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Ms. Sue Scatolini
State of California Department of Transportation
4050 Taylor Street MS 242
San Diego, CA 92110

I-5 Coastal Lagoons Tidewater Goby (*Eucyclogobius newberryi*)
Comprehensive Suitability and Survey

Dear Ms. Scatolini:

As part of the California Department of Transportation (CALTRANS) Interstate-5 widening project, the U.S. Fish and Wildlife Services (USFWS) requires a review of the status of the federally- and state-listed endangered tidewater goby (*Eucyclogobius newberri*) at the Buena Vista and Batiquitos Lagoons in support of the biological assessment for the proposed widening. Merkel & Associates, Inc. (M&A) conducted a habitat assessment and protocol surveys for tidewater goby for the purpose of determining the potential habitat suitability and presence or absence of this species at Buena Vista and Batiquitos Lagoons. This report presents the results of the comprehensive suitability assessment and surveys performed in support of the project.

Location

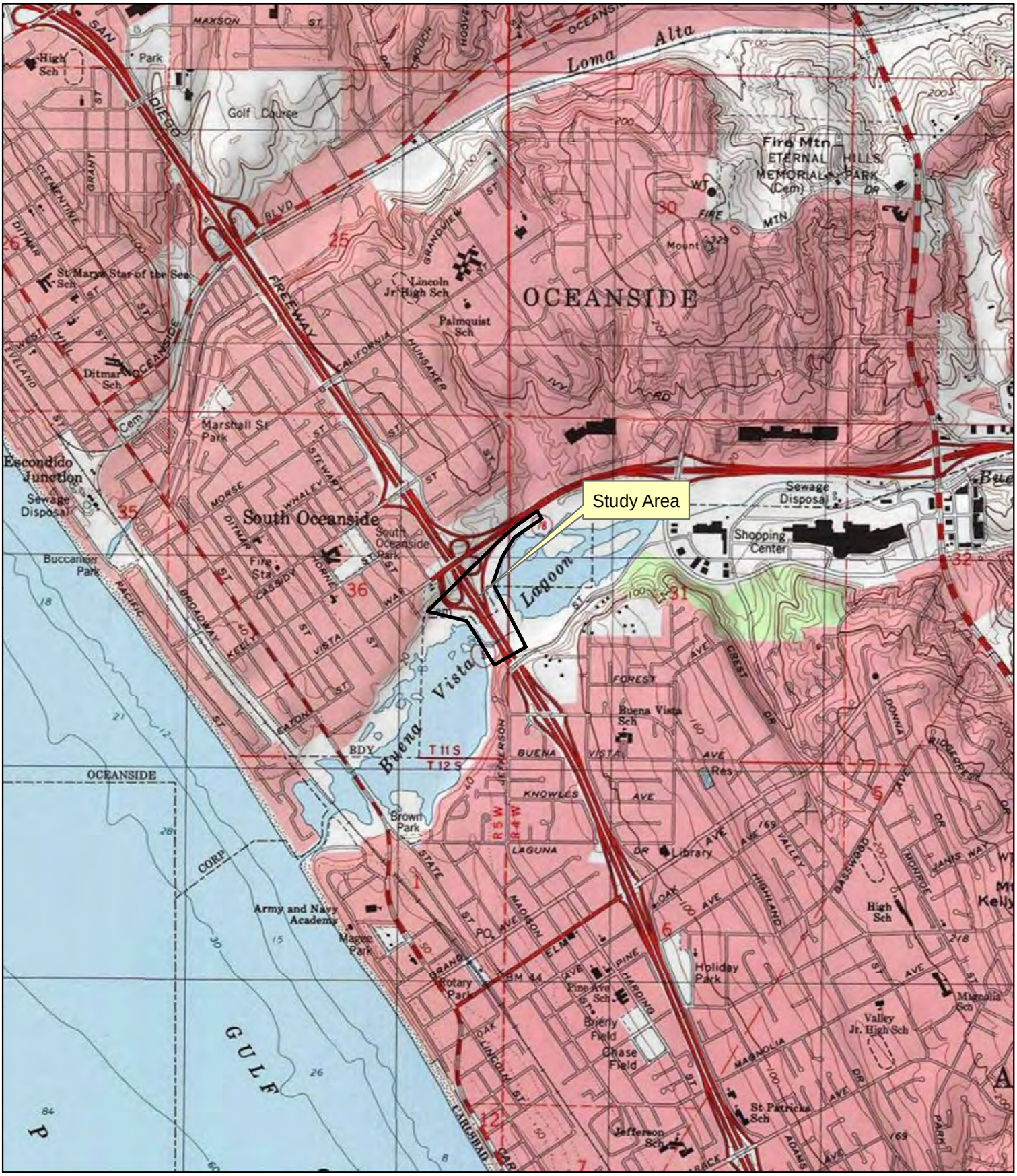
Buena Vista Lagoon is located in northern San Diego County in the Carlsbad Watershed on the border between the cities of Oceanside and Carlsbad, within Sections 31 and 36, Township 12 South and 11 South, Range 5 West of the U.S. Geological Survey San Luis Rey, California Quadrangle (Figure 1).

