Alviso to Montague Bridge, and in the Palo Alto bayfront area (Wilson and Iwamura 1989). Other effects have resulted from this gradual change in the elevation of the ground surface: one of these is damage to wells within the area in which subsidence occurred (Roll 1964); and another has to do with the amount of land below sea level in the region. As the land subsided, levees fronting on the Bay and the main streams were raised, often 6 to 10 feet, in order to prevent flooding. This has reduced the extent of tidal marshes, which provide important wildlife habitat, and has diminished daily tidal exchanges, making the South Bay more stagnant.

Several attempts have been made to arrest the problem of land subsidence, and relative success has been achieved in recent decades. Figure 7-26 shows the relationship between groundwater elevations and land subsidence in Santa Clara County. The subsidence issue led to the creation

Insert Figure 7-25 (Front)

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Insert Figure 7-26 (Front)

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of the Santa Clara Valley Water Conservation District in 1928, the forerunner of the current Water District. Dams built in the 1930s for water conservation and for flood control provided an alternative source of water to the overpumped aquifers. Following the construction of water conservation reservoirs in the mountains, groundwater levels and pressures began to rise in 1935. This rise continued until 1944. During the period of water level recovery, land subsidence slowed from 1937 to 1948. The years between 1937 and 1944 were a very wet period. After 1944, water levels again started to decline as increased pumping resulted in overdraft, and subsidence resumed in 1948. With the importation of surface waters from the State and Federal Water Projects and the Hetch Hetchy system in 1965, pumping draft from the Basin was reduced, and overdraft of the Basin was eliminated. Subsidence ceased in 1969 as pressures in the lower aquifer zone started to recover, a trend that has continued in recent years for wells located in the interior portion of the subbasin. In contrast, wells located at the margins of the subbasin have not yet recovered to preoverdraft levels (Iwamura 1995). The possibility exists, however, that further subsidence could resume with an extended drought period (Wilson and Iwamura 1989).

7.2.5 Groundwater Recharge Facilities

There are two types of groundwater recharge facilities in the Basin: onstream recharge facilities and offstream recharge facilities. Onstream recharge takes place when rainwater or water released from reservoirs flows into the sandy-gravelly bed of a stream and then seeps downward into an aquifer (Water District 1978). During summer months, the Water District releases water from its reservoirs, allowing it to flow downstream through stream reaches that have permeable streambeds. In some instances, the Water District also releases imported water for percolation from “turnouts” from the extensive water distribution system in the Santa Clara Valley. Onstream percolation is enhanced through the construction of “spreader dams” (temporary gravel dams) in certain stream reaches in order to slow the water and increase percolation.

Offstream recharge occurs in groundwater recharge ponds (commonly referred to as percolation ponds). These are located at carefully chosen sites where gravels and sands have been naturally deposited at or near ground level and where water can soak down most easily into the aquifer(s) (Water District 1978). See Table 7-8 for information on the groundwater recharge facilities (Percolation Ponds) in the Basin. The Water District operates offstream percolation ponds along Stevens Creek; along Los Gatos Creek downstream of Lexington and Vasona Reservoirs; along Alamitos Creek, Guadalupe Creek, and the Guadalupe River downstream of Almaden, Calero, and Guadalupe Reservoirs; along Coyote Creek downstream of Anderson Reservoir; and along Lower Penitencia Creek.

Instream and offstream percolation ponds are not a new phenomenon. Local farmers formed the Valley Water Conservation Association in the early 1920s and began constructing in-channel “spreading dams.” These low-check dams constructed from a variety of local materials were installed in order to retard the flow of water during the winter months, thereby increasing percolation of water into the underground aquifers for storage. The Santa Clara Valley Water Conservation District began purchasing land, installing removable dams, and operating

Table 7-8

percolation ponds along Los Gatos Creek, Guadalupe/Alamitos Creeks, and Coyote Creek in the early 1930s (California History Center 1981). Lake Lagunita was constructed for percolation to downstream wells by former Governor Leland Stanford in the 1870s (San Francisquito Creek-Our Natural Resource, 1994).

7.2.5.1 Coyote Percolation Pond

Coyote Percolation Pond, completed in 1934, is located in southern San Jose at the northeast corner of the intersection of Metcalf Road. It has an average surface area of 30 acres and a capacity of 150 acre-feet (Water District 1995).

