City of Santa Barbara Existing Conditions Report- Fisheries

Draft Sections for Inclusion in Final Report

May 2005

Prepared for:
Questa Engineering Corp.
1220 Brickyard Cove Rd. Suite 206
Pt. Richmond, CA 94807

Prepared by:
Matt W. Stoecker
Stoecker Ecological
P.O. Box 2062
Santa Barbara, Ca. 93120
Matt@StoeckerEcological.com
www.StoeckerEcological.com

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4.8 City-Wide Watershed-Fisheries

Rainbow trout/steelhead (*O. mykiss*)

The watersheds that occur within the City of Santa Barbara provide a variety of aquatic habitat types that support several fish species. The upper stream reaches of Arroyo Burro, Mission Creek, and Sycamore Creek contain habitat conditions suitable for the rainbow trout (*O. mykiss*). Mission Creek and its primary tributary Rattlesnake Creek are the only stream reaches within the City currently known to contain a population of *O. mykiss*. Stoecker obtained and compiled numerous historic records of rainbow trout and adult steelhead presence in Mission and Rattlesnake Creeks (Stoecker 2002). The historic freshwater distribution of the anadromous form of *O. mykiss*, or steelhead, has been severely limited in City watersheds due to the construction of migration barriers. Despite the presence of numerous impassable barriers on lower Mission Creek, adult steelhead continue to migrate up Mission Creek to an impassable CALTRANS concrete channel, downstream of which adults have recently been observed spawning in sub-optimal habitat (pers. obsrv. Stoecker 2005). The continued presence of *O. mykiss* in upper Mission Creek and Rattlesnake Creek, and their ability to migrate downstream to the ocean, is one likely origin of adult steelhead migrating into lower Mission Creek.

An historic account exists of rainbow trout occurrence in Arroyo Burro and San Roque Creek until the 1940's (Stoecker 2002). Adult steelhead were reportedly sighted in the Arroyo Burro lagoon in the 1980's downstream of the Cliff Drive Bridge concrete apron barrier (Stoecker 2002). It is likely that adult steelhead have attempted to recolonize Arroyo Burro in recent times, but have been blocked at the Cliff Drive barrier or the next upstream grade control structure. The San Roque Creek tributary of Arroyo Burro contains suitable habitat conditions to support a population of *O. mykiss* and with adequate migratory access at downstream barriers the watershed can support an anadromous steelhead population.

Only vague, anecdotal references to *O. mykiss* occurrence have been obtained for Sycamore Creek following extensive research and interviews (Stoecker 2002). Sycamore Creek contains poor to fair salmonid habitat conditions in the middle and upper reaches and likely supported a limited population of *O. mykiss* and opportunistic occurrence of steelhead during wetter years. Laguna Creek does not contain adequate habitat conditions to support a viable *O. mykiss* population. However, the Laguna Creek lagoon is connected to the Mission Creek lagoon and may see sporadic steelhead occurrence as adult and juvenile fish inhabit this shared lagoon.

Other Fish Species

The lagoons that occur at the mouths of each watershed in the City are productive and unique aquatic habitats. Despite being significantly modified, confined, and polluted with the growth of City of Santa Barbara these lagoons continue to function as ecologically important habitats. These mixing zones of fresh and saline water combine to create a suitable habitat for a variety of fish species, some of which require such habitats to survive. Lagoons also provide important acclimation zones for migratory fish that utilize both fresh and saltwater habitats for different life stages, such as the steelhead. The documented occurrence of some fish species in the lagoons has been fairly consistent

over time while some species presence is highly sporadic and opportunistic. Several recent surveying efforts have been conducted in the lagoons and the number and type of fish species present in each lagoon appears to be variable over time as aquatic conditions change and species migrate in and out of the lagoons. Some species can tolerate freshwater conditions and may attempt to migrate upstream to some extent. Collectively, these lagoons are known to support a number of fish species including, arrow goby, mudsucker, topsmelt, tidewater goby, staghorn sculpin, California killifish, prickly sculpin, and stickleback (pers. comm. Swift 2005, Johnson 2005). As noted previously, steelhead also utilize the Mission Creek lagoon during certain times of the years and may enter Arroyo Burro, Sycamore Creek, and Laguna Creek lagoons during certain years in attempts to explore upstream.

The lagoon at Arroyo Burro is the most ecologically diverse and intact lagoon in the City and supports a higher abundance of tidewater goby than the other lagoons in the City (Johnson 2005). Tidewater goby populations were also observed by ECORP Consulting in the Mission Creek lagoon and the Laguna Creek lagoon downstream of the tide gates (Johnson 2005). No tidewater gobies were observed upstream of the Cliff Drive grade control structure on Arroyo Burro. Swift noted that the Sycamore Creek lagoon usually has tidewater gobies, at least, and less commonly the other fish species mentioned above, but since it is a small lagoon the species composition varies more with the season and connectivity to the ocean (pers. comm. Swift 2005). Exotic mosquito fish are also present in Laguna Creek upstream of the pump house (pers. comm. Johnson 2005). It is likely that addition fish species occasionally enter the City lagoons from the ocean and utilize these aquatic habitats and some species would migrate upstream to some extent given adequate migration at fish barriers.

5.11 Arroyo Burro Watershed Conditions-Fisheries

Fisheries Occurrence

Arroyo Burro does not appear to currently support a salmonid population. Stoecker observed no salmonids during extensive surveying of the watershed in 2001 and 2002 (Stoecker 2002). Daniel Wilson did not observe any salmonids while conducting extensive field surveys of Arroyo Burro for the *Creek Inventory and Assessment Study* by URS in 2000 (pers. comm. Wilson 2005). More than one adult steelhead was reportedly observed by City of Santa Barbara Public Works personnel in lower Arroyo Burro as recently as they early 1980's (pers. comm. Trautwein, Stoecker 2002). The owner of the San Roque Ranch, Mr. Klein, reported that a family that has lived in the Arroyo Burro watershed since the 1800's informed him about the presence of steelhead and trout in lower San Roque Creek and Arroyo Burro before the 1940's" (Stoecker 2002). An anecdotal reference of historical salmonid presence came for Ed Henke, who has been conducting historical research on southern steelhead. A requested document from Henke noted that "Steelhead", "Salmon", and "Native/Resident Trout/Juvenile Steelhead" occurred in Arroyo Burro sometime in the past. It is likely that rainbow trout and anadromous steelhead utilized Arroyo Burro extensively in the past when adequate migratory access occurred between the ocean and suitable spawning and rearing habitat in the upper watershed.

Fisheries Habitat Conditions

Stoecker conducted salmonid habitat assessment surveys of Arroyo Burro in 2001 and 2002. Arroyo Burro contained 7.21 miles of habitat for steelhead from the ocean to a natural upstream barrier in upper San Roque Creek. With a maximum score of 1.00, salmonid habitat quality within the Arroyo Burro watershed ranged from extremely poor (0.17) within the concrete reach from Highway 101 to Hope Avenue to good to excellent (0.85) in upper San Roque Creek. Average salmonid habitat quality for the Arroyo Burro watershed was fair at 0.54. The total salmonid habitat score (quality x quantity) for Arroyo Burro was 3.72, which ranked 10th highest out of 24 watersheds along the southern Santa Barbara County coast (Stoecker 2005).

Lower Arroyo Burro

The Arroyo Burro lagoon has been significantly reduced in size and is constricted by adjacent parking lots and the Cliff Drive Bridge. The lagoon does retain some heterogeneity with riparian vegetation along the upper north side and native banks along the east side. A recent study by ECORPS Consulting noted that the Arroyo Burro lagoon has the highest quality lagoon habitat in the City and greatest density of tidewater goby. Lower Arroyo Burro retains surface flows throughout the summer and fall due to the prolific systems of springs near Veronica Springs. This summer flow could provide adequate rearing conditions for salmonids and other fish species and helps to sustain the lagoon water elevation.

Upstream of Cliff Drive the exotic giant reed becomes extremely dense. Failed pipe and wire revetment is present. Increased bank erosion and high siltation in the streambed occur. Silt and sand deposits over 2 feet deep occur in some stream reaches. Significant migration barriers to all fish species occur at the Cliff Drive grade control structure and a private grade control structure 0.33 miles upstream of Cliff Drive.

Middle Arroyo Burro (Las Positas Creek to San Roque Creek)

Salmonid habitat conditions improve upstream of Torino Drive with an increase in undercut banks, run/pool habitat, mature riparian canopy, and a decrease in fine sediment deposits in the streambed. Exotic plant species continue to dominate the riparian understory. Fair rearing habitat for salmonids occurs in this reach upstream to the Highway 101 outlet, with scattered, but consistent, shallow pools and runs and the presence of groundwater seeps and small springs that maintained low surface flows during summer 2001 surveys (Stoecker 2002). Spawning conditions for salmonids is poor in this reach due to moderate to high substrate embeddedness and a low amount of adequately sized substrate. Significant migration barriers to fish occur at the Torino Drive culvert, the Calle de los Amigos culvert, a small dam, a metal pipe and boulder blockage, and extensive interlocking concrete culverts and channelization extending from Highway 101 upstream to the San Roque Creek/Arroyo Burro confluence.

Upper Arroyo Burro (Upstream of San Roque Creek)

Upstream of San Roque Creek, Arroyo Burro is a small tributary that can dry out by mid summer. Habitat conditions are poor to fair with high substrate embeddedness and apparent lack of adequate summer flow and pool habitat. This reach of Arroyo Burro has not been extensively surveyed, but does not appear to contain significant habitat value for potential future salmonid restoration.

Las Positas Creek

Las Positas Creek has been highly modified by concrete channelization and contains poor habitat conditions for fish and other aquatic species.

San Roque Creek

San Roque Creek is the primary headwater tributary of the Arroyo Burro watershed. Upstream of the Arroyo Burro confluence, San Roque Creek contains a higher percentage of cobbles and boulders and a reduction in fine silts and sand deposits. Trickling surface flows were still observed just upstream of Arroyo Burro in July 2001 (pers. obsrv. Stoecker 2001). Salmonid habitat conditions are fair in lower San Roque Creek. Surface flows become sporadic upstream of Hitchcock Street. Minimal riparian canopy cover occurs upstream of State Street where adjacent parking lots and development have constricted the stream channel with associated concrete bank revetment. The creek also becomes dry upstream of this concrete revetment to the Highway 192 Bridge during mid summer. Fewer “backyard” exotic plant species occur from the downstream end of Stevens Park upstream. Mature sycamore, live oak, and alder trees occur and increase the canopy cover to over 60%.

