Hydrology and Water Quality Inventory

Introduction

The San Diego River Park Plan proposes enhancements to the natural hydrologic processes of the river. These improvements will also fulfill other recreational, cultural, and wildlife objectives. Changes to river processes have created poor water quality, low habitat diversity, increased erosion, flow restrictions, flooding issues, and excessive invasive vegetative growth. Improvements to flow and water quality would begin to address these problems while also providing a valuable recreational resource.

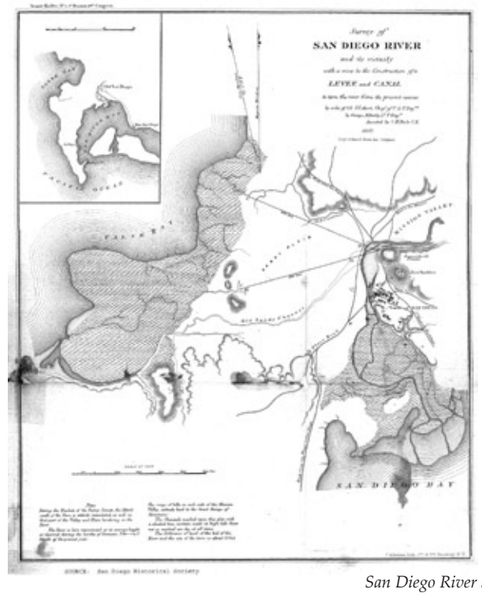
Mission Valley Agriculture in 1916
Source: San Diego Historical Society

History of the San Diego River

The San Diego River has been dramatically altered by human activity. Historically, the river flowed unimpeded from its headwaters in the Cleveland National Forest within California to its delta at the Pacific Ocean. River flows varied throughout the year and from year to year. In wet years, the river had strong year-round flows, while in dry years, flows disappeared completely during the summer months. Major flooding occurred infrequently; when it did occur the river was so powerful that it could change courses and terminate at either San Diego Bay or present day Mission Bay Park. The source of water was limited to precipitation inputs within the watershed. Unrestricted river flows transported sediments from the river's headwaters to the Pacific Ocean where the sediments helped replenish San Diego's beaches. Unimpeded flows in extreme wet weather events could exceed 100,000 cubic feet per second (cfs).

Beginning in the early 1800s and continuing to present day, humans have attempted to control the river's flows by constructing dams or levees, and by channeling the river. Old Mission Dam, located in what is now the Mission Trails Regional Park, was completed in 1816. It was the first dam on the river and was used by Spanish missionaries. The dam at Lake Cuyamuca was built in the 1880's, and two additional dams, the El Capitan and the San Vicente, were built in the mid-1900s to facilitate increased water supply for the growing San Diego population. Water was pumped from the San Diego River at Palm Canyon in present day Presdio Park up to on e of the earliest reservoirs in San Diego in what is now Mission Hills. Water was also diverted via flume from Lake Cuyamuca to the growing community of San Diego. Such projects were critical to inhabiting this desert environment. The region also began importing water from outside sources including the Colorado River and the Sacramento River/San Joaquin River Delta. These dams decreased the San Diego River's flows by storing water that would have normally flowed into the river. However, major floods still occurred despite the decreased river flows. Thus, to control flooding, the U.S. Army Corps of Engineers channelized numerous sections of the river, concentrating primarily on the sections in the City of San Diego. Channelizing the river consisted of straightening the river to remove meanders and paving/armoring the riverbanks so that water could flow downstream faster.

Despite the efforts to control flooding, it still occurs in San Diego because



San Diego River survey 1853

1916 Flood at old Town San Diego
Source: San Diego Historical Society

the quantity of water in the river has increased over time. Impermeable surfaces, nonpoint source runoff, the channelized river, and imported water are primary contributors to this increase. Impermeable surfaces such as roads, parking lots, and buildings prevent rainwater from infiltrating into the ground, causing large quantities of water to run-off directly into the river via stormwater collection systems.