Coyote Percolation Pond is one of a series of percolation ponds impounding the northwest/southeast trending Coyote Creek that flows along the center of the Santa Clara Valley. The series of ponds is used for groundwater recharge of the Santa Clara groundwater subbasin (Water District 1995).

7.2.5.2 Los Gatos Percolation Ponds

The Los Gatos Percolation Ponds, also referred to as the Camden Percolation Ponds, are within Los Gatos Creek County Park just west of State Highway 17 and south of Camden Avenue in the City of Campbell. Water from Los Gatos Creek is diverted to three principal ponds with a combined surface area of 59 acres and a capacity of 1,780 acre-feet. The Los Gatos Percolation Ponds were completed in 1935 (Water District 1995).

The primary use of the ponds is for recharge of the Santa Clara groundwater subbasin. The ponds divert water from Los Gatos Creek and receive water from the Water District Central Pipeline that carries untreated water from the South Bay Aqueduct (Water District 1995).

The Los Gatos Percolation Ponds are in the alluvial deposits created by Los Gatos Creek before it was channelized. Los Gatos Creek flows northeast from the percolation ponds and joins the Guadalupe River in central San Jose (Water District 1995).

7.2.5.3 Instream Percolation Ponds

In the past, the Water District utilized seasonal in-channel impoundments and Guadelupe Creek to enhance groundwater recharge on the Guadalupe River and its tributaries Los Gatos Creek and Guadalupe Creek, as well as on Coyote, Stevens, and Saratoga Creeks. These in-channel percolation ponds were created by installing gravel spreader dams across the stream. The spreader dams remained in place from approximately April to September. Year-round dams were maintained in Coyote Creek. In-channel flash board dams are still used on Los Gatos Creek above Camden Avenue for percolation and water diversion purposes causing negative riparian impacts and fish migration blockings.

A 5-year study found that temperatures in percolation ponds were often marginal for steelhead and would require high food supply to provide rearing habitat (Habitat Restoration Group 1995).

While in-channel percolation ponds have the potential to provide rearing habitat for juvenile steelhead if temperatures, dissolved oxygen, and food resources are suitable, only a few possible steelhead were captured over a 5-year study (Habitat Restoration Group 1995). In addition, the lake-like (lentic) habitat found in percolation ponds tends to favor nonnative fishes such as bluegill, sunfish, goldfish, and largemouth bass. Largemouth bass can prey on juvenile steelhead. In addition, these nonnative fish can invade adjacent stream habitat. In-channel percolation ponds often reduce streamflow downstream. Maintenance of percolation ponds often requires draining the pond completely, stranding thousands of fish. Finally, gravel dam sites become shallow passage barriers if the low-flow channel is not maintained following removal.

7.3 Designated Beneficial Uses for the Santa Clara Basin

7.3.1 Beneficial Uses of Waterbodies

The Regional Board, in consultation with state and local authorities and based upon best available information, designates existing and potential beneficial uses for significant surface and ground waterbodies in the region. The following discussion describes the beneficial uses of surface waters, groundwaters and marshes designated by the Regional Board in its 1995 *Water Quality Control Plan for the San Francisco Basin* (Basin Plan).

The definitions of beneficial uses provided below are taken from the Basin Plan. The words in italics are the definitions taken directly from the Basin Plan. This is followed by a summary of some of the water quality requirements. The reader is directed to Chapter 2 of the Basin Plan for a detailed description. The beneficial uses are presented in alphabetical order using their abbreviations.

(***AGR) Agricultural Supply.*** *Uses of water for farming, horticulture, or ranching, including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.*

Water quality objectives and standards are set to prevent (1) soluble salt accumulations, (2) chemical changes in the soil, (3) toxicity to crops, and (4) potential disease transmission to humans through reclaimed water use. Irrigation water classification systems, arable soil classification systems, and public health criteria related to reuse of wastewater have been developed with consideration given to these issues.

(ASBS) Areas of Special Biological Significance. *Areas designated by the State Water Resources Control Board.*

Alteration of natural water quality in these areas is undesirable, and therefore potential impacts (such as wastes to be discharged) generally must occur at a sufficient distance from these areas to maintain natural water quality conditions. Areas of special biological significance include marine life refuges or ecological reserves, and other areas designated by the State Board where the preservation and enhancement of natural resources requires special protection.