During July 2001 surveys, summer surface flows were observed to occur from the Highway 192 Bridge upstream to the upper identified natural barrier within Rancho San

Roque. Water temperatures of 68 degrees Fahrenheit were measured during this time and fair to good salmonid spawning and rearing habitat conditions were observed. Summer pool habitat occurs upstream of Highway 192 and larger boulders provide good instream cover. Aquatic insects are moderately abundant as a food source. A high diversity of mature riparian trees provides shade and canopy cover up to 85%.

Upstream of the San Roque Debris Dam, salmonid habitat conditions improve with an increase in pools depth and frequency, instream cover, boulders, spawning gravel conditions, and cooler summer water temperatures. High quality salmonid habitat conditions continue to occur upstream into Rancho San Roque where clean spawning gravels occur in conjunction with plunge pool type rearing habitat. Upper San Roque Creek has adequate habitat conditions to support a self-sustainable population of rainbow trout and anadromous steelhead population if migratory access is provided at downstream barriers. Significant fish passage barriers occur at the Hitchcock Street culvert, the San Remo Drive culvert, several grade control structure upstream and downstream of the Ontare Road Bridge, and the County's San Roque Debris Dam.

6.11 Mission Creek Watershed Conditions- Fisheries

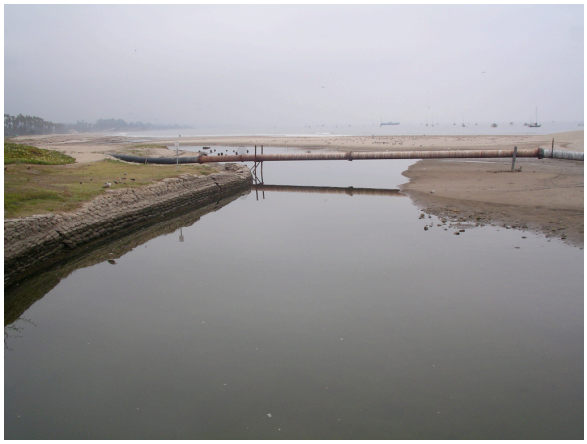
Fisheries Occurrence

Mission Creek is the only watershed draining through the City of Santa Barbara that has extensive historical records of *O. mykiss* presence, including adult steelhead occurrence. *O. mykiss* have consistently been observed in historic and contemporary times throughout the Rattlesnake Creek tributary and the main stem of Mission Creek downstream of Rattlesnake Creek. Rainbow trout in Rattlesnake Creek have been observed successfully spawning upstream and downstream of Las Canoas Bridge between April and June (pers. obsrv. Stoecker 2001-2004). Historic records of *O. mykiss* upstream of Rattlesnake Creek in upper Mission Creek could not be found despite an abundance of high quality salmonid habitat upstream to a large impassable waterfall under the Tunnel Road bridge crossing. No *O. mykiss* were observed during extensive ground and snorkeling surveys of upper Mission Creek by Stoecker in 2001 and 2002 and it appears that the population has been extirpated from upper Mission Creek. It is likely that upper Mission Creek is not being recolonized by *O. mykiss* from adjacent populations on Rattlesnake and Mission Creek due to a natural, 6-foot tall boulder cascade barrier that occurs immediately upstream of the Rattlesnake Creek confluence. *O. mykiss* were observed in the pool immediately downstream of this cascade where Rattlesnake Creek flows into Mission Creek, but none were observed upstream (pers. obsrv. Stoecker 2001). While smaller *O. mykiss* appear to be unable to migrate upstream of this cascade due to jump height limitations, stronger adult steelhead would be able to migrate upstream of this cascade with relative ease with moderate to high stream flows. By providing adequate fish passage at several impassable migration barriers downstream, adult steelhead will be able to naturally recolonize upper Mission Creek in the future and greatly expand the watersheds *O. mykiss* population size and distribution. Due to the high quality spawning and rearing habitat conditions in Mission Creek and Rattlesnake Creek, the Mission Creek watershed holds the greatest potential for restoring a viable, self-sustainable steelhead population.

Fisheries Habitat Conditions

Stoecker conducted salmonid habitat assessment surveys of Mission Creek in 2001 and 2002. Mission Creek contained 9.26 miles of habitat for steelhead from the ocean to upstream impassable waterfalls in upper Mission Creek and Rattlesnake Creek. With a maximum score of 1.00, salmonid habitat quality within the Mission Creek watershed ranged from extremely poor (0.08) within the CALTRANS concrete channel to excellent (0.96 and 0.94) in upper Rattlesnake Creek and upper Mission Creek, respectively. Average salmonid habitat quality for the Mission Creek watershed was fair to good at 0.63. The total salmonid habitat score (quality x quantity) for Mission Creek was 5.67, which ranked 5th highest out of 24 watersheds along the southern Santa Barbara County coast (Stoecker 2005).

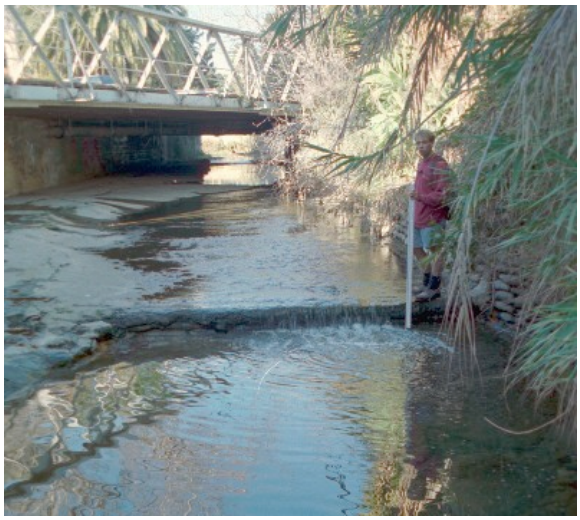
Mission Creek Lagoon



The Mission Creek lagoon is highly confined by urban development. The lagoon provides important habitat for a variety of previously mentioned fish species, including migratory steelhead. A recent ECORP Consulting study of the tidewater goby within the Mission Creek lagoon concluded that marginal habitat conditions seem to be the limiting factor in tidewater goby abundance (Johnson 2005). The lack of structural complexity and urban pollution inputs have decreased the aquatic habitat conditions for all fish species that currently and historically utilized this lagoon. The lagoon continues to provide an important acclimation zone for migrating adult and juvenile steelhead trout as they transition between fresh and saline environments.

Lower Mission Creek

Three separate concrete-lined channel reaches totaling 1.15 miles occur along the downstream 2.49 stream miles of Mission Creek. This lower reach of Mission Creek consists of many different types of bank protection measures carried out by various entities over the past. The most downstream Santa Barbara County Flood Control District channel measures 0.17 mile. The relatively flat channel gradient, presence of eroded holes, and vegetation growing along the river-left side allows upstream steelhead passage during moderate to high stream flows. Upstream passage is limited during low flows, when shallow water depth occurs throughout the channel length.



Two CALTRANS concrete-lined channels occur upstream. The downstream trapezoidal channel measures 0.74 mile. The slope of the downstream 200 feet of the channel measured less than 1%. Near the Anapamu pedestrian bridge crossing, Highway 101 crosses over a portion of the concrete channel where it enters a large box culvert. Upstream fish passage is not possible during low-flows due to the unconfined, shallow water depth across the channel. Upstream steelhead passage is prevented during moderate to high flows due to the lack of adequate resting areas and excessive water velocities. Steelhead spawning has been observed in recent years downstream from the first CALTRANS channel, but marginal habitat conditions, limited summer surface flows, and poor water quality likely do not permit juvenile fish to survive. Approximately 88% of the Mission Creek watershed occurs upstream of the downstream-most impassable CALTRANS channel. Alternative designs for providing steelhead passage within the CALTRANS channels are currently being developed and reviewed.

Upstream of the first CALTRANS channel, natural streambed conditions occur for 0.37 miles to the second CALTRANS channel, the outlet of which occurs downstream from the Mission Creek Bridge. Cobble and gravel substrate is dominant in this reach with relatively low substrate embeddedness. Spawning substrate size is adequate, but surface flows usually subside by early summer and could leave fish stranded. Several isolated pools may persist into summer and fall during wetter years and provide limited over-summering habitat for fish.

The second CALTRANS channel measures 0.27 mile. This concrete trapezoidal channel is similar to the downstream CALTRANS channel. A 2-foot drop occurs at the channel outlet. After this short jump upstream migrating steelhead would encounter

similar migration limitations as described for the downstream channel. This channel is shorter than the first CALTRANS channel, but the slope increases to 1.2% at the upstream end further limiting upstream fish passage due to excessive water velocities during higher flows, lack of resting areas, and shallow water depth during lower flows.

Upstream of the second CALTRANS channel, Mission Creek is typically dry upstream to near the Natural History Museum from early summer until after the first winter rains. The stream channel through Oak Park is in a fairly natural state with boulder and cobble dominated substrate and mature riparian trees. A grade control structure at Tallant Road presents an impassable barrier to upstream fish passage.

Mission Creek (Downstream of the Natural History Museum to Rattlesnake Creek)

Summer surface flows from upper Mission Creek and Rattlesnake Creek typically extend downstream past the Natural History Museum for several hundred yards before going subsurface. Rainbow trout occur throughout the summer from pools adjacent to the Museum upstream to the Rattlesnake Creek confluence. Salmonid spawning and rearing habitat conditions in this reach are fair to good with fairly clean, adequately sized substrate, adequate instream cover, mature riparian canopy conditions, and step-pool habitat. Significant fish migration barriers occur at a grade control structure adjacent to the Museum, the Mission Canyon Road Bridge, and the Highway 192 Bridge.
Mission Creek Upstream of Rattlesnake Creek

Upper Mission Creek

Despite the presence of high quality habitat conditions in Mission Creek upstream of Rattlesnake Creek, *O. mykiss* have not been observed in recent history upstream of a 6-foot tall boulder cascade immediately upstream of the Rattlesnake Creek confluence. The population was likely extirpated in the past and the smaller *O. mykiss* currently present downstream have not been able to jump upstream of the cascade. Adult steelhead would be able to jump the cascade and recolonize upper Mission Creek with downstream migratory access provided at barriers. Impacts from the Old Mission Dam and the construction of the Tunnel that conveys water through the Santa Ynez Mountains from Gibraltar Dam may have contributed to the *O. mykiss* decline and extirpation in upper Mission Creek. Significant fish migration barriers occur at the #2 Mission Canyon Road Bridge and an upstream pipeline crossing grade control structure.

Moderate to high quality spawning and rearing habitat conditions continue through the Santa Barbara Botanical Gardens to the impassable Old Mission Dam. Low stream flows go subsurface for several hundred feet upstream of the Old Mission Dam where permeable substrate has been deposited behind the dam. The dry dam deposits impose a considerable gap in aquatic connectivity for much of the year. Habitat conditions are further degraded upstream of the County's impassable Mission Creek Debris Basin Dam where operations denude adjacent riparian vegetation, increase erosion, and enable invasive exotic species to spread.