The City of San Diego imports approximately 90% of its water supply. This water enters the river from residential and commercial runoff, irrigation run-off, treated effluent of a sewage treatment facility in Santee, and during flooding events from reservoir overflow. The imported water is suspected to be a significant water source to the river and is the major cause of year-round flow in the lower San Diego River reaches.

The water quality of the San Diego River, like its flows, has been affected by a number of factors, including dams, increases in impermeable surfaces, and increases in imported water use by the growing population of San Diego. The El Capitan and San Vicente dams have caused increased riverbank erosion by capturing sediments that were historically carried to the delta and the ocean. Urban runoff transports a host of pollutants to the river, including oils and grease, gasoline, bacteria, trash, nutrients, sediments, and pesticides. The detrimental effects of urban runoff on the water quality of the San Diego River have been observed and documented in a number of studies (Anchor 2003). The lower San Diego River has been designated as water quality limited for phosphorus, dissolved oxygen, fecal coliform, and total dissolved solids. Furthermore, evaluations of water quality based on surveys of a

stream's biological organisms (biological assessments) performed from 1997 to 2001, indicate that the lower San Diego River exhibited degraded biological and physical integrity (RWQCB 2003, Anchor 2003).

Key River Processes

The quantity and velocity of a river's waters can affect the river channel itself, the availability of nutrients to the biota, and the aquatic habitat diversity. River flows can alter the physical river channel by transporting or depositing sediments downstream, and by eroding the riverbanks. Sediments transported to habitats downstream can provide additional nutrients to the biota in these habitats. The size of sediments transported correlates to water velocity with larger-sized particles typically being transported only during storm events, when flows are likely to be highest. Pulse flows (high flows occurring during storm events) are particularly important since they can transport particulate nutrients and larger-sized sediments while flushing the riverbeds of fine sediments. Fine sediments can degrade aquatic ecosystems by covering a river's gravel bottom, and thereby preventing fish and numerous invertebrates from feeding or reproducing.

Transport of a variety of sediment sizes is important in creating a diverse aquatic ecosystem with both riffle and pool habitats. Riffle habitats are areas "of shallow, turbulent water passing through or over stones or gravel of a fairly uniform size" (Horne and Goldman 1994). Small invertebrates and fish eggs can obtain the oxygen they need in riffle habitats on the river bed while being protected from predators. Relatively slower flows, a substrate mixture of stones and fine-grain sediments, and an accumulation of decaying terrestrial debris characterize pool habitats (Horne and Goldman 1994). Different environmental conditions allow different biota to exist in pool habitats than those existing in riffle habitats.

Dense vegetation in the river channel can fragment or degrade river habitats, slow river flows, and cause increased sediment deposition or flooding in those areas. Types of vegetation that could negatively affect the river's ecosystem or water quality include plants floating on the water's surface or terrestrial plants that are growing in shallow areas of the river channel. Floating plants, such as Water Primrose in particular, can disrupt the aquatic foodweb by causing excessive shading. Large quantities of shading can prevent growth of flora (ex. algae or macrophytes) and remove a food source for many invertebrates (NRC 1992).