(COLD) Cold Freshwater Habitat. *Uses of water that support coldwater ecosystems, including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.*

Water quality objectives/standards are set to protect cold freshwater habitats to support anadromous fisheries (e.g., salmon, steelhead) and trout and other coldwater fisheries. Such objectives set limits on key habitat requirements such as temperature, toxicity, and dissolved oxygen. Life within these waters is relatively intolerant to environmental stresses.

(COMM) Ocean, Commercial, and Sport Fishing. *Uses of water for commercial and recreational collection of fish, shellfish, and other organisms in oceans, bays, and estuaries, including, but not limited to, uses involving organisms intended for human consumption or bait purposes.*

The protection of ocean fishing is largely dependent upon protection of habitats where fish reproduce and forage.

(EST) Estuarine Habitat. *Uses of water that support estuarine ecosystems, including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds), and the propagation, sustenance, and migration of estuarine organisms.*

The protection of estuarine habitat is contingent upon (1) the maintenance of adequate Delta outflow to provide mixing and salinity control; and (2) provisions to protect wildlife habitat associated with marshlands and the Bay periphery (i.e., prevention of fill activities). Estuarine habitat is associated with moderate seasonal fluctuations in dissolved oxygen, pH, and temperature.

(FRSH) Freshwater Replenishment. *Uses of water for natural or artificial maintenance of surface water quantity or quality.*

The Basin Plan does not provide any description of water quality requirements for FRSH.

(GWR) Groundwater Recharge. *Uses of water for natural or artificial recharge of groundwater for purposes of future extraction, maintenance of water quality, or halting saltwater intrusion into freshwater aquifers.*

The requirements for groundwater recharge operations generally reflect the future use to be made of the water stored underground. Hence, the water quality objectives are set to protect those future uses. Future beneficial uses for groundwater in the Basin include municipal and domestic supply, agricultural supply, industrial process supply, and industrial service supply.

(IND) Industrial Service Supply. *Uses of water for industrial activities that do not depend primarily on water quality, including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, and oil well pressurization.*

Most industrial service supplies have few water quality limitations except for gross constraints, such as freedom from unusual debris, and salt or total dissolved solids.

(MAR) Marine Habitat. *Uses of water that support marine ecosystems, including, but not limited to, preservation or enhancement of marine habitats, vegetation such as kelp, fish, shellfish, wildlife (e.g., marine mammals, shorebirds).*

In many cases, the protection of marine habitat will be accomplished by measures that protect wildlife habitat generally, but more stringent objectives may be necessary for waterfowl marshes and other habitats, such as those for shellfish and marine fishes. This beneficial use does not apply to waters within the Estuary. Instead, the EST beneficial use applies to the South Bay.

(MIGR) Fish Migration. *Uses of water that support habitats necessary for migration, acclimatization between freshwater and saltwater, and protection of aquatic organisms that are temporary inhabitants of waters within the region.*

The water quality objectives established for coldwater fisheries protect anadromous fish as well; however, for migratory species, particular attention must be paid to maintaining zones of passage. Barriers to migration or free movement of migratory fish impacts reproduction. Natural tidal movement in estuaries and adequate river flows are necessary to sustain migratory fish and their offspring. A water quality barrier, whether thermal, physical, or chemical, that prevents migration is an indicator of nonprotection of this use.

(MUN) Municipal and Domestic Supply. *Uses of water for community, military, or individual water supply systems, including, but not limited to, drinking water supply.*

The principal issues involving municipal water supply quality are (1) protection of public health; (2) aesthetic acceptability of the water; and (3) the economic impacts associated with treatment- or quality-related damages. Published water quality objectives give limits for known health-related constituents and most properties affecting public acceptance. These objectives for drinking water include the EPA Drinking Water Standards and the California State Department of Health Services criteria.

Water quality objectives relate to prevention of direct disease transmission, toxic effects, and increased susceptibility to disease. In addition, aesthetic factors are important and include parameters associated with excessive hardness, unpleasant odor or taste, turbidity, and color. Though not listed in the Basin Plan, corrosive potential and disinfection byproduct precursors should be included in the water quality objectives.

(NAV) Navigation. *Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.*

The Basin Plan does not provide any description of water quality required for NAV.

(PRO) Industrial Process Supply. *Uses of water for industrial activities that depend primarily on water quality.*

Water quality requirements differ widely among the many industrial processes in use today. Because of this, no specific criteria have been applied to the quality of raw water supplies.