Upstream of the debris dam salmonid habitat conditions become excellent with an abundance of high quality spawning gravels associated with excellent pools up to 8 feet in depth and abundant instream and riparian cover. Future fish passage efforts at downstream migration barriers will allow steelhead to naturally recolonize upper Mission Creek to a 15-foot tall bedrock waterfall underneath the Tunnel Road Bridge crossing.

Rattlesnake Creek

Rattlesnake Creek contains high quality habitat conditions from Mission Creek upstream to the Las Canoas Road Bridge. A reproducing *O. mykiss* population occurs throughout this reach where adequate spawning substrate conditions and pools are present in moderate to high abundance. Salmonid habitat conditions continue to improve upstream of Las Canoas Road, except at the County's impassable Debris Basin Dam where the stream channel is routinely filled with debris and then excavated. Habitat conditions are degraded upstream of the Debris Basin Dam where operations denude adjacent riparian vegetation, increase erosion, and enable invasive exotic species to spread. Immediately upstream of the debris basin, spawning and rearing habitat conditions become excellent with abundant instream and riparian cover, clean spawning substrate, undercut banks, and large boulder and bedrock pools up to 7 feet deep. A reproducing population of *O. mykiss* is present from Mission Creek upstream for over 2 miles to a series of bedrock waterfalls.

7.11 Sycamore Creek Watershed Conditions- Fisheries

Fish Occurrence

Sycamore Creek does not appear to currently support a salmonid population, although much of the watershed has not been adequately surveyed. No salmonids were observed during limited March 13, 2005 surveying by Stoecker. Daniel Wilson did not observe any salmonids while conducting extensive field surveys of Sycamore Creek for the *Creek Inventory and Assessment Study* by URS in 2000 (pers. comm. Wilson 2005). Only anecdotal references to historic salmonid occurrence in Sycamore Creek were found during extensive historical research of material and interviews (Stoecker 2002). One reference came from Ed Henke, who has been conducting historical research on southern steelhead occurrence. A requested document from Henke noted that "Native/Resident Trout/Juvenile Steelhead" occurred in Sycamore Creek at some time in the past.
A small populations of *O. mykiss* likely occurred in the upper reaches of this system historically with occasional adult steelhead migration upstream from the ocean during some years.

Historically, natural droughts, fires, and natural erosion have likely been significant limiting factors for *O. mykiss* productivity in Sycamore Creek. Low summer stream flows and highly erosive soil downstream of Conejo Road continue to limit salmonid habitat conditions. Periodic cycles of extirpation and recolonization of *O. mykiss* due to natural events likely occurred in the past. Urban development, construction

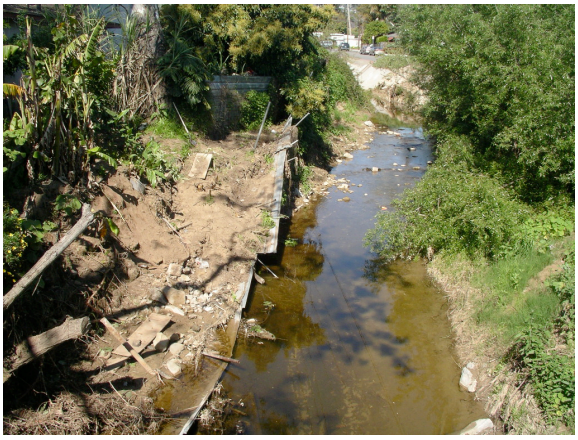
of migration barriers, water extraction, riparian degradation, increased erosion, and reduced water quality have only further limited this watershed and its fisheries potential. It is uncertain whether this system could support a viable population of *O. mykiss* in the future due to the natural and anthropogenic limitations. Fortunately, Sycamore Creek does not appear to have many complicated fish migration barriers and adequate access could be provided too much of the watershed at a relatively low cost compared to other watersheds on the southern Santa Barbara County coast. In order to revive a population of *O. mykiss* to Sycamore Creek, restoration efforts should focus on providing fish passage to headwater habitat, reducing erosion, sustaining adequate surface flows and possibly increasing surface flows by reducing potential water extraction.

Fisheries Habitat Conditions

Sycamore Creek Lagoon

The lagoon at the mouth of Sycamore Creek is highly constricted by adjacent housing developments, roadways and road crossings. The streambed is mainly comprised of sand and silt. Stream flow was observed across the sandbar through a small channel 7 feet wide and between 2-7 inches in depth during February 2005 (pers. obsrv. Stoecker 2005). Out-migration of fish species would be possible during observed flows and limited upstream access from the ocean would be possible for smaller fish species or life stages. The lagoon was observed to extend upstream to a triple-box culvert road crossing to the Santa Barbara Zoo. The lagoon provides limited, but important habitat for estuarine fish species.

Lower Sycamore (Between the Santa Barbara Zoo Culvert and Alameda Padre Serra)



Lower Sycamore Creek is highly impacted by urban development, however the stream has not been confined to a concrete channel and retains a semi-natural streambed. Several road crossings of various configurations occur in this reach. Some of these crossings would present mild to moderate fish passage impediments to upstream migrating salmonids. Pipe and Wire revetment in various states of failure occur throughout much of this reach. Mature, native riparian vegetation mixed with a high abundance and diversity of exotic plant species occurs throughout this reach. Relatively poor to fair quality salmonid habitat conditions occur with a highly embedded silt and sand dominated substrate bottom, limited pool development, low to absent summer stream flows, and impacted water quality.

Middle Sycamore

Upstream of Alameda Padres Sera, the Sycamore Creek channel is confined as it cuts through the erosive foothills north of Santa Barbara. Dozens of private road crossings and driveways occur in this reach. Heavy winter rains frequently cause severe landslides on adjacent stream banks and hillsides. The stream substrate was observed to contain a high amount of fine sediment resulting in substrate embeddedness of 60% or more. Mature, native riparian trees including Sycamore, Live Oak, and Willow are present. Large boulders occur in this reach and create step pool and pocketwater habitat with pools up to 3 feet deep. A large boulder cascade occurs just downstream of the

Sycamore/Coyote Creek confluence. Step pool habitat occurs downstream of the cascade with a 3 foot deep pool and adequate salmonid rearing habitat. Spawning substrate conditions are limited due to the high amount of fine sediment deposition and embeddedness.

Upper Sycamore

Just upstream of the Shefield Creek confluence a large boulder cascade occurs with multiple drops up to 3 feet in height. This cascade may limit upstream salmonid passage during all but high stream flows. Within Parma Park just upstream of the East Fork of Sycamore Creek, two boulder cascades drop approximately 4 feet each into small downstream pools less than 1-foot in depth. Each of these cascades would present a high severity barrier for all salmonid life stages during all stream flows. Upstream passage is unlikely, but may be possible for adult steelhead during ideal migration flows. Significant fish migration barriers occur at the Conejo Road culvert and the Stanwood Drive culvert.

Coyote Creek

At the Stanwood Drive Bridge, Coyote Creek contains fair habitat conditions for salmonid spawning and rearing with a low abundance of moderately embedded spawning gravels and small pools up to 2 feet in depth. Two impassable concrete grade control structures occur immediately upstream from the Chelham Creek confluence that would effectively block upstream salmonid migration into Coyote Creek.

Chelham Creek

Chelham Creek contains fair habitat conditions for salmonid spawning and rearing upstream from Coyote Creek with a low abundance of moderately embedded spawning substrate and small pools up to 2 feet deep. Upstream of Coyote Road the creek channel is much smaller and low surface flows were present in March of an above average precipitation winter (pers. obsrv. Stoecker 2005). The persistence of summer flows in Chelham Creek is not well known, but may be a significant limiting factor to potential future salmonid presence. Significant fish migration barriers occur at a concrete grade apron just upstream of Coyote Creek, the Coyote Road culvert, both Highway 192 culverts, a private driveway crossing adjacent to Highway 192, and at the Chelham Way culverts.

Westmont Creek

This creek was only observed immediately upstream of the confluence with Chelham Creek where an impassable 10-foot tall debris dam occurs. Trickling surface flows were observed in March of an above average precipitation winter (pers. obsrv. Stoecker 2005). The persistence of summer flows in Westmont Creek is not well known, but appears to be a major limiting factor to potential future salmonid presence.

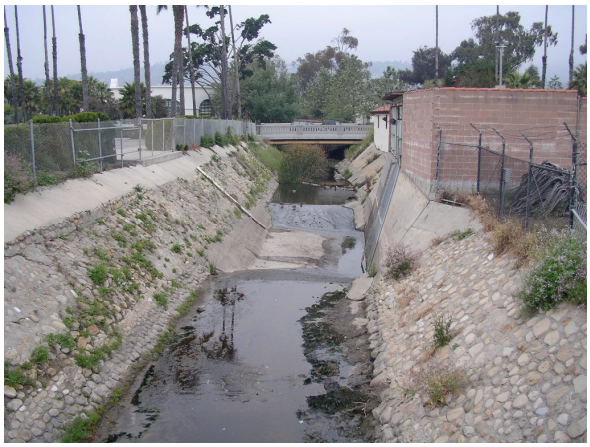
8.11 Laguna Creek Watershed Conditions- Fisheries

Fish Occurrence

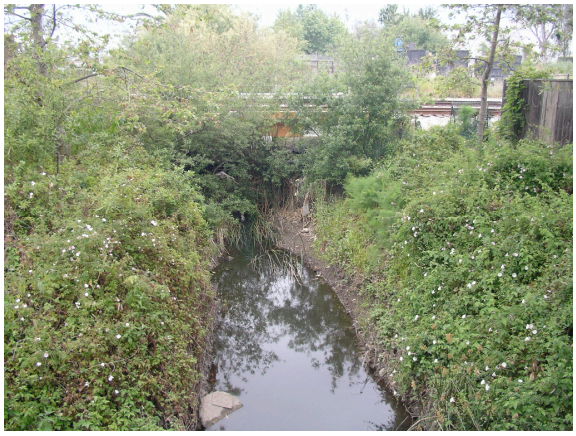
No observations or documentation of *O. mykiss* are known for Laguna Creek although the lagoon typically flows into the Mission Creek lagoon, which does support steelhead. Fish species occurrence in the Laguna Creek lagoon is likely similar to that of the connected Mission Creek lagoon. Tidewater goby presence "on the ocean side of the tidal gates" was noted in the URS 2000 report. George Johnson noted the presence of Gambusia upstream of the tidal gates in Laguna Creek (pers. comm. Johnson 2005).