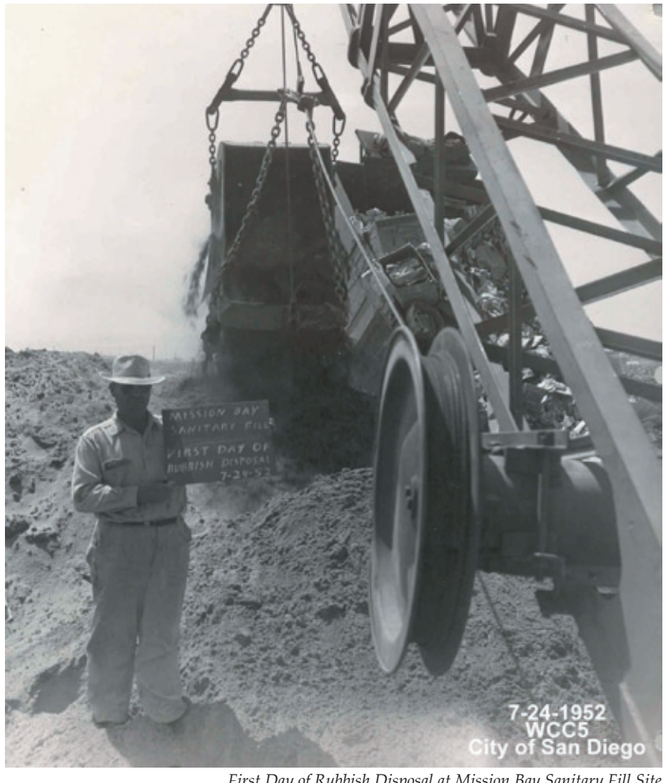
Channelizing rivers or restricting river meanders can also detrimentally affect aquatic and riparian habitats. Negative effects of channelizing rivers include removal of riparian vegetation and therefore habitat, loss of in-stream cover, altered riffle pool sequences, decreased stream sinuosity, altered substrate composition, increased bank erosion, increased suspended sediment and increased stream velocity. Restoration of river meanders can improve water quality by allowing more time for natural cleansing processes. River meanders can also decrease flooding and improve (and increase) aquatic and terrestrial habitats by increasing the stream corridor width. When necessary artificial structures or other aeration devices should be considered for improving water quality

Water Quality and Land Use

Water quality is directly linked to land uses within the watershed and especially adjacent to the stream channel. Land use practices in the San Diego River watershed and Mission Valley in particular have had profound and adverse impacts on the health of the river. Urban development has converted natural vegetated groundcover to impervious surface materials such as roads, roofs, and parking lots. The natural vegetated surfaces slowed the rate of run-off, and increased absorption into the ground creating an effective filtration and purification process. When this natural system is eliminated by paving the ground surface pollutants are more likely to flow directly into surface water systems. As development increases, the sources of pollution increase as well, bringing proportionately higher levels of vehicle emissions, car maintenance wastes, municipal sewage, pesticides, hazardous wastes, pet wastes and trash that can be washed directly into the river.

The San Diego River has been degraded by pollution from a variety of surface sources and is threatened by at least two subsurface sources, including the landfill between the river and Mission Bay and a bezene plume northeast of Qualcomm Stadium. The landfill is currently being studied and a Site Assessment is available at the City of San Diego Environmental Services Department.

Pre-Sanitary Fill Site
Source: 7-17-52 WCC2 City of San Diego



First Day of Rubbish Disposal at Mission Bay Sanitary Fill Site
Source: 7-24-52 WCC3 City of San Diego

MTBE Isocentration Contours
Source: Levine Fricke - Mission Valley Terminal
Project No. 002-10143-02
MTBE Isoconcentration Map and Well Section (A-A') Augist 2003
Figure No. 9

Groundwater

The San Diego River is located within the service area of the San Diego County Water Authority (SDCWA), and associated with two groundwater basins: the Santee/El Monte Groundwater Basin and the Mission Valley Groundwater Basin. The focus here is the Mission Valley Basin, which is a shallow alluvial aquifer underlying an east-west trending valley that extends from the eastern terminus of Mission Gorge out to San Diego Bay in Coastal San Diego. The basin is bounded by the contacts of alluvium with the semi-permeable San Diego and Poway Formations and the impermeable Linda Vista Formation. The southwestern boundary is the San Diego Bay.