Batiquitos Lagoon is located in the Carlsbad Watershed within the City of Carlsbad, north San Diego County within Sections 33 and 34, Township 12 South, Range 5 West of the U.S. Geological Survey San Encinitas, California Quadrangle (Figure 2).

Historic Background

Buena Vista Lagoon

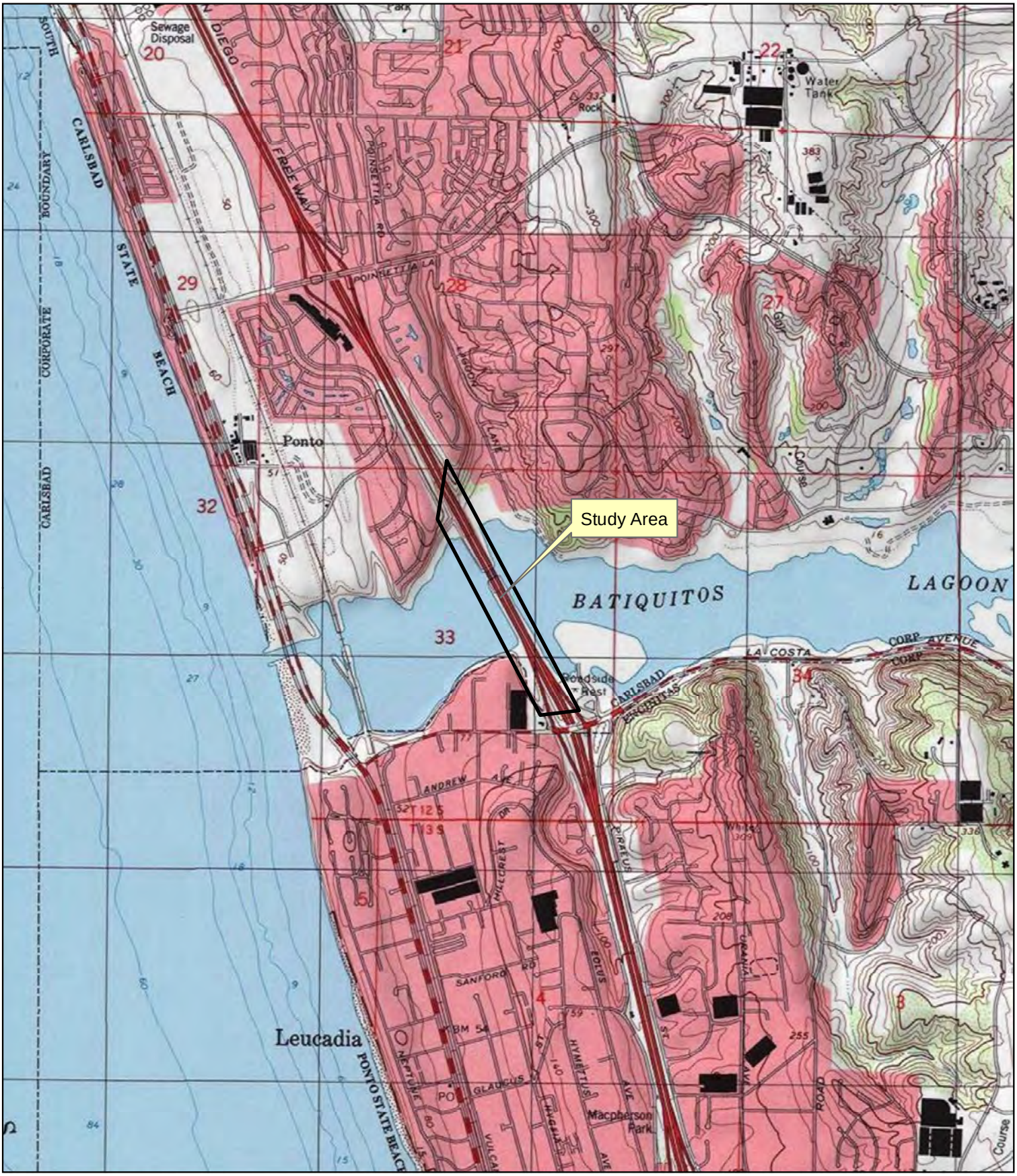
Buena Vista lagoon, more aptly described as a shallow coastal lake, is an approximately 200-acre freshwater system, separated from the Pacific Ocean by an aging weir structure with a crest elevation above the highest high tide at +5.6 feet Mean Sea Level (MSL). As a result, the lagoon typically does not receive marine water exchanges except at extreme tides combined with high surf conditions. Under these cases, a small amount of surf wash may enter the lagoon. The principal hydrologic influence in Buena Vista Lagoon is the inflow of Buena Vista Creek at the easternmost end of the system. The creek is a perennial stream that predominantly drains an urban watershed. Several storm drains discharge to the lagoon along its perimeter. Hydrologic structures at roadway