Lower Laguna Creek and Lagoon

Laguna Creek is typically a tributary to the Mission Creek lagoon, depending on sandbar formation, tidal elevation, and seasonal lagoon configuration. The Laguna Creek lagoon and upstream watershed are highly modified and constricted by a tidal dam, concrete channelization, water pumping facilities, drainage pipes, and an extensive underground urban drainage system. These modifications have reduced the size and ecological function of the lagoon and lower creek. Downstream of Cabrillo Boulevard, Laguna Creek is confined to an irregular trapezoidal channel constructed of both concrete and cobble. The channel extends downstream from Cabrillo Boulevard and drops in elevation to a large metal debris grate. An eastern channel breaks off the main channelized reach and conveys flows through the debris grate into a pump house water collection area. Downstream of the metal debris grate the western concrete channel extends downstream to a tidal gate dam, which prevents tidal flows from extending upstream. Creek flows that do not enter the pump house flow through this tidal gate dam and into the western arm of the lagoon. Creek flows that enter the pump house are pumped into an eastern concrete trapezoidal channel that conveys flows downstream across a boulder riprap apron and into the eastern arm of the lagoon. Two corrugated metal pipes also direct lower flows from the eastern concrete channel through the island separating the two channels and into the western lagoon arm just downstream of the tidal gate dam.



This channelized pumping station complex is intended to prevent the expansion of tidal water upstream and the accumulation of creek floodwaters upstream. The Laguna Creek streambed between the Highway 101 freeway and the pump house is reportedly lower in elevation than the high tide elevation and without the tidal gate dam tidal flows would migrate upstream. Combined high creek flows and culvert discharge do not drain to the ocean well and can flood adjacent buildings and streets. The pump house periodically pumps flows to the lagoon preventing water from backing up in the upstream channel.



Laguna Creek has a natural substrate bottom upstream of Cabrillo Boulevard to Highway 101. The creek is impacted by adjacent development, but sustains exotic mosquito fish and therefore contains year-round flow during most summers and could support native fish species with adequate migratory access from the lagoon. Upstream of Highway 101, Laguna Creek is mainly comprised of a network of underground culverts and urban street drainages.

9.8.1 Arroyo Burro Watershed Specific Issues (Constraints/Opportunities)

Lagoon Enhancement

Long-term objectives for Arroyo Burro lagoon restoration should include assessing the feasibility of reducing the size of the main parking lot at the Brown Pelican and Watershed Resource Center and establishing a buffer of native vegetation along the lower lagoon. This action would help to reduce the direct drainage of automotive pollution and parking lot runoff into the lagoon. Eliminate or reduce the size of the overflow parking lot to the north along the upper lagoon, allowing lagoon expansion and creating a native vegetation buffer along the lagoon would enhance lagoon function and water quality. Eliminating the Cliff Drive Bridge and entire downstream grade control structure would allow lagoon expansion upstream and unimpeded migration for all aquatic lagoon species, including adult steelhead. Replacing the undersized Cliff Drive Bridge with a wider span bridge that does not impact the stream channel could also provide a larger storm flow conveyance capacity. This long-term planning effort should also identify methods to reduce the amount of storm water being conveyed directly into the lagoon through several existing storm drains.

Cliff Drive Bridge and Grade Control Structure

This concrete and boulder grade control structure occurs immediately downstream of the Cliff Drive bridge. This structure represents a severe barrier to upstream fish migration and limits estuary size and function. Short-term steelhead passage modifications are currently being planned at this site. A series of resting/jumping pools are scheduled to be created within the apron during the summer of 2005. Complete removal of the structure and bridge should be coordinated with a long-term lagoon restoration planning effort.

Grade Control Structure 0.33 miles upstream from Cliff Drive Bridge

This concrete and boulder grade control structure measures 6 feet 2 inches tall and contains slopes between 20-30%. This dam-like structure is completely filled with sediment on the upstream side. Due to the excessive slopes encountered and lack of resting areas, upstream steelhead passage is likely not possible during all stream flows. An estimated 91.1% of the watershed occurs upstream of this structure. The most effective, self-sustainable solution for ensuring effective fish passage at this site is to remove all or most of the structure, reinforce adjacent stream banks using bioengineering techniques and stabilizing the stream grade. A detailed assessment of this structure needs to be conducted to determine potential implications of removal. Several homes adjacent

to the stream channel would be impacted by removal and require sufficient bank protection measures. Providing fish passage at this site is a high priority for future steelhead recolonization.

Torino Drive Culvert

This concrete double-box culvert measures 117 feet in length with a slope of less than 1%. Each culvert box measures 11 feet 10 inches tall by 12 feet wide. The outlet of the culvert drops vertically 2 feet 9 inches to a smooth concrete apron that extends downstream 11 feet with a slope of 2%. This concrete apron transitions into a boulder and concrete riprap apron that extends downstream 35 feet with a slope of 15%. The outlet of the apron drops 1-foot to the downstream natural substrate. This double box culvert is a complete barrier to fish passage due to the steep slopes encountered on the apron, lack of resting areas on the upper reach of the apron, excessive jump height at the culvert outlet, and shallow water depth or excessive water velocities encountered inside the apron. The most effective fish passage project at this site would be to remove the entire structure and replace it with a wide-span bridge that does not impact the stream channel.

Broken Grade Control Structure

This small concrete and boulder grade control structure occurs near the 100-foot elevation and spans 17 feet across the creek. The old structure is in poor conditions with adjacent failed concrete culverts and bank erosion on river-right. During low stream

flows a 1-foot 3 inch drop was measured downstream of the structure to a downstream pool measuring 3 feet in depth. This structure should be removed and banks stabilized to improve fish passage during low stream flows and decrease erosion on the river-right bank. Additional investigation is needed to determine if the concrete is protecting an underground utility and the potential impacts of removal.

Calle de los Amigos Culvert

This concrete double-box culvert measures 76 feet in length with a slope of less than 1%. Each culvert box measures 12 feet tall by 12 feet wide. The outlet of the culvert is at streambed grade. An irregular inlet apron comprised of embedded boulders and cobbles extends upstream from the culvert 34 feet with a slope of 24% at the upper smooth concrete portion. This double box culvert is a high severity barrier to fish passage due to the steep slopes encountered on the inlet apron, lack of resting areas on the upper reach of the apron, and shallow water depth or excessive water velocities encountered inside the apron. The most effective fish passage project at this site would be to remove the entire structure and replace it with a wide-span bridge that does not impact the stream channel.

Small Dam/Grade Control Structure

This concrete structure spans 41 feet across the stream channel and drops flows 3 feet onto a concrete apron that extends 12 feet downstream. This structure would prevent any upstream fish passage during low and moderate flow conditions. The structure could

allow very limited upstream steelhead passage during high flows when the concrete apron is submerged more than 2 feet in depth. Additional investigations are needed to determine the current use and desirability of this structure. If the structure is not necessary, it should be removed to provide effective fish passage in the future.

Two Grade Control Structures

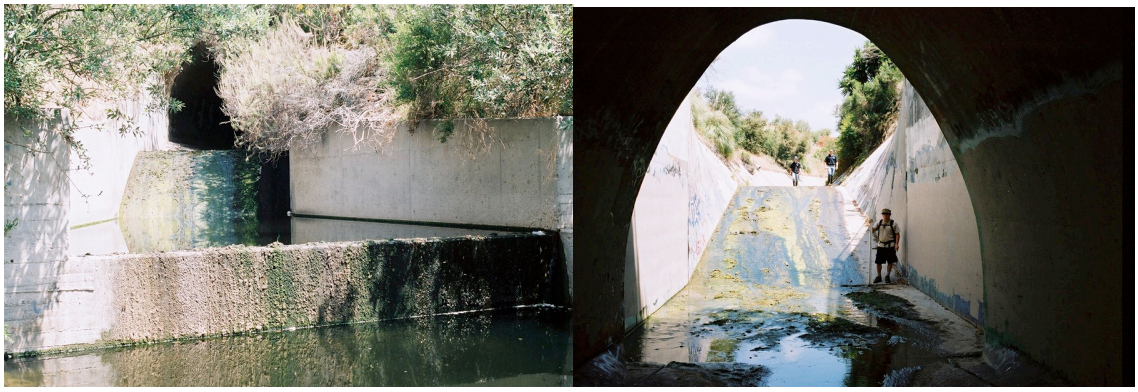
These two small concrete grade control structures are approximately 80 feet apart from each other and occur downstream 0.2 miles from Highway 101. Neither structure represents a severe fish migration barrier, but both could be notched at center or removed to improve low-flow fish passage conditions.

Metal Pipe and Boulder Blockage

This failed pipe and boulder occurs 0.17 miles downstream of Highway 101 and severely confines the stream channel. Metal pipes span across the channel and are partially buried by large imported boulder. A 14-foot long flat concrete slab occurs downstream and a near vertical sacrete bank revetment occurs on river-left. The boulders extend over 6 feet tall above the downstream concrete slab. During lower stream flows all water is conveyed under the boulders and upstream sediment deposits. The concrete slab prevents downstream pool formation and the excessive jump height of the pipe and boulder blockage would prevent upstream salmonid passage during most or all flows, depending on configuration and higher flow routing. Failed pipe and wire revetment

upstream is further confining the creek and causing bank failure and a high amount of erosion. This barrier and adjacent reaches needs to be further assessed to determine the feasibility of removing much of the modifications within the channel, providing effective fish passage, expanding channel flow capacity, reducing bank erosion, and stabilizing the stream channel using bioengineering approaches.

Highway 101 and Union Pacific Culvert



This complex culvert crossing contains a steep inlet apron that connects to upstream concrete channelization and a steep outlet apron that connects to a downstream concrete scour box. The downstream concrete wall of the scour box rises 3 feet above the downstream pool surface. The scour box measures 20 feet wide by 30 feet long and contains 9-foot tall sidewalls. The culvert outlet apron extends into the scour box, which has a maximum water depth of 4 feet. The outlet apron rises 5 feet above the box with a slope of approximately 45% to a mild sloping apron that extends 16 feet upstream to the culvert outlet. The concrete arch culvert measures 12 feet 6 inches tall by 13 feet wide at the base. The culvert length is approximately 0.08 miles. The inlet apron extends 51 feet to the upstream concrete channel with a steep slope of 18%. This culvert structure is impassable to all salmonid life stages during all flows due to excessive velocities and/or shallow water depths encountered on both inlet and outlet aprons and through the culvert. Providing fish passage at this site needs to be coordinated with the upstream concrete channel and requires a detailed assessment.