The principal water bearing deposit is the Quaternary age alluvium consisting of medium to coarse-grained sand and gravel. This alluvium has an average thickness of about 80 feet and a maximum thickness of about 100 feet. The Mission Valley Basin is among some of the more productive of the aquifers lying within the jurisdictional boundaries of SDCWA. The average well production is about 1,000 gallons per minute and the average specific yield is about 15 percent. The San Diego Formation is found within this basin and is generally less than 100 feet thick east of the Rose Canyon fault system. West of the Rose Canyon fault, the San Diego Formation becomes thicker, reaching a maximum thickness of about 1,000 feet. The primary source of recharge for this basin is infiltration of stream flow from the San Diego River.

The California Department of Water Resources estimated storage capacity of the basin to be on the order of 42,000 acre-feet in 1975. San Diego County Water Authority estimated a total storage capacity of about 40,000 acre-feet 1997, indicating a gradual decline in storage capability over time. SDCWA estimated that water was pumped from the basin at the rate of about 500 acre-feet per year in 1997. Impairments to the Mission Valley Groundwater Basin include magnesium and sulfate from domestic use. Chloride and total dissolved solids concentrations are high for domestic and irrigation use. Seawater intrusion is suspected (California Department of Water Resources 2004).

The proposed actions of the San Diego River Park will likely have no negative impact to groundwater resources. Increasing the length of the river by increasing meander and broadening the riparian channel may lead to increased groundwater recharge. None of the proposed actions are reliant upon groundwater resources for implementation. However further study of groundwater quality and quantity, its effects on habitat and wildlife and the potential for groundwater recharge are warranted.