(RARE) Preservation of Rare and Endangered Species. *Uses of waters that support habitats necessary for the survival and successful maintenance of plant or animal species established under state and/or federal law as rare, threatened, or endangered.*

The water quality objectives for protection of rare and endangered species are often the same as those for protection of fish and wildlife habitats. However, where rare or endangered species exist, special control requirements may be necessary to assure attainment of this use and may vary slightly with the environmental needs of each particular species.

(REC1) Water Contact Recreation. *Uses of water for recreational activities involving body contact with water where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, waterskiing, skin and scuba diving, surfing, whitewater activities, fishing, and uses of natural hot springs.*

Water contact implies a risk of waterborne disease transmission and involves human health; accordingly, objectives required to protect this use include limits on bacterial concentrations, tastes and odors, and floating material.

(REC2) Noncontact Water Recreation. *Uses of water for recreational activities involving proximity to water but not normally involving contact with water where water ingestion is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tide pool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.*

Water quality considerations relevant to noncontact water recreation, such as hiking, camping, or boating, and those activities related to tide pool or other nature studies require protection of habitats and aesthetic features from odors or floating materials.

(SHELL) Shellfish Harvesting. *Uses of water that support habitats suitable for the collection of crustaceans and filter feeding shellfish (e.g., clams, oysters, and mussels) for human consumption, commercial, or sport purposes.*

Shellfish harvesting areas require protection and management to preserve the resource and protect public health. The potential for disease transmission and direct poisoning of humans is of considerable concern in shellfish regulation; therefore, bacteriological objectives for the open ocean, bays, and estuarine waters where shellfish cultivation and harvesting occur are established to protect public health.

(SPWN) Fish Spawning. *Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.*

Dissolved oxygen levels in spawning areas should ideally approach saturation levels. Free movement of water is essential to maintain well-oxygenated conditions around eggs deposited in sediments. Water temperature, size distribution and organic content of sediments, water depth, and current velocity are also important determinants of spawning area adequacy.

(WARM) Warm Freshwater Habitat. *Uses of water that support warmwater ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.*

The warm freshwater habitats supporting bass, bluegill, perch, and other panfish are generally lakes and reservoirs, although some minor streams will serve this purpose where streamflow is sufficient to sustain the fishery. The habitat is also important to a variety of nonfish species, such as frogs, crayfish, and insects, which provide food for fish and small mammals. This habitat is less sensitive to environmental changes, but more diverse than the cold freshwater habitat, and the ranges of objectives for temperature, dissolved oxygen, pH, and turbidity are usually greater.

(WILD) Wildlife Habitat. *Uses of waters that support wildlife habitats, including, but not limited to, the preservation and enhancement of vegetation and prey species used by wildlife, such as waterfowl.*

The two most important types of wildlife habitat are riparian and wetland habitats. These habitats can be impacted by development, erosion, and sedimentation, and by poor water quality. The water quality requirements of wildlife pertain to the water directly ingested, the aquatic habitat itself, and the effect of water quality on the production of food materials. Waterfowl habitat is particularly sensitive to changes in water quality. Dissolved oxygen, pH, alkalinity, salinity, turbidity, settleable matter, oil, toxicants, and specific disease organisms are water quality parameters particularly important to waterfowl habitat.

Present and Potential Beneficial Uses in the Region. The Regional Board has designated beneficial uses for surface and groundwaters, and has begun to address beneficial uses associated with wetland areas. According to the Basin Plan, inland surface waters support or could support municipal and domestic supply (MUN); agricultural supply (AGR); industrial process supply (PRO); groundwater recharge (GWR); water contact recreation (REC1); noncontact water recreation (REC2); wildlife habitat (WILD); cold freshwater habitat (COLD); warm freshwater habitat (WARM); fish migration (MIGR); and fish spawning (SPWN). In addition to the above uses, the Estuary supports estuarine habitat (EST); industrial service supply (IND); and navigation (NAV).

Groundwater in the region supports or could support municipal and domestic water supply (MUN); industrial water supply (IND); industrial process water supply (PRO); agricultural water supply (AGR); and freshwater replenishment to surface waters (FRSH).

The Regional Board is in the process of developing a Regional Wetlands Management Plan that will "identify and specify the beneficial uses and/or functions and values of existing wetlands and establish wetland habitat goals for the region" (Regional Board 1995). Potential beneficial uses of wetlands include wildlife habitat (WILD); preservation of rare and endangered species (RARE); shellfish harvesting (SHELL); water contact recreation (REC 1); noncontact water recreation (REC 2); ocean, commercial, and sport fishing (COMM); marine habitat (MAR); fish migration (MIGR); fish spawning (SPWN); and estuarine habitat (EST). Wetlands improve water quality.