Concrete Channelization and Hope Avenue Culvert

A concrete channel extends from the inlet apron at the Highway 101 culvert upstream and connects to a culvert under Hope Avenue. The combined structures confine the creek to approximately 0.28 miles of concrete bottom upstream to the confluence of Arroyo Burro and San Roque Creek. The trapezoidal concrete channel measures 15 feet 6 inches across the flat bottom. The slope of the channel near the upstream end measures less than 1%. The upstream end of the channel connects to a double box culvert under Hope Avenue. Both boxes measure 16 feet tall by 16 feet wide. A smooth concrete inlet apron extends 50 feet with a slope of 7%. Arroyo Burro and San Roque Creek meet at the top of the inlet apron. Upstream steelhead migration is not possible during lower flows when shallow water is spread out across the channel and culvert or during higher flows when excessive velocities would be encountered on the steep culvert inlet apron. A detailed fish passage assessment is need for this entire reach in conjunction with the downstream culvert at Highway 101. Naturalization of the channel bottom and bridge replacement at Hope Avenue would provide the most effective fish passage and stream habitat restoration alternative.

Hitchcock Street Culvert

This single-box concrete culvert measures 102 feet long and 6 feet tall by 10 feet wide. The slope inside the smooth bottom culvert measured less than 1%. An outlet apron extends 17 feet 6 inches downstream from the culvert and drops 1-foot to the substrate below. This structure would prevent upstream steelhead passage during most flows due to the lack of resting areas, excessive length, shallow water conditions during lower flows, and excessive water velocities during higher flows. A detailed assessment of this structure should be conducted to determine if the culvert is adequately sized for a 100-year flow event and determine the feasibility of replacing it with a wide-span bridge. A bridge would provide increased flow conveyance, the most effective fish passage, and restored stream habitat.

State Street Culvert

This double-box concrete culvert and inlet apron measure 189 feet long and each box measures 10 feet tall by 10 feet wide. The slope inside the smooth bottom culvert measured less than 1%. This structure would limit upstream steelhead passage due to shallow water depth during lower flows and excessive water velocities during higher flows. An assessment of this structure should be conducted to determine the feasibility of replacing it with a wide-span bridge or modifying the culvert for fish passage. A bridge would provide increased flow conveyance, the most effective fish passage, and restored stream habitat.

Riparian and Bank Restoration Upstream of State Street

Upstream of the State Street culvert the adjacent stream banks have been highly developed with concrete bank revetment on river-right and parking lots extending to the edge of both banks. The riparian canopy has been cut down in this reach and the stream is exposed to direct sunlight. A study should determine the feasibility of removing at least 25 feet of both parking lots adjacent to the top of the stream bank, removing concrete revetment, using biotechnical bank stabilization, and reestablishing native riparian over-story vegetation. This action would reduce pollution inputs from the parking lots, provide shade for the stream, reduce erosion, and improve riparian and aquatic habitat conditions.

San Remo Drive Culvert

This double-box culvert measures 82 feet 6 inches long and each box measures 8 feet tall by 8 feet wide. The slope inside the smooth bottom culvert measures 2%. The outlet of the culvert drops 1-foot 7 inches to a boulder and concrete apron that extends between 8 and 15 feet downstream. The downstream apron does not allow pool development preventing salmonids from jumping into the culvert during migration flows. In addition, the culvert would limit upstream steelhead passage due to shallow water depth during lower flows and excessive water velocities during higher flows. An assessment of this structure should be conducted to determine the feasibility of replacing it with a wide-span bridge. A bridge would provide increased flow conveyance, the most effective fish passage, and restored stream habitat.

Grade Control Structure Downstream of Ontare Road

This reach of stream has been modified with sacrete bank revetment and a sacrete and concrete grade control structure to protect adjacent homes on edge of the creek bank. The grade control measures 18 feet wide across the channel and 21 long with a slope of 3.6%. The outlet of the structure drops 2 feet 4 inches to the downstream substrate. A stormwater drain 3 feet 6 inches in diameter empties onto the structure. Adjacent bank revetment is damaged and undercut in several locations and failed pipe and wire revetment occurs downstream. Upstream steelhead passage at this site would be limited due to the jump height onto the structure, shallow water depth during lower flows, and excessive water velocities during higher flows. When adequate jump depth occurs in the downstream pool during moderate flows some adult steelhead would be able to jump onto the structure and swim upstream. A study should be conducted to determine the

feasibility of removing or modifying this structure and potentially the adjacent bank revetments and establishing a stabile naturalized channel. In addition, the failed pipe and wire revetment downstream should be removed and the stormdrain should be studied to determine how best to prevent direct, untreated discharge into the creek.

Five Grade Control Structure Upstream of Ontare Road

A patchwork of five concrete and sacrete grade control structures occur over a stretch of approximately 400 feet beginning approximately 700 feet upstream of the Ontare Road bridge. These structures tie into bank revetment projects of various design and condition. They range from 6 inches to 2 feet 6 inches in height and span 14 to 18 feet across the channel. Upstream migrating steelhead could jump or swim past each of these structures during moderate to high flow events, but would be limited during lower flows due to the jump height and shallow water depths encountered across the structures. Each structure should be removed or notched at center to confine lower stream flows, reduce the required jump height, and improve low-flow migration.

Southern California Gas Company Pipeline Grade Control Structure

A shallow U-shaped concrete and boulder riprap grade control structure occurs under the Highway 192 Bridge. The concrete measures 21 feet wide by 27 feet long with a slope of 2.5%. Flows drop 9 inches from the outlet to the downstream substrate. Sufficient velocity breaks occur on the structure to allow upstream steelhead passage during most flow conditions, but low flow passage may be limited due to shallow water

depth and the short jump height. High stream flows may produce excessive velocities for upstream migration by smaller salmonids. Additional assessment of the structure is needed to determine the feasibility of removing the concrete and installing an aerial pipeline crossing.

San Roque Creek County Debris Basin Dam

This concrete and boulder debris basin dam conveys flows through a 3-foot diameter corrugated metal culvert with a length of approximately 80 feet. The damaged, rusty culvert has been lined with a smooth concrete bottom. The culvert is completely broken through for much of the culvert length. Downstream of the culvert outlet, low stream flows drop 1-foot 8 inches down the steep concrete dam face into a 2-foot 5-inch deep downstream pool. The length of the culvert, smooth surface, and lack of velocity breaks would produce excessive water velocities that would prevent upstream steelhead passage during all flows. The upstream debris basin is routinely cleared of debris and the stream is highly exposed to direct sunlight. Native vegetation has been cleared and exotic plant species dominate the basin and are spread downstream. Additional studies are needed to assess the feasibility of modifying or removing this dam and potential impacts to the downstream environment and flood control operations.

9.8.1 Mission Watershed Specific Issues (Constraints/Opportunities)

The following descriptions of specific Mission Creek fish migration barriers, fish passage assessments, and recommended actions draw extensively from Stoecker 2002.

Lower Mission Creek Concrete Channels

Conceptual alternative designs are currently being investigated to provide fish passage at the CALTRANS concrete channels. It is recommended that as much of concrete channel as possible be removed and naturalized along with channel modification alternatives. In the short-term some channelized reaches will need to remain partially in place. For these reaches removal of the concrete bottom and establishment of a roughened bottom with the ability to retain natural substrate is recommended. This new channel bottom can be lower in elevation to increase channel capacity and tied into the existing concrete walls to maintain structural integrity. The new bottom should be able to focus lower stream flows to ensure adequate water depth and fish migration during low

flows. A long-term strategy should be developed to gradually and systematically acquire prioritized property from creekside landowners. With property acquisition it will be possible to eventually remove most or all of the concrete channel and establish a naturalized stream channel, riparian buffer zone, and recreational trail. The naturalized channel should also be expanded in size from the current concrete channel to improve flood flow conveyance. Bioengineered bank protection measures should be utilized to protect these naturalized reaches. Providing effective fish passage at these channels is the essential first step for restoring the Mission Creek steelhead population.

Pedregosa Street Grade Control Structures

Two grade control structures occur under the Pedregosa Street Bridge. Downstream of the bridge a 1-foot thick concrete curb extends across the channel between adjacent concrete walls. The curb height measured 3 feet above the surface of a concrete apron that extends downstream. The downstream side of the structure and adjacent bank revetments are substantially undercut. This structure would impede upstream steelhead passage during moderate and low flows when the downstream pool depth is not sufficient to allow jumping the structure. The curb should be modified or removed to provide unimpeded future steelhead passage. If removal is not possible, a notch approximately 3 feet wide and 8 inches deep should be cut near the center of the curb and a wide downstream-facing U-shaped notch cut in the apron immediately downstream of this curb notch. This would focus attraction flows, reduce the horizontal and vertical jump required, and help to create a deeper jump pool downstream. A small concrete grade control structure measuring 4 feet 6 inches thick extends 34 feet across the channel under the bridge. This structure is partial buried with substrate. Upstream fish passage over this structure would have a minimal degree of difficulty. If modifications to the curb downstream occur, removal of this structure should be considered or a notch should be cut at the center of the structure to concentrate low flows.

Tallant Road Apron

Underneath the Tallant Road Bridge a complex series of concrete-lined bottom and grade control features extend for 126 feet. The grade control structure measured 4 feet 2 inches in height above the downstream pool and flows dropped at an angle of approximately 45 degrees to a relatively flat 10-foot long apron. Upstream of the grade control, a mild sloping concrete bottom extends 42 feet upstream. A concrete apron with a slope of 8% extends 22 feet upstream to the base of a17 inch tall curb. Concrete extends under the bridge for 41 feet with a slope of 2.6% to natural substrate upstream. The structure has significant undercutting on the downstream end and adjacent banks due to scour. Upstream steelhead migration at this crossing would not be possible during all flow conditions due to the excessive jump heights, lack of jump pool depth at the concrete curb, and excessive water velocities over the concrete apron and bottom. The most effective fish passage project is to remove the entire structure and install a wide-span bridge that does not impact the stream channel. Additional studies are needed to assess the feasibility of removing this structure and stabilizing the upstream banks and private property. Replacement would also increase the channel flow capacity and reduce flooding potential at the bridge.

Natural History Museum Grade Control Structure

This concrete and boulder grade control structure is keyed into a stone revetment wall on the river-right stream bank and measured 24 feet across the channel. The downstream pool depth measured 2 feet 2 inches during low flow conditions and is limited by a concrete-lined bottom. The jump height from the pool surface to the top of

the structure measured 3 feet 2 inches during low flows. During moderate and low stream flows the structure limits upstream passage for smaller salmonids due to the limited depth of the concrete-lined pool downstream, moderate jump height, and significant horizontal jump distance. Increased jump pool depth during higher stream flows would enable upstream passage for most salmonids. Cutting a notch in the structure approximately 3 feet wide and 8 inches deep slightly toward the river-left side would improve upstream passage conditions for juvenile salmonids and future adult steelhead migration during lower flows. This action would reduce the jump height, length and steepness of the top of the structure, and concentrate flows toward the deepest part of the downstream pool for an increased jump depth.