Project Vicinity Map

I-5 Coastal Lagoons Tidewater Goby Surveys
Buena Vista Lagoon Habitat Assessment
Source: USGS 7.5' San Luis Rey, CA Quadrangle

Figure 1



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Project Vicinity Map
I-5 Coastal Lagoons Tidewater Goby Surveys
Batiquitos Lagoon Habitat Assessment
Source: USGS 7.5' Encinitas, CA Quadrangle

Figure 2

and railroad infrastructure, and the weir at the downstream end of the lagoon, divide the lagoon into four basins. The division into basins has been made even more distinct by the expansion of freshwater marsh over the past two decades that now forms a considerable barrier to water flow and aquatic resource interchange between basins. The basins are generally described by each of the controlling downstream flow controlling structures. The eastern basin is termed the I-5 basin, the central basin is termed the Highway 101 basin, the next most westerly basin is termed the railroad basin, and the final basin in the lagoon is termed the weir basin.

Batiquitos Lagoon

Now a thriving tidal system, Batiquitos Lagoon was largely non-tidal, experiencing infrequent tidal circulation for the last 90 years. Natural changes within the lagoon environments had been accelerated and altered by human intervention in the form of historically poor watershed management and changes in the lagoon, including the construction of a number of partial fill and bridge crossings (Southern Railroad, Pacific Coast Highway, Santa Fe Railroad, and Interstate 5). Other notable impacts have included the construction of the San Marcos Dam upstream of the lagoon, episodic flood events, the discharge of treated wastewater into the lagoon between 1967 and 1974, and a failed effort near the turn of the century to dike portions of the lagoon to establish salt harvesting ponds (California State Coastal Conservancy 1989). Combined with the bridge restrictions to flows within the lagoon, heavy development of the 30.48-square mile watershed feeding the lagoon had resulted in significant influx of sediment and heavy agricultural and residential land-use has resulted in significant nutrient loading from fertilizers and increased run-off (CH2M Hill 1989). Hydrologic structures at roadway and railroad infrastructure, and the upland developed communities to the northeast, east, and southeast of the lagoon, divide the lagoon into three basins; west basin, central basin, and east basin.

By the early 1970's, the lagoon ecosystem had notably deteriorated; and by the early 1980's, had achieved an advanced state of sediment infilling and eutrophication. The wetland habitat within the eastern lagoon was progressively being converted to uplands through sediment fan growth. During spring months, algal blooms substantially covered the lagoon as evidenced by large mats of green macroalgae and a "green soup" of phytoplankton was common. During the summer months, an odor of decaying algae extended for up to two or more miles around the lagoon. Associated with the nutrient rich, shallow, closed conditions, dissolved oxygen, salinity, water temperature, pH, and other water quality parameters were highly variable on a diurnal and seasonal basis (CH2M Hill 1989). This resulted in a substantial decline in aquatic species diversity (fish and invertebrates) and a subsequent reduction in the diversity of other species (e.g. migratory birds) dependent upon the system.