7.3.2 Designated Beneficial Uses for the Santa Clara Basin

7.3.2.1 1995 Basin Plan Designations

The latest Basin Plan (Regional Board 1995) designates specific beneficial uses to surface waterbodies in the Basin. These are listed in Table 7-9. The beneficial uses of a waterbody generally apply to all its tributaries (This is known as the "Tributary Rule"). In some cases, a beneficial use may not be applicable to the entire body of water.

Within the Santa Clara Basin, the Regional Board has designated the following as existing beneficial uses of groundwater: municipal and domestic water supply (MUN); industrial process water supply (PROC); industrial service water supply (IND); and agricultural water supply (AGR).

The South Bay, currently the only wetland area designated by the Regional Board within Santa Clara Basin, has the following beneficial uses associated with it: estuarine habitat (EST); fish migration (MIGR); ocean, commercial, and sport fishing (COMM); preservation of rare and endangered species (RARE); water contact recreation (REC1); noncontact water recreation (REC2); fish spawning (SPWN); and wildlife habitat (WILD).

7.3.2.2 Comments on Basin Plan Designations

WMI Stakeholders have identified errors and omissions in the 1995 Basin Plan's designations. There is also disagreement over some of the designations. One objective of the WMI process is to work with the Regional Board to improve the Basin Plan throughout the stakeholder process. Stakeholders' increased understanding of the Basin's resources leads to suggested changes to the Regional Board's designations. For example, the Water District's recent fieldwork could be used to improve Table 7-9 in the area of existing Basin fisheries. Designations for beneficial uses for some of the listed waterbodies in the table are also controvesial, based on stakeholders' first-hand knowledge of specific waterbodies.

This section presents some of the problems that have been identified with the Basin Plan's Table 2-5 (Table 7-9). These problems have been categorized as errors, omissions, or redesignation considerations. There may be other corrections, but this list identifies some general problems associated with Table 7-9. The Regional Board should evaluate the need to update the Basin Plan table and establish a process to work with the WMI on this effort.

Table 7-9
Page 1 of 1

Errors in Basin Plan Table 2-5

- The Guadalupe Reservoir is incorrectly listed under Coyote Creek and should be listed under Guadalupe River.
- Coyote *Reservoir* appears to be identified as Coyote *Lake.*
- Anderson Lake is incorrectly listed under the Guadalupe River and Anderson *Lake* should be changed to Anderson *Reservoir*.
- Anderson *Reservoir* should be listed under Coyote Creek.
- Vasona Reservoir seems to be identified as Vasona Lake.
- Stivers Lagoon appears to be identified as Fremont Lagoon and should be in the Arroyo La Laguna watershed.
- Lake Elizabeth (not Elizabeth Lake) is in the Arroyo La Laguna watershed, not Coyote.
- Penitencia Creek should be *Lower* Penitencia Creek.
- Herbert Creek is listed twice under Guadalupe River.
- Los Gatos Creek is listed twice; once with a number of beneficial uses, and the other with no beneficial uses.
- The Campbell Percolation Pond (listed under the Guadalupe River) is a percolation pond and should not be listed as a waterbody.
- Searsville Lake is in the San Francisquito Creek watershed.

Omissions in Basin Plan Table 2-5

- There are a number of creeks, lakes, lagoons, and reservoirs listed under the Coyote Creek which cannot be located on most available maps (e.g., Fremont Lagoon, Sandy Wool Lake, Halls Valley Reservoir), while other better-known creeks that do appear on most maps are not listed (e.g., Thompson Creek, Fisher Creek, and Yerba Buena Creek).
- Anderson Reservoir, the area’s largest, is not listed, although it may be incorrectly listed as Anderson Lake (see Errors above).
- There are numerous significant waterbodies not listed under the Guadalupe River. They include Alviso Slough, Lake Almaden, Canoas, Ross, Calero, and Rincon Creeks, as well as a number of other minor creeks.
- Adobe Creek is not listed in the table.
- San Tomas is not listed, with Saratoga Creek as a tributary.
- Barron Creek is not listed.

7.3.2.3 Redesignation Considerations

The following comments were made by some WMI stakeholders based on their understanding of the local waterbodies. The Regional Board should review the merits of these comments when redesignating the Basin beneficial uses.