Mission Canyon Road Bridge

This stone arch bridge has been reinforced with a concrete bottom and sloping apron that are significantly damaged. The concrete bottom and apron measured 58 feet in length. The smooth concrete apron measured 6 feet 11 inches in length with a slope of 31%. The jump height from the downstream pool surface to the top of the apron measured 2 feet 9 inches. During low flows the downstream pool jump depth measured 3 feet 4 inches. A small 7-inch deep pool in broken concrete exists at the upstream end of the sloping apron and extends upstream 16 feet. The upper 35 feet of concrete bottom has a slope of less than 2%. The concrete bottom is in poor condition with significant damage throughout its length. During moderate migration flows the downstream pool has sufficient depth to allow a moderately difficult adult steelhead jump upstream to the shallow pool and concrete channel. During high stream flows migration may become more difficult as stream velocities are accelerated along the concrete-lined bottom and down the sloping apron, pushing the jump location further back in the downstream pool. Additional analysis of this structure is needed to evaluate potential fish passage alternatives. Removing the entire structure and replacing it with a wide-span bridge that does not impact the stream channel would accomplish the most effective fish passage. Depending on the structural integrity of the bridge, portions of the concrete bottom may be able to be removed and bridge supports reinforced. Removal of the apron and creation of resting pools in the concrete bottom may be a cost effective solution.

Highway 192 Bridge Apron

Immediately downstream of the bridge a long concrete and boulder riprap apron extends 34 feet downstream with a slope of 11%. Flows drop vertically 9 inches off the apron into the downstream pool, which has a jump depth of over 4 feet. Exposed, damaged metal re-bar at the downstream end of the apron presents a significant hazard to upstream migrating salmonids. The apron is in poor condition with significant wear and undercutting on the downstream side. The apron is also causing major scour and bank erosion that appears to be contributing to loss of property on both downstream banks and undermining of the road fill. The downstream pool has sufficient depth to allow an easy jump onto the apron, but from there upstream migrating salmonids encounter excessive water velocities and/or shallow water depth that prevents upstream passage. Effective passage at this site is essential to providing upstream access to existing o. mykiss populations and for future steelhead recovery upper Mission and Rattlesnake Creeks. The most effective fish passage alternative would be the removal of the apron and either stabilize the existing bridge or replace it with a wide-span bridge out of the stream channel. Additional analysis is needed to determine suitable design alternatives.

Mission Canyon Road Bridge #2

This bridge has a stone block and concrete bottom that measured 66 feet long with an overall slope of 5%. The downstream end is extremely damaged with a large, irregular-shaped hole eroded completely through the concrete. A confined chute is eroded on the downstream 12 feet into the downstream pool. The downstream end of the

structure and adjacent bank revetments are significantly undercut and damaged. The downstream pool has sufficient depth to allow a moderately difficult jump upstream onto the concrete channel by an adult steelhead. Shallow water depth during low flows and excessive water velocities during high flows will limit the window of opportunity to upstream salmonid passage. Additional analysis is needed to assess the feasibility of naturalizing the streambed under the bridge and reinforcing the bridge supports should be studied. Complete replacement of the bridge with a wide-span bridge out of the stream channel would have the greatest benefit for fish passage and may help to increase the flow capacity and reduce or eliminate downstream erosion of the structure and adjacent private property.

Southern California Gas Co./City of Santa Barbara Pipeline Grade Control Structure

This concrete and boulder structure spans the entire stream channel and apparently was built to protect a subsurface pipeline. The jump height of the structure measures 3 feet 7 inches from the outlet lip to the downstream the pool surface. The structure is extremely undercut on the downstream side and at risk of failure. During moderate migration flows the downstream pool would fill sufficiently to increase the jump depth and reduce the jump height and allow limited upstream steelhead migration. This structure would present a significant impediment to juvenile salmonid migration during all flows and adult migration during low flows. Additional studies are needed to assess the feasibility of removing the structure and running the pipeline overhead out of the channel. This aerial conversion is a desirable modification and has been successfully implemented on Alder Creek in Santa Barbara County.

Exotic Plant Removal Upstream of Rattlesnake Creek

Upstream of the Rattlesnake Creek confluence there is a high abundance of exotic plant species that are taking over the native riparian vegetation. An infestation of Ivy occurs throughout much of this reach upstream into the lower portion of the Botanical Gardens. A creekside garden park called Creek Spirit is growing and dumping considerable amounts of exotic plant material into the creek, which may be spreading much of the exotics observed downstream. Efforts to remove and control the spread of exotic plant species should be undertaken in this reach.

Old Mission Dam-Santa Barbara Botanical Gardens

This 1807 dam historically diverted stream flows into an aqueduct that carried the water to a storage reservoir near the Mission. The total height of the dam from the downstream substrate to the top of the structure measured 27 feet 9 inches. The dam shows significant signs of wear, downstream scour, and adjacent bank erosion. Upstream passage of all salmonid life stages during all stream flows is prevented due to the excessive height of the dam. A detailed alternatives analysis should be conducted that looks at several fish passage options, including full and partial dam removal, to make the most informed decision about restoring future steelhead runs upstream. Dam removal would reestablish the aquatic connectivity of Mission Creek, open access to upper Mission Creek for eventual steelhead recolonization and restore surface flows upstream of the dam that often go subsurface into the sediment backed up behind the dam. A fish ladder is not encouraged due to their susceptibility to clogging and limited effectiveness under low flow conditions. The subsurface flow conditions that exist upstream of the dam for much of the year presents a significant problem for any fish passage project that leaves the dam in place.

Mission Creek County Debris Basin Dam

This County operated concrete and boulder debris basin dam conveys flows low flower through a smooth concrete culvert with a length of 68 feet 8 inches and slope of

6.1%. Downstream of the culvert outlet, stream flows drop 7 inches onto a small concrete apron that extends 3 feet downstream with a moderate slope. Flows then drop 2 feet 9 inches from the apron to the surface of the downstream pool. The length of the culvert, smooth surface, and relatively steep slope produce excessive water velocities with no resting areas that would prevent upstream passage. Additional studies are needed to assess the feasibility of modifying or removing this dam and potential impacts to the downstream environment and flood control operations.

Old Stone Dam

This stone dam measures 16 feet 6 inches across the stream channel with a height of 4 feet 2 inches above the downstream pool, which had a jump depth of 4 feet 11 inches. The structure is extremely undercut on the downstream side. The downstream pool has sufficient depth to allow a moderately difficult jump over the dam during ideal moderate flow conditions. Passage for juveniles and adult steelhead during low stream flows will be difficult or impossible depending on the depth of the downstream pool. This old dam does not appear to serve any purpose and no adjacent development would be impacted by its removal. This dam can be broken apart with relative ease, low cost, minimal consequence, and would provide significant benefit to future salmonid passage.

Rattlesnake Pipeline Crossing

A 20-inch diameter pipeline crosses the creek with damaged concrete across the top. The height from the surface of the downstream pool to the top of the pipe and

concrete measured 3 feet during low flows. The downstream jump depth measured 5 feet 6 inches. This pipeline crossing has experienced major undercutting and stream flow is now passing under the pipe in several places. Scour has eroded most of the sediment away from under the pipe. The downstream pool has sufficient depth to allow a moderately difficult jump over this structure during most flows. Additional studies are needed to assess the feasibility of removing the structure and running the pipeline overhead and out of the channel.

Rattlesnake Riprap Channelization

This channelized reach of Rattlesnake Creek measures approximately 30 feet in length and consists of concrete, imported boulders, sacrete riprap. The creek channel is confined to 10 feet in width for sections of this channelized reach. A large boulder keyed into the bank revetments on both sides produces a two-step drop approximately 6 feet in height above the downstream pool surface. This structure was likely built to protect the adjacent residences, which are precariously close to the stream channel on the adjacent banks. This patchwork of revetment projects has been built into the channel of the creek, reducing the flow capacity and width. Excessive jump heights and water velocities through this confined stream reach prevent all upstream fish passage. A detailed study of this stream reach is needed to formulate fish passage alternatives that also protect adjacent residences.

Private Bridge and Apron off Las Canoas Road

A concrete apron extends approximately 40 feet under a private driveway and drops a total of 4 feet to the downstream pool. The structure appears to be in fair condition with significant downstream undercutting and adjacent bank erosion. During low flows, the spread out and shallow water depth across the smooth concrete prevents all upstream fish passage. During moderate to high stream flows, excessive water velocities across the concrete and lack of resting areas would preclude upstream fish passage. The most effective fish passage option and traffic safety is to remove the entire structure and replace it with a wide-span bridge that does not impact the stream channel. Obtaining landowner support and conducting a detailed analysis of the bridge replacement is needed.

Obsolete Diversion Dam Downstream of Skofield Park

This old concrete diversion dam and 7-inch diameter pipe are no longer functioning. The pipe intake is buried by sediment upstream. The height of the dam above the surface of the downstream pool measures 1 foot 6 inches during low flows and the downstream pool measured 4 feet 1 inch deep. The structure is in poor condition with major undercutting on the downstream side due to scour. The downstream pool provides sufficient depth to allow upstream salmonid passage with a minimal to low degree of difficulty during all flows. This obsolete structure should be broken up and the metal pipe removed to prevent potential downstream pipe blockage with a structural failure and to improve upstream fish passage during low stream flows.

Aerial Pipeline Footing Blockage Downstream of Las Canoas Bridge

This aerial pipeline crossing has two separate structural supports in the stream channel that have blocked large boulders and debris creating several waterfalls and steep cascades over 6 feet in height with minimal jump pool depths. The pipe crossing supports are failing, with the concrete bases separated from the streambed. The boulders and debris backed up behind the failing pipe supports have excessive jump heights and steep sloping cascades that produce extremely difficult or impassable upstream migration for salmonids, depending on the seasonal configuration. The aerial pipeline crossing should be redesigned to eliminate structures within the streambed that impede sediment transport, restrict upstream fish migration, and present a blockage hazards.

Las Canoas Bridge

A stone block bottom extends 37 feet 3 inches under this stone arch bridge with a slope of approximately 2%. At the upstream end of the bridge the bottom width between the bridge supports measured 27 feet 10 inches wide and the height of the arch bridge from the center of the bottom measured 11 feet 6 inches. Downstream of this relatively flat section under the bridge, a concrete apron measuring 14 feet 8 inches in length drops with a slope of 26.4%. The downstream end of the apron drops vertically 2 feet 9 inches to the pool downstream. This bridge is owned by the City of Santa Barbara. The apron appears to have been built to prevent scour from undermining the bridge. Scour is now undermined the apron and adjacent banks downstream. The river-left bank is experiencing considerable erosion caused by this structure, which is compromising the integrity of Las Canoas Road. Excessive water velocities and/or shallow water depth on the steep apron prevent all upstream salmonid migration at this site. A detailed study of

fish passage alternatives is needed and should consider removing the entire structure and replacing it with a wider span bridge that does not impact the stream channel, impeded fish migration, limit vehicular traffic like the current one-lane bridge, or further promote scour and bank erosion. This action would have the greatest results for fish passage and likely other traffic related objectives.