The lagoon was restored in 1994-1996 by the Port of Los Angeles and City of Carlsbad, under the Batiquitos Lagoon Enhancement Project, to a fully tidal environment by dredging out accumulated sediments, stabilizing the ocean inlet, and implementing an on-going maintenance dredging program. The lagoon was converted from an intermittently closed brackish water environment to a fully marine tidal environment. This change resulted in a significant reduction in freshwater and brackish water marshlands, elimination of freshwater fish from the lagoon, and a habitat conversion to saltwater marsh habitat and open tidal waters. Freshwater and brackish habitats are now restricted to small pockets at major storm drain outlets and areas near the major creeks entering the far eastern end of the lagoon. Batiquitos Lagoon is now a thriving tidal lagoon ecosystem.

From a marine communities standpoint, the provision of a permanent connection to coastal waters increased invertebrate and fish community structure and species richness. Sensitive species gains are perhaps among the most notable benefits of the restoration effort. California least tern (*Sternula antillarum browni*), the western snowy plover (*Charadrius alexandrinus nivosus*), the Belding's Savannah sparrow (*Passerculus sandwichensis beldingi*) and light-footed clapper rail (*Rallus longirostris levipes*) have all increased in population numbers and stability as a result of the restoration of the lagoon system. The restoration of Batiquitos Lagoon has been highly successful and continued maintenance programs have assisted in the persistence of a flourishing lagoon system.

Tidewater Goby

The U.S. Fish and Wildlife Service's (USFWS) declared the tidewater goby a federally endangered species in 1994. This species is threatened by habitat loss and degradation, as well as natural environmental fluctuations occurring within the restricted environments occupied by the species attributable to human destruction and manipulation of coastal wetlands. Tidewater gobies generally do not do well in areas with abundant fish, amphibian, reptile, or invertebrate predators. Due to human population concentration and associated disturbance, tidewater gobies are most threatened in southern California (Swenson 1999). The tidewater goby was found in coastal brackish water habitats in California, originally from the mouth of the Smith River in Del Norte County, south to Agua Hedionda Lagoon, San Diego County (Swift *et al*1989). Buena Vista and Batiquitos Lagoons represent two of the most southern lagoons in the historic geographic range for tidewater goby. The lagoons, however, have not supported known populations of tidewater gobies for over 10 years (CDFG 2012). In 2008, the USFWS published a final revised critical habitat for the tidewater goby, deleting the San Diego County lagoons south of Camp Pendleton from critical habitat (Federal Register / Vol. 73, No. 21 / January 31, 2008: Page 5920-6006). New proposed critical habitat for tidewater goby in 2011, still excludes the lagoons south of Camp Pendleton but does include the San Luis Rey River mouth (Federal Register / Vol. 77, No. 142 / July 21, 2012). The only known tidewater goby populations south of the Santa Clara River are located on the United States Marine Corps Base at Camp Pendleton (Holland 1992, M&A 2004). The limited distribution and small size of all populations makes the probability of severe reduction or extirpation high.

Tidewater goby habitat typically supports freshwater and brackish water emergent plant species, including southern cattail (*Typha domingensis*) and California bulrush (*Schoenoplectus californicus*). Additional habitat components typically associated with gobies include algal mats and submerged widgeongrass (*Ruppia maritima*). These components provide refugia from predators and protected breeding grounds for gobies. Gobies are a euryhaline species and can tolerate wide ranges of salinity from freshwater to full marine and even hypersaline conditions. The species, however, is generally found in waters with salinities less than 12 ppt (Swift et al. 1989). The species has only rarely been collected in fully marine environments and is typically believed to persist in open coastal area only after being washed out of lagoons during flood events. While the species is not typically considered to be a marine species, the capacity to survive in full marine environments may play an important role in allowing gobies to recolonize areas after extirpation events (Swift et al. 1989).

Habitat Assessment

M&A biologists conducted a habitat assessment for the tidewater goby within Buena Vista Lagoon and Batiquitos Lagoon on July 11, 2012 (M&A 2012). Field investigations occurred within the I-5 basin at Buena Vista Lagoon and within the central and east basin at Batiquitos Lagoon and covered a 500-foot buffer corridor to the east and west of the proposed I-5 freeway expansion (Figures 1 and 2). Biologists walked the periphery of the study areas and characterized the available habitat, collected overview photos of the habitat, described the vegetation community and available water bodies, and categorized the types of water bodies when encountered. Within identified waters, the biologists noted substrate and measured average depth of water, water temperature and salinity using a Hydrolab Quanta. A habitat suitability matrix for Buena Vista and Batiquitos Lagoons (Table 1 and Table 2, respectively) was created to identify the potential suitability for tidewater goby presence/absence.