- For clarity, waterways in the Basin that have diverse characteristics should have listings for each of the major sections, or alternatively, they should only be listed once and all beneficial uses should be included. Los Gatos Creek is an example of this type of stream. There are numerous distinct sections of Los Gatos Creek (e.g., natural, channelized, concrete channel). Each section has unique characteristics, and different beneficial uses.

- Guadalupe River is used by coldwater salmonids for migration and spawning and is used by southwestern pond turtle, but the table does not reflect this.

- The Guadalupe River is navigable under California law and is used for small watercraft navigation, and water contact recreation (swimming in Almaden Reservoir). The table does not reflect this.

- Guadalupe Creek, above the Masson Dam, is a coldwater stream and has a self-sustaining population of resident rainbow trout. It also has potential habitat for the southwestern pond turtle, the California red legged frog, and migrating salmonids. The table does not reflect this.

- Coyote Creek should be considered navigable.

- Alamitos and Calero Creeks have a population of self-sustaining fish and have the potential habitat for migrating salmonids, the red legged frog, and the southwestern pond turtle. The table does not reflect this.

- Fishery information from the Water District indicates that there are numerous waterbodies for which beneficial use designations (specifically, coldwater fisheries, migration, rare, and spawning) should be adjusted in the table. This information is included in an endnote to this chapter.[i]

- The Regional Board staff have requested that the San Francisquito Watershed CRMP assist in groundtruthing the beneficial uses as a pilot project; however, resources for the efforts have to be identified. SCVURPPP has suggested the Coyote watershed as a demonstration site.

7.4 Conveyance Functions of Water Corridors in the Santa Clara Basin

The community relies on the local stream and creek corridors to convey water within the Basin and to the Bay. This conveyance function is not a beneficial use identified and defined by the Regional Board. Watershed management planning needs to acknowledge the conveyance functions when addressing the designated beneficial uses.

The conveyance function can be separated into three categories: (1) conveyance of stormwater, (2) conveyance of dry-weather flows, and (3) conveyance of water stored in reservoirs to groundwater recharge facilities.

- **Dry-Weather Flow Conveyance**. During dry weather, Basin streams and creeks convey natural base flows and nonstormwater discharges received from storm sewers to the Bay. Certain nonstormwater discharges are allowed to flow to stormdrains by municipal and industrial stormwater permits. Examples of these discharges include pumped uncontaminated groundwater, planned and unplanned discharges from potable water sources, water line and hydrant flushing, landscape irrigation, air conditioning condensate, and individual residential car washing. These discharges, called conditionally exempted discharges, must take steps to minimize adverse effects from their discharge on water quality.

- **Stormwater Conveyance**. During storm events, Basin streams and creeks convey runoff from land areas and urban stormwater discharges from storm drains to the Bay. Thus, local streams are an integral part of the Basin's flood control and private property flood protection system. It is important to acknowledge the flood management function of the streams, and adjacent floodplains.

- **Groundwater Recharge Supply Conveyance**. The Water District stores local runoff water and imported water in reservoirs. This water is released to recharge the groundwater basin through percolation ponds and instream recharge. The Water District relies on Basin creeks, streams and pipelines to convey recharge water from the reservoirs or pipelines to the percolation ponds.

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[i] Below are specific suggestions from the Santa Clara Valley Water District for redesignation based on the District's most recent experiences with these watersheds. The designation codes from Table 7-9 are used (e.g., E = existing beneficial use).

Coldwater Fisheries:

- **Los Trancos Creek** = E per steelhead/rainbow trout populations
- **Upper Penitencia Creek** = E per steelhead/rainbow trout populations and some limited evidence of Chinook salmon.
- **San Felipe Creek** = E per rainbow trout populations
- **Vasona Lake** = L per significant warming during the summer months. Only intermittent trout plants would be successful except during the winter months.
- **Los Gatos Creek** = E below Camden drop structure per evidence of steelhead and Chinook spawning observations. Summer temperatures/flows may not be optimal for summer steelhead rearing.

- **Alamitos Creek** = E per resident populations of rainbow trout below Almaden Reservoir. Current laddering project at the Blossom Hill drop structure may provide access to anadromous salmonids.

- **Guadalupe Creek** = E per resident populations of rainbow trout below Guadalupe Reservoir. Current laddering projects at the Blossom Hill drop structure and Masson Diversion may provide access to anadromous salmonids.