Rattlesnake Creek County Debris Basin Dam

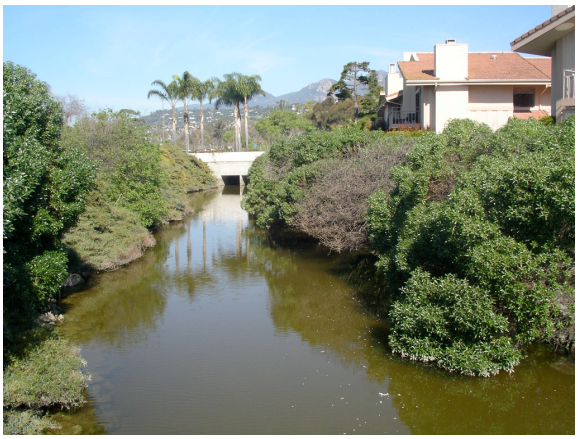
This County owned concrete and boulder debris dam conveys low flows through a smooth concrete culvert with a measured length of 65 feet and slope of 5.4%. Downstream of the culvert outlet, a smooth concrete apron with an overall slope measured at 11.4% extends13 feet 10 inches. The apron ends abruptly and stream flow falls vertically 5 feet 7 inches to the substrate below. There is no developed jump pool downstream and flows fall directly onto woody debris and gravel with a water depth of 3 inches. The dam appears to be in fair condition with significant downstream scour and only moderate concrete damage. Upstream passage of salmonids at this site is not possible during all stream flows due to the lack of a downstream jump pool, excessive jump height, steep apron, and high velocities and/or shallow water depth throughout the long, relatively steep culvert. Additional studies are needed to assess the feasibility of modifying or removing this dam and potential impacts to the downstream environment and flood control operations.

Old Chumash Dam on Rattlesnake Creek

This old 1808 mission dam is composed of cut stones, cobbles, and likely lime mortar. The dam no longer functions and is naturally being broken apart. The dam measured 35 feet across the channel and is keyed into bedrock walls on both sides. The total height of the dam from the downstream substrate to the top of the dam measured 21 feet 10 inches. A major portion of the dam has blown out and stream flows now fall 11 feet 6 inches from the damaged notch to the surface of the downstream pool, which measured 4 feet 10 inches deep. The dam is in extremely poor condition with massive structural failure and significant undercutting on the downstream side. Sediment is backed up to the top of the failed notch. Recent unpermitted efforts to repair parts of the dam have occurred and should be deterred. The excessive height of the dam prevents upstream salmonid migration during all flows. The dam will likely blow out on its own, but if fish passage efforts at downstream barriers allows steelhead to migrate upstream to this site and passage is still significantly impeded, the rest of the dam should be broken apart.

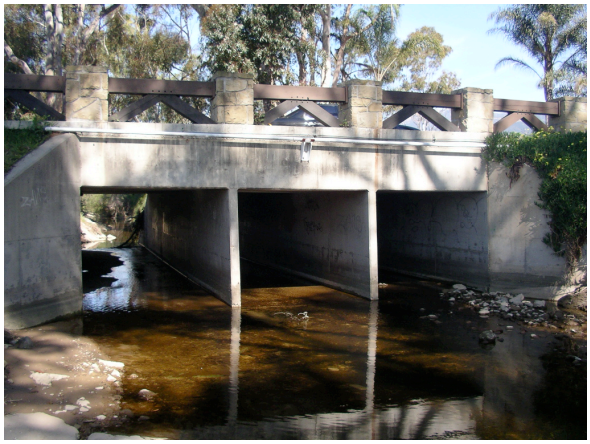
9.8.1 Sycamore Watershed Specific Issues (Constraints/Opportunities)

Lagoon Constriction



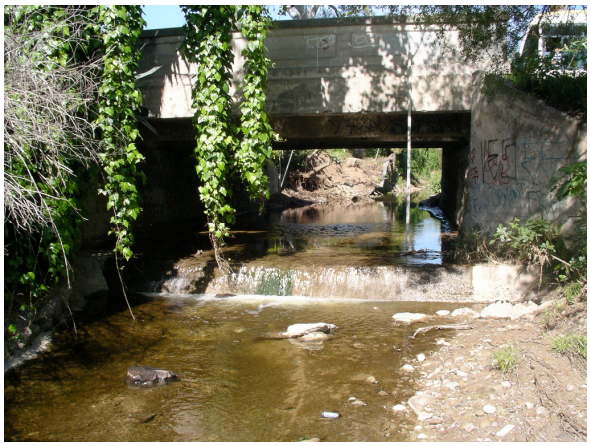
The lagoon has been considerably reduced in size due to the construction of road crossings, adjacent roads, and housing development. In addition, non-native vegetation and various bank revetment materials dominate the lagoon banks. There does not appear to be much room to expand the lagoon size due to the adjacent developments. A study should be conducted to determine effective lagoon restoration ideas.

Santa Barbara Zoo Triple-Box Culvert



This road crossing contains three box culverts, each measuring 6 feet 8 inches wide by 8 feet tall. The culvert extends approximately 60 feet in length with a slope of less than 2%. Low surface flows are spread out through each box of the culvert. This crossing appears to limit the upstream extend of the lagoon and also limits upstream fish migration during lower flows due to the shallow water depth spread across the culvert boxes. Installation of curbs to focus low flows into the middle culvert to increase water depth along with increasing the water depth and roughness of the middle culvert should be further evaluated.

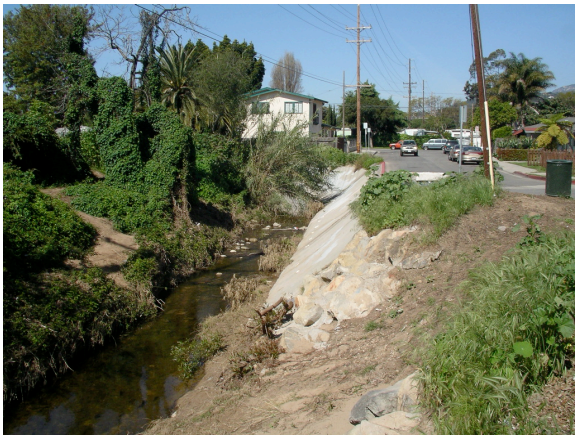
Punta Gorda Bridge



This bridge appears to be undersized and in poor condition with extensive upstream river-right bank erosion. The bridge limits upstream fish passage due to the presence of a concrete bottom and apron at the downstream end. The downstream apron measured 4 feet 6 inches in length and rises 2 feet 4 inches in height to the concrete bottom under the bridge. The concrete bottom extends 12 feet under the bridge and is then buried by substrate. This structure would limit upstream fish passage during lower flows due to the moderate jump height and shallow, and unconfined water depth across the concrete bottom. The most effective fish passage option is removal of the structure and replacement with a wide-span bridge that does not impact the stream channel.

Determine when the Road Department is considering protection measures or bridge replacement at this site and coordinate improving fish passage at the same time.

Soledad St. Revetment



Concrete bank revetment extends along the river-left side of the creek adjacent to Soledad Street and upstream toward Indio Muerto Street. There is no riparian vegetation along the creek bank adjacent to Soledad Street. The concrete revetment combines with instream concrete and boulder grade control structures in the stream channel and other bank protection measures upstream. The grade control structure likely limits fish passage during lower flows, but not significantly. This stream reach has been highly modified and degraded. An adjacent vacant lot on the west side of the creek may provide a unique opportunity to realign the creek toward the vacant lot, remove some of the concrete within the stream channel, establish a native riparian zone, connect an existing trail from Soledad to Punta Gorda Street, provide a public open space/park, and enhance flood conveyance and stream habitat conditions.

Carpinteria Street Bridge

This older bridge contains wood supports on concrete footings that occur within the stream channel. The footings and supports are significant debris blockage features that increase the likelihood of failure and/or adjacent flooding. Removal of this bridge and adjacent pipe and wire revetment and installation of a wide-span bridge would enhance stream habitat, sediment transport, and reduce flooding potential.

Montecito Street

This old stone arch bridge appears to be significantly undersized with upstream bank erosion and side cutting. A large mature Sycamore tree occurs on the upstream side. Pipe and wire revetment occurs downstream and upstream on the river-right side. Removal of the pipe and wire revetment would enhance stream function and eliminate debris blockage and metal trash.

Alameda Padre Serra Bridge

A small concrete grade control curb occurs downstream of this bridge. This 14 to 20 inch thick curb produces a 3-foot 9-inch drop to the downstream substrate. A 2-foot deep pool occurs downstream and would provide sufficient depth to allow limited upstream salmonid fish passage during moderate to high stream flows. During low flows, the structure would limit upstream passage for juvenile salmonids. Cutting a small notch in the curb measuring approximately 3 feet wide by 8 inches deep would enhance low-flow fish passage at the site by focusing lower flows and reducing the jump height.

Conejo Road Culvert

The culvert diameter measures 4 feet 7 inches and extends approximately 40 feet in length. The slope is approximately 4%. Flows dropped 3 inches into a downstream pool with a maximum depth of 5 feet. This undersized culvert overtopped during the past winter and upstream debris was recently removed. Deposited sediment at the inlet has produced a 2-foot drop into the culvert. Depending on inlet configuration, this culvert would likely be impassable to all salmonid life stages during all flow conditions due to the excessive slope of the smooth culvert and velocities encountered during high flows and the presence of the inlet sediment deposit. Replacement of this undersized, unsafe crossing with a wide-span bridge would provide the most effective fish passage and traffic safety and should be studied further.

Stanwood Drive/Highway192 Culvert

The original stone arch bridge dated at 1919 has a rough stone and concrete bottom and newer concrete extension downstream. The rough stone bottom extends approximately 34 feet with a slope of 3 to 4%. Flows drop 2 vertical feet onto the downstream substrate. Some of the surface flow remains on natural substrate and a portion flows onto a downstream concrete curb and drops 9 inches into a small downstream pool measuring 2 feet 6 inches in depth. During moderate to high stream flows, adults steelhead would be able to migrate upstream of this structure with a moderate degree of difficulty. Reducing the jump onto the stone bottom and creating rest pools and a low flow channel across the stone bottom would improve lower flow salmonid migration. Removal of all or some of the stone bottom and protection of the bridge supports should also be investigated. Prior to any project at this crossing, further examination of the entire downstream creek channel to Conejo Road should be conducted to ensure that additional natural or anthropogenic fish barriers do not occur.