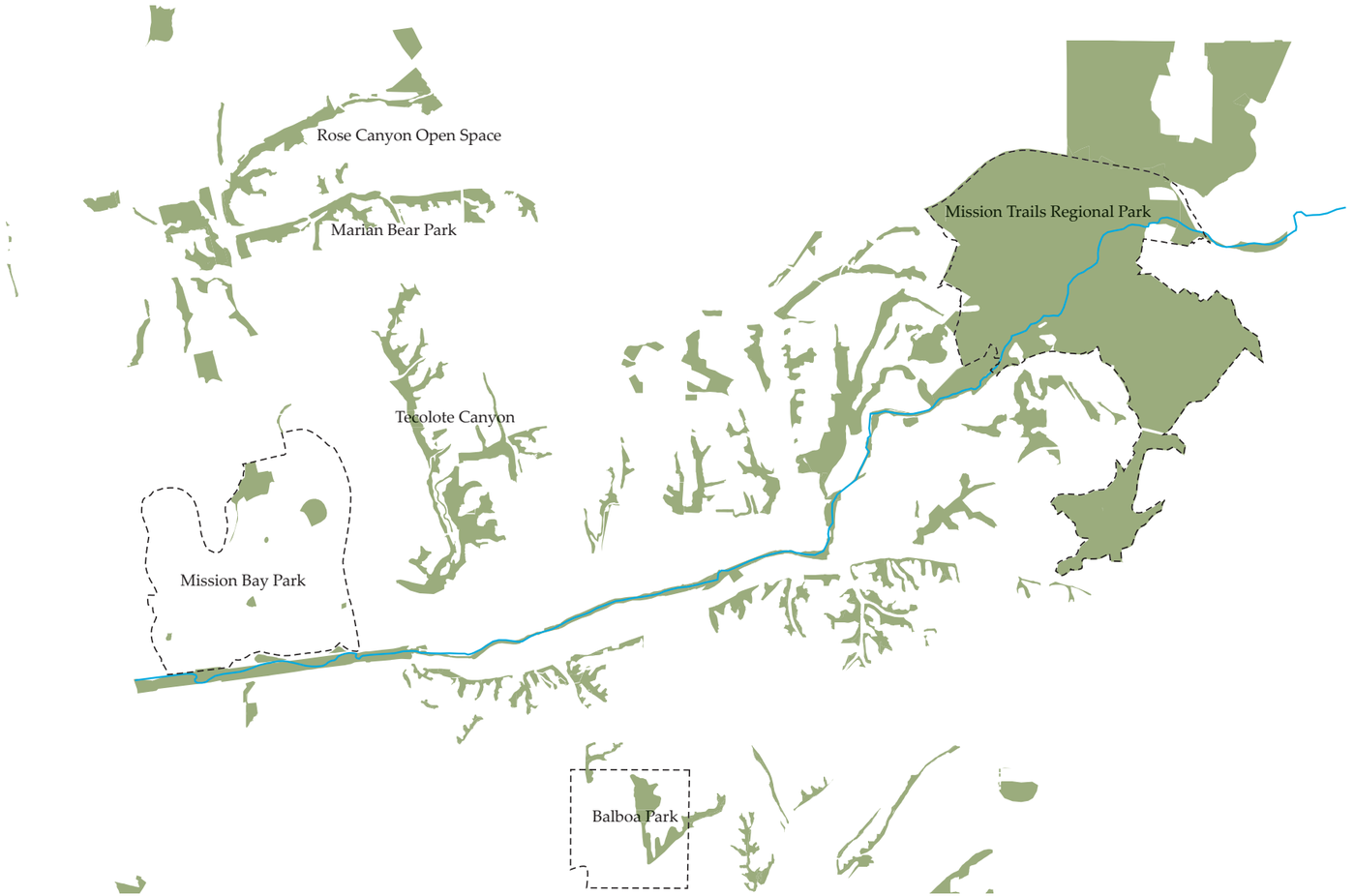
Habitat and Wildlife Inventory

Ecosystem Characterization

The warm, dry summers and cool, wet winters of the southern California climate supported the evolution of a dynamic ecosystem. Alternating from one extreme to the other, from summer and fall wildfires to winter downpours and floods, climatic events required the vegetation and wildlife of the region to adapt so that fire and flood became integral components of the ecosystems in the region. The large-scale transformation of these ecological processes—through fire suppression, alteration of watershed hydrology, reduction and fragmentation of habitat driven by population growth and associated development in the San Diego River watershed—has resulted in conditions for plants and wildlife that are significantly different than those to which they had adapted. Conditions today are different than those that were present just fifty years ago. Changes in sediment transport, water volume and water quality discussed in the San Diego River Park Conceptual Plan and detailed in the Hydrology and Water Quality Inventory affect the structure and distribution of vegetation and wildlife. Loss of habitat and fragmentation due to development can reduce populations of plants and animals and prevent genetic dispersal resulting in localized extirpations and degraded habitat.

Flood Disturbance

Due to the dry summers and wet winters typical of the mediterranean climate of Southern California, most rivers are low-flowing or intermittent for the majority of the year, but subject to sudden, large flood flows during the wet season. Prior to significant alteration and hydrologic changes, the San Diego River fits this pattern. Prior to damming, average flow at the Santee gauge station of 25 cubic feet per second (cfs) contrasted with peak measured flood flows of 70,200 cfs; post-dam flood levels only approach 9,590 cfs. Dam building, channelization, and gravel mining alter river dynamics so the river no longer functions as the primary disturbance agent in the riparian corridor. Flooding, erosion, deposition, and shifting of the riverbed uproot vegetation in one place while at the same time creating new land for plants to colonize. The result was a diverse mosaic of riparian vegetation, some areas supporting a mature riparian forest and other areas colonized with pioneer species. Flooding does occur, but significant erosion, deposition, and shifting of the riverbed no longer occur. As described in the Hydrology and Water Quality Inventory in this report, return flows in developed areas have changed the river from ephemeral to perennial, with water flowing consistently throughout the year. Due to these changes, the riparian vegetation supported by the river tends to maintain a homogenous character of a shrub understory, with a mature overstory canopy where human disturbance does not occur. These changes to river hydrology and dynamics will also cause populations of species that prefer the modified hydrologic conditions to increase to the detriment of those species that are better adapted to the historic conditions.



Multiple Habitat Planning Areas

Fire Disturbance