The results of the habitat assessment indicate that preferred tidewater goby habitat occurs at the Buena Vista Lagoon, although extremely poor connectivity to the ocean would adversely affect potential for goby colonization of the lagoon. Ten areas of shallow brackish water were proposed for sampling (Figure 3). Each site contains parameters in which tidewater gobies have been documented. Each site supports coastal brackish marsh components, including southern cattail, California bulrush, and pacific pickleweed (*Sarcocornia pacifica*). Saltgrass (*Distichlis spicata*), salty Susan (*Jaumea carnosa*), and alkali heath (*Frankenia salina*) were also present, but less abundant. The dense cattails create barriers to predatory fish, amphibian, and invertebrate movement and sustain the small quiescent pools that have potential to support gobies. Evidence of crayfish (*Procambarus* sp.) and the presence of mosquito fish (*Gambusia affinis*) and amphipods were noted within the proposed sampling pools. Larger channels and open basins of the lagoon are areas that lack vegetation barriers that provide a degree of predator protection for small fish. More open lagoon environments are known to support carp and goldfish, as well as, highly predatory largemouth bass, bluegill, green sunfish, black crappie, bullhead, and channel catfish. These predatory species would be expected to keep any possible goby numbers low, making them difficult to detect, if present. For this reason, sampling has focused on the more protected pools considered to have a greater potential to support gobies, but does include two sampling locations in the immediate vicinity of the I-5 bridge, that represent conditions of the more open lagoon channels and basins (West 1 and I-5 Bridge).

The habitat assessment for the Batiquitos Lagoon resulted in poor suitability for tidewater goby to persist. The species is a brackish water fish that does well in intermittently closed and open lagoons and estuaries where there is adequate cover to avoid being washed out to sea by winter storms but tolerant to saline conditions that kill off freshwater predators during winter months and salt water predators when the lagoon closes. Although this species can tolerate a wide range of salinities (0-42 ppt), it appears to prefer low-salinity water (0-12 ppt) and inhabit watercourses with no or limited currents. During the recent habitat assessment, no isolated, open water, shallow pools, or channels were found within the study area. The area supporting water is connected to the entire open lagoon and supports marine aquatic habitats including common eelgrass (*Zostera marina*) and *Sargassum* sp. and has a salinity of 34.2 ppt. California cordgrass (*Spartina foliosa*) dominates the periphery of the lagoon and most of the study area. Horn snails (*Cerithidea californica*) and crabs (*Hemigrapsis* sp.) were noted in the sand and mud along the shoreline. Small pockets of southern cattail and California bulrush were documented within the study area but these areas occurred on

Table 1. Buena Vista Suitability Matrix

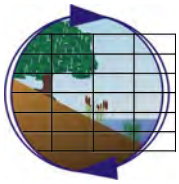
Potential Sampling Point #	Vegetation Community	Water Body Size (M)	Substrate Type	Depth (M)	Temperature (° C)	Salinity (ppt)	Suitable (Yes/No)
West 1	Coastal Brackish Marsh and Open Water	15 wide connects with outer lagoon	Soft Mud Bottom	0.6	24.18	2.21	Yes
West 2	Coastal Brackish Marsh and Open Water	1x30	Soft Mud Bottom	0.3	21.19	2.46	Yes
I-5 Bridge	Rock Rip Rap And Open Water	10 wide connects with outer lagoon	Soft Mud Bottom	0.5	23.48	2.18	Yes
East 1	Coastal Brackish Marsh and Open Water	5x30	Soft Mud Bottom	0.3	20.77	2.13	Yes
East 2	Coastal Brackish Marsh and Open Water	6x6	Soft Mud Bottom	0.5	21.25	2.8	Yes
East 3	Coastal Brackish Marsh and Open Water	7x10	Soft Mud Bottom	0.5	21.25	2.8	Yes
East 4	Coastal Brackish Marsh and Open Water	3x15	Soft Mud Bottom	0.25	21.78	3.14	Yes
East 5	Coastal Brackish Marsh and Open Water	5x90	Soft Mud Bottom	0.3	22.1	2.51	Yes
East 6	Freshwater Marsh and Open Water	7x7	Soft Mud Bottom	0.1	21.58	2.39	Yes
East 7	Coastal Brackish Marsh and Open Water	7x20	Soft Mud Bottom	0.3	22.36	2.6	Yes