Coyote Creek Concrete Chutes

Approximately 40 feet upstream from the Stanwood Drive/Highway 192 Bridge crossing of Coyote Creek, this concrete chute conveys stream flows into a large pool at

the Chelham Creek confluence. Access to survey this structure was not obtained, but limited observations were made from the bridge. The chute appears to be approximately 14 feet in length with a slope of approximately 30%. Stream flows drop approximately 4 feet from the chute outlet to the surface of the downstream pool. The downstream pool depth was observed to be approximately 3 feet. This structure would prevent all upstream salmonid passage due to the excessive slope and water velocities encountered. The purpose of the chute is unknown, but it may be a grade control structure that was used for an upstream dirt road crossing or to stabilize the stream grade and upstream residential development. Removal of the chute and biotechnical bank and grade stabilization at this site would provide fish passage and ecological connectively at this site and should be studied. Limited observations were made of another concrete structure 50 feet upstream of this chute adjacent to a private home. Any project at the chute should further assess the upstream concrete feature at the same time.

Chelham Creek Concrete Apron

A concrete apron occurs approximately 150 feet upstream of the Coyote Creek confluence. This apron drops surface flows approximately 4 feet to a downstream pool with a depth of 2 feet. This structure does not appear to have a current use and may be associated with the nearby concrete chute on Coyote Creek just upstream from Chelham Creek. This obsolete structure should be further assessed and if feasible removed to allow ecological connectivity and improve potential future fish passage.

Chelham Creek Culvert at Coyote Road

The confluence of Westmont and Chelham Creeks occurs at this culvert inlet. This 34-foot long concrete box culvert measured 8 feet tall and 8 feet wide. The slope of the culvert measured approximately 1.5%. Stream flows drop 3 feet 3 inches from the culvert outlet to the pool surface downstream. During lower flows, the excessive jump height and shallow water depth in the culvert would prevent any upstream fish passage. During moderate to high flows, adult steelhead would be able to jump into the culvert, but excessive water velocities would limit upstream passage. Ecological connectively would be improved with removal of this culvert and installation of a bridge. Additional assessment is needed to analyze bridge replacement options.

Chelham Creek Sycamore Canyon Road/Highway 192 Culvert

This concrete box culvert occurs approximately 75 feet upstream from the Westmont Creek confluence. The culvert measures 4 feet 5 inches tall and 6 feet 6 inches wide at the outlet. The inlet of the culvert measures 3 feet 9 inches wide. Flows drop 1-foot 4 inches to a small downstream pool measuring 3 feet in depth. The culvert appears to be undersized and signs of overtopping during the last winter rains were observed at the inlet. The culvert bottom was observed to be broken in several locations. Removal of this culvert and installation of a wide-span bridge should be studied and would provide ecological connectivity, future fish passage, improved flow capacity, and reduced flooding.

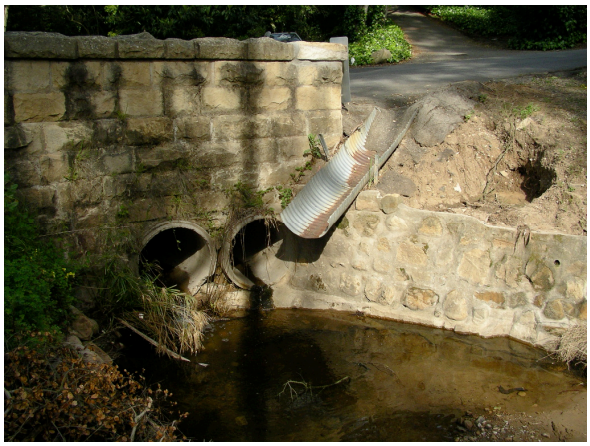
Chelham Creek Private Box Culvert

This concrete box culvert occurs on private property adjacent to Highway 192. A steep concrete apron occurs at the outlet of this culvert and drops flows 5 feet to the downstream substrate. This structure should be further assessed with landowner cooperation and removal and bridge installation considered.

Chelham Creek Sycamore Canyon Road/Highway 192 Culvert #2

This concrete box culvert extends under the road in an arch shape. The outlet dimensions of the culvert measured 4 feet 2 inches tall by 4 feet wide. Flows were observed to drop 1 foot 6 inches to a downstream pool depth of 2 feet 6 inches. The culvert bottom consists of cobble and concrete. A 2-foot drop occurs at a boulder jam at the inlet of the culvert. Upstream fish passage would not be possible during low flows due to shallow water depth within the culvert and the inlet drop. During moderate flows limited upstream fish passage may be possible depending on the inlet conditions and sediment deposition. The culvert is likely undersized. A bridge or larger embedded culvert or arch culvert would provide improved ecological connectivity and flow capacity at this road crossing and should be assessed further.

Chelham Way Culverts



Two circular concrete culverts with 3-foot diameters convey low to moderate flows under Chelham Way. Upstream debris removal and signs of overtopping during last winter flows were observed at the culvert inlets. Sediment deposits at the inlet produced drops between 1 to 2 feet into the culvert. The moderately steep slope within he culverts and smooth surface, combined with inlet sediment deposits, would prevent upstream fish passage during all flows. This undersized culvert crossing should be further assessed and replaced with a wide-span bridge to provide ecological connectivity and eliminate road flooding and erosion.

Westmont Creek Dam

This 10-foot tall boulder and concrete dam occurs approximately 100 feet upstream of the Chelham Creek confluence. The dam is completely filled in with sediment and conveys all flows over the dam and downstream face. The usefulness of this dam should be determined and dam removal feasibility assessed.

9.8.1 Laguna Watershed Specific Issues (Constraints/Opportunities)

Lower Laguna Creek and Lagoon Restoration

Restoration of lower Laguna Creek and lagoon provides a unique opportunity to improve ecological function, flood and tidal conveyance, recreational opportunities, and water quality. A detailed study is needed to further explore alternatives for restoration that would be compatible with upstream flood control objectives. Of critical importance is analysis of existing elevations for the stream channel and adjacent facilities throughout the lower reaches of the Laguna Creek watershed.

Several Laguna Creek restoration components to investigate are:

1) Removal of all concrete channelization downstream of Cabrillo Boulevard and naturalization of the stream channel with biotechnical bank stabilization.
2) Removal of the tidal gate dam and, if needed, reestablishment of a bioengineered feature that regulates inland tidal flow. Removal of the dam and associated bank revetment could allow for the western expansion of the lagoon to its former partnership with the Mission Creek lagoon. The overall combined Mission/Laguna lagoon expansion could considerably increase the combined size and ecological function of these two partner lagoons. Removal of the exotic ice plant between the lagoons and establishment of native vegetation should also be considered.
3) Eliminate portions or all of the island between the two Laguna Creek concrete channels and expand the size of the lagoon. Replant the remaining portion of the island with native species. Potentially create a small lagoon viewing deck and informational signage adjacent to the pedestrian path on the island.
4) Move the dredge pipeline adjacent to the pedestrian bridge.
5) Remove 50-100 feet of the City parking lot on the west side of the creek channel and allow for expansion and or meandering of the lagoon and creek. Establish a buffer zone of native vegetation between the parking lot and the naturalized stream channel.
6) Assess the feasibility of connecting the creek channel upstream of Cabrillo Boulevard to the existing pond and wetland system in the Chase Palm Park. Remove the exotic bass and any other fish species from the ponds. Investigate the possibility of converting this pond area to also be utilized as a water collection and biofiltration area wetland.
7) Investigate the potential for eliminating the need for a pump house facility. Careful examination of channel elevations and alternative methods may provide alternatives to pumping or at least identify more sustainable pumping methods that utilize solar power or other methods to reduce maintenance costs and pollution.

10.0 Information Gaps

City-Wide

Water Budget Study

A comprehensive water budget study of the City watersheds should be conducted to assess historic and current water extraction and flow conditions and to project future

conditions. The ecological function and future restoration efforts will be highly dependant on the existence of adequate surface flows. Groundwater extraction, urban development of impervious soil, surface flow diversions, concrete channel construction, Gibraltar Dam Tunnel construction, stormwater discharge, agricultural operations, riparian canopy conditions, and a variety of other factors all impact the occurrence of surface flows in the creek. Such a water budget study is highly complex, but highly useful in determining what conditions were natural, identifying limiting factors, establishing restoration objectives, identifying opportunities to improve surface flows, and developing a long-term plan to establish dedicated instream surface flows.

Arroyo Burro

Post-Project Monitoring of Cliff Drive Fish Passage Project

Following fish passage modifications at Cliff Drive, monitoring of fish passage effectiveness should be conducted across a wide range of flow conditions to determine project effectiveness.

Upper Arroyo Burro Stream Survey

Arroyo Burro has not been extensively surveyed upstream of San Roque Creek and fish passage and habitat conditions are not well known. Permission to access private stream reaches should be requested and stream surveys conducted to determine whether potential fish migration barriers occur in this reach. Salmonid habitat conditions should also be assessed during late summer and any likely pool habitat surveyed for fish presence.

Mission Creek

Tunnel Water Discharges

The mysterious absence of *O. mykiss* in upper Mission Creek should be further studied. In particular the impacts of the City's Tunnel project on aquatic habitat conditions in upper Mission Creek should be investigated. Discharge of poor water quality from the Tunnel into upper Mission may be negatively impacting the creek by introducing harmful water conditions from Gibraltar Reservoir and the Santa Ynez River. The introduction of exotic fish species and crawfish into upper Mission Creek from the Tunnel have been observed (pers. obsrv. Stoecker 2002). These exotic species may be introducing disease, competition, and predation into the Mission Creek watershed. The construction of this Tunnel, as well as others along the South Coast, reportedly altered and reduced the flow of essential springs feeding the upper watershed and may have contributed to significant dewatering of the creek. These impacts may have serious implications to all future Mission Creek watershed restoration and especially steelhead recovery. A thorough study of the Tunnel impacts on the watershed and stream flows should be conducted and would make an interesting project for UCSB graduate students.

Sycamore

Additional Stream Surveys Needed

Between Alameda Padre Sera and Conejo Road there are more than a dozen private roads crossing Sycamore Creek. None of these crossings have been surveyed due to the lack of requested permission to access private land. It is likely that some of these crossings have associated structures that may impact fish passage. In addition, upper Coyote Creek, Westmont Creek, and Chelham Creeks should be extensively surveyed due top the lack of information about these reaches on private lands. Permission to access these private stream reaches should be requested and road crossings surveyed to determine whether potential fish migration barriers occur in this reach. Salmonid habitat conditions should also be assessed during late summer and any likely pools surveyed for fish presence.

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Personal Communication

Johnson, George. City of Santa Barbara

Swift, Camm. Fisheries Biologist

Wilson, Daniel. Consultant