- **Herbert Creek** = E per resident populations of rainbow trout above reservoir. No good recent data on reservoir use by this population.

- **Add Tributary to Guadalupe Creek: Pheasant Creek** = P per resident populations of rainbow trout in Guadalupe Creek. Access at confluence is through a culvert and 1- to 2-foot drop. Recent accounts of occurrence are unconfirmed.

- **Add Tributary to Guadalupe Creek: Reynolds Creek** = E per resident populations of rainbow trout in Creek, recently observed.

- **Add Tributary to Guadalupe River: Arroyo Calero Creek** = E per resident populations of rainbow trout below Calero Reservoir. Current laddering project at the Blossom Hill drop structure may provide access to anadromous salmonids.

Migration:

- **Upper Penitencia Creek** = E Anadromous steelhead run in this creek. There may be some use by Chinook salmon.

- **Guadalupe River** = E Anadromous steelhead and Chinook salmon run in this river. The fish ladder at Blossom Hill, currently under construction, will permit access to the tributaries of the upper watershed.

- **Alamitos Creek** = P The fish ladder at Blossom Hill, currently under construction, will permit access to this tributary of the upper watershed of Guadalupe River for anadromous steelhead and Chinook salmon.

- **Guadalupe Creek** = P The fish ladders at Blossom Hill and Masson diversion, currently under construction, will permit access to this tributary of the upper watershed of Guadalupe River for anadromous steelhead and Chinook salmon.

Rare (NOTE: Regional Board designations have not been updated to reflect recent listings by CDFG/USFWS/NMFS):

- **San Francisquito Creek** = E per presence of steelhead.

- **Stevens Creek** = E per presence of steelhead.

- **Upper Penitencia Creek =** E per presence of steelhead.

- **San Felipe Creek** = P per potential presence of California red-legged frog.

- **Guadalupe River** = E per presence of steelhead.

- **Los Gatos Creek** = E per presence of steelhead.

- **Alamitos Creek** = P per potential presence of steelhead resulting from fish ladder project at Blossom Hill.

- **Guadalupe Creek** = P per potential presence of steelhead resulting from fish ladder projects at Blossom Hill and Masson Diversion.

- **Add Tributary to Guadalupe Creek:** Pheasant Creek = P per anticipated populations of steelhead trout in Guadalupe Creek resulting from fish ladder projects at Blossom Hill and Masson Diversion. Access at confluence is through a culvert and 1- to 2-foot drop.

- **Add Tributary to Guadalupe Creek:** Reynolds Creek = P per anticipated populations of steelhead trout in Guadalupe Creek resulting from fish ladder projects at Blossom Hill and Masson Diversion.

Fish Spawning:

- **Saratoga Creek** = E per various year classes of resident trout. Successful spawning/reproduction.

- **Los Trancos Creek** = E per various year classes of steelhead and resident trout. Successful spawning/reproduction.

- **Stevens Creek** = E per various year classes of resident and anadromous trout. Successful spawning/reproduction.

- **Penitencia Creek** = E per various year classes of resident and anadromous trout. Successful spawning/reproduction.

- **San Felipe Creek** = E per various year classes of resident trout. Successful spawning/reproduction.

- **Alamitos Creek** = E per various year classes of resident trout. Successful spawning/reproduction. Anticipated successful use of tributary by steelhead and Chinook due to fish laddering at Blossom Hill on Guadalupe River.

- **Guadalupe Creek =** E per various year classes of resident trout. Successful spawning/reproduction. Anticipated successful use of tributary by steelhead and Chinook due to fish laddering at Blossom Hill on Guadalupe River.

- **Arroyo Calero Creek =** E per various year classes of resident trout. Successful spawning/reproduction. Anticipated successful use of tributary by steelhead and Chinook due to fish laddering at Blossom Hill on Guadalupe River.

- **Add tributary to Guadalupe Creek**: Pheasant Creek = P per various year classes of resident trout in Guadalupe Creek. Successful spawning/reproduction. Unconfirmed for Pheasant Creek. Anticipated successful use of tributary by steelhead due to fish laddering at Blossom Hill on Guadalupe River.

- **Add tributary to Guadalupe Creek: Reynolds Creek** = P per various year classes of resident trout in Guadalupe Creek. Successful spawning/reproduction. Unconfirmed for Reynolds Creek. Anticipated successful use of tributary by steelhead due to fish laddering at Blossom Hill on Guadalupe River.

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