M = meters, ° C = Celsius, ppt = parts per thousand

Table 2. Batiquitos Suitability Matrix

Potential Sampling Point #	Vegetation Community	Water Body Size (M)	Substrate Type	Depth (M)	Temperature (° C)	Salinity (ppt)	Suitable (Yes/No)
Batiquitos Lagoon	Salt Marsh and Open Water	Open to entire Lagoon / No perennial freshwater sources in study area	Sand	0.3	22.9	34.2	No

M = meters, ° C = Celsius, ppt = parts per thousand



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Tidewater Goby Sampling Locations

I-5 Coastal Lagoons Tidewater Goby Surveys

Figure 3

the upland portion of the site and did not support standing or flowing water. Based on these findings, protocol tidewater goby surveys were not conducted at the Batiquitos Lagoon, as no suitable habitat was identified within the project study area.

Methods

In accordance with the current 2006 *Tidewater Goby Survey Protocol* (USFWS 2006, Appendix F), the size of Buena Vista Lagoon was considered to determine sampling effort and proper equipment to be used. Buena Vista Lagoon is considered a large body of water in its entirety. The habitat suitability study provided ten areas proposed for tidewater goby sampling that fit the parameters in which tidewater gobies are found. However, two sites (West 1 and the I-5 Bridge) were eliminated from sampling due to the water depth exceeding 2 meters at each location (Figure 3). Ultimately, eight sample points within the lagoon fell within the project's area of interest that fit the parameters for tidewater goby habitat. Each sample site was treated as a discreet small water body, each with an area less than one acre. Several photos were taken of the overall lagoon habitat and at each individual sample location (Attached Photos 1 and 2).

USFWS tidewater goby survey guidelines for small water bodies include a minimum of 15 seine hauls to be pulled at each sampling point, or enough times to cover the body with only 20% overlap. The survey methods for the sampling points consisted of a combination of seine hauls, dipnetting, and minnow trapping. A small seine, (2.0 meters x 1.2 meters, 3 millimeter "Ace" mesh seine with 13 one once weights every 15 centimeters) was used at each sample point with the exception of sample point 2 West. This sample point supported approximately 95% vegetation cover thus eliminating seining as a sample method. Instead, dipnet sampling was the sole method of sampling at this location. The small seine was utilized to sample waters between 0-0.6m in depth. The entirety of each pool was sampled by positioning the seine either perpendicular to the shore or within the vegetation along the open waters edge and held in place by one researcher standing at the edge of the water and a second researcher in the water. In some cases (sample locations East 7 and East 4) both investigators were in the water and pulling seines within the center of the water body. The seine haul length for each pull was 10m with the number of hauls varying at each sample point but covering the entire water body at each point. Dipnetting and minnow trapping were used to supplement the seining effort, at the rest of the sampling sites. Standard hand held dipnets were used at the sites that supported a high percent vegetation cover at the periphery of the pool (Table 3). Minnow traps were deployed in the larger pools including sample points West 1 and the I-5 Bridge during the first survey. However, once the biologists entered the water at these sample points, the water depth exceeded 3.0 meters immediately at the shoreline. Due to the deep water at these two locations, it was determined that the areas would not be preferred goby habitat. As a result, sample points West 1 and I-5 Bridge were eliminated from the second sampling effort.

Protocol Surveys

M&A conducted protocol surveys for the tidewater goby in accordance with the current USFWS *Tidewater Goby Protocol* (USFWS 2006) as authorized under M&A's federal Endangered Species Act (ESA), Section 10(a)(1)(A) permit #797999-7.4 and California Department of Fish and Game (CDFG) Memorandum of Understanding (MOU) (Table 3). Tidewater goby surveys were performed by USFWS permitted biologist, Antonette Gutierrez, and were assisted by Mary Tamburro and James Schacher. The first sampling event took place on July 16, 2012. Field conditions during the survey

included no cloud cover, temperatures of 70-75 degrees Fahrenheit and wind speeds of 0-5 miles per hour. The second sampling event occurred on August 20, 2012. Field conditions during the survey included 35% cloud cover, temperatures of 74-78 degrees Fahrenheit and wind speeds of 0-3 miles per hour.

Results

No tidewater gobies were found during either sampling event. Table 3 below summarizes the sampling effort at each of the sample points. Only freshwater fish, invertebrate and amphibian species were captured or observed. Mosquitofish were present in the thousands throughout the survey area. Two mid-water column fish species were noted prior to the start of seining and included an unidentified shiner and a school of juvenile bullhead (*Ameiurus* sp.). Attempts to capture these species during the hauling efforts were unsuccessful. Attempts to capture these species with dipnets also resulted in a negative capture. An abundance of crayfish and freshwater snails (*Physa* sp.) were evident throughout the entire survey area. Bullfrogs called from the surrounding vegetation, and a tadpole was caught at sample point East 6.

Table 3. Survey Results

Protocol Survey Point Number	Date	Temp./ Salinity (°C/ppt)	Minnow Trap (y/n)	Dip Net (y/n)	Hauls (#)	Animals Found (in nets, traps, and visually seen while surveying)
I-5 Bridge	7/16/12	23.5/2.2	y	n	0	None
West 1	7/16/12	24.1/2.2	y	n	0	None
West 2	7/16/12	26.0/2.3	n	y	0	mosquitofish, crayfish
	8/20/12	24.8/3.2	n	y	0	mosquitofish
East 1	7/16/12	27.2/2.7	n	y	2	mosquitofish
	8/20/12	24.9/2.5	n	n	1	mosquitofish, unid. shiner, juvenile bullhead,
East 2	7/16/12	24.4/2.1	n	n	2	crayfish, mosquitofish, aquatic insects
	8/20/12	24.6/2.2	n	n	1	mosquitofish
East 3	7/16/12	25.1/2.6	y	n	3	mosquitofish
	8/20/12	24.8/3.2	y	y	3	mosquitofish, bullfrog tadpole
East 4	7/16/12	26.2/2.8	n	n	2	crayfish exoskeleton, snails present, mosquitofish
	8/20/12	24.9/3.0	n	y	2	mosquitofish
East 5	7/16/12	25.7/2.4	n	n	6	crayfish exoskeleton, Physa sp. snails, mosquitofish
	8/20/12	24.6/2.6	y	y	6	mosquitofish
East 6	7/16/12	23.9/2.4	n	y	3	aquatic insects, mosquitofish, crayfish, bullfrog
	8/20/12	24.4/2.5	y	n	2	mosquitofish
East 7	7/16/12	24.2/2.4	n	y	4	amphipods, aquatic insects and arachnids, mosquitofish
	8/20/12	24.5/2.4	n	y	4	mosquitofish, unid. shiner,

Discussion

At present, neither Buena Vista Lagoon nor Batiquitos Lagoon are considered to have a high potential for supporting tidewater gobies due to physical alterations of the environments through time and significant changes to the lagoon hydrologic regimes. In the case of Buena Vista Lagoon, the system has been nearly fully blocked from the Pacific Ocean, the only potential source of natural recruitment since 1971, was when the present weir was constructed and during extremely infrequent combined high tide and high surf events. The construction of the weir led to the development of a stable freshwater environment that supports a large suite of goby predators. The considerable predation potential, low chance of natural recolonization and the lack of recent detection of gobies in the lagoon suggest gobies have been extirpated from the system or have never been present. At Batiquitos, the intermittently closed lagoon was restored to full tidal conditions from 1994-1996. Since this period, potentially suitable habitat for tidewater goby has been limited to areas near freshwater discharges where highly variable salinities would be expected to control both freshwater and marine predators. Except at the mouths of creeks or other freshwater input location, fully marine lagoons are not considered to be preferred goby habitat.

In the systems studied, the tidewater goby is not expected to be present due to its vulnerability to extirpation and poor colonization potential. The data collected and literature research verifies the continued presence of a large predator base in both lagoons; thus adding to the high difficulty for tidewater goby to become established at either lagoon system. Based on the site reviews, it is our belief that tidewater gobies are not present in either lagoon system at this time and are not likely to become established in either system under the current conditions prevailing within the systems.

Please do not hesitate to contact project manager, Antonette Gutierrez, or me if you have any questions or need any additional information.

Sincerely,

Keith W. Merkel
Principal Consultant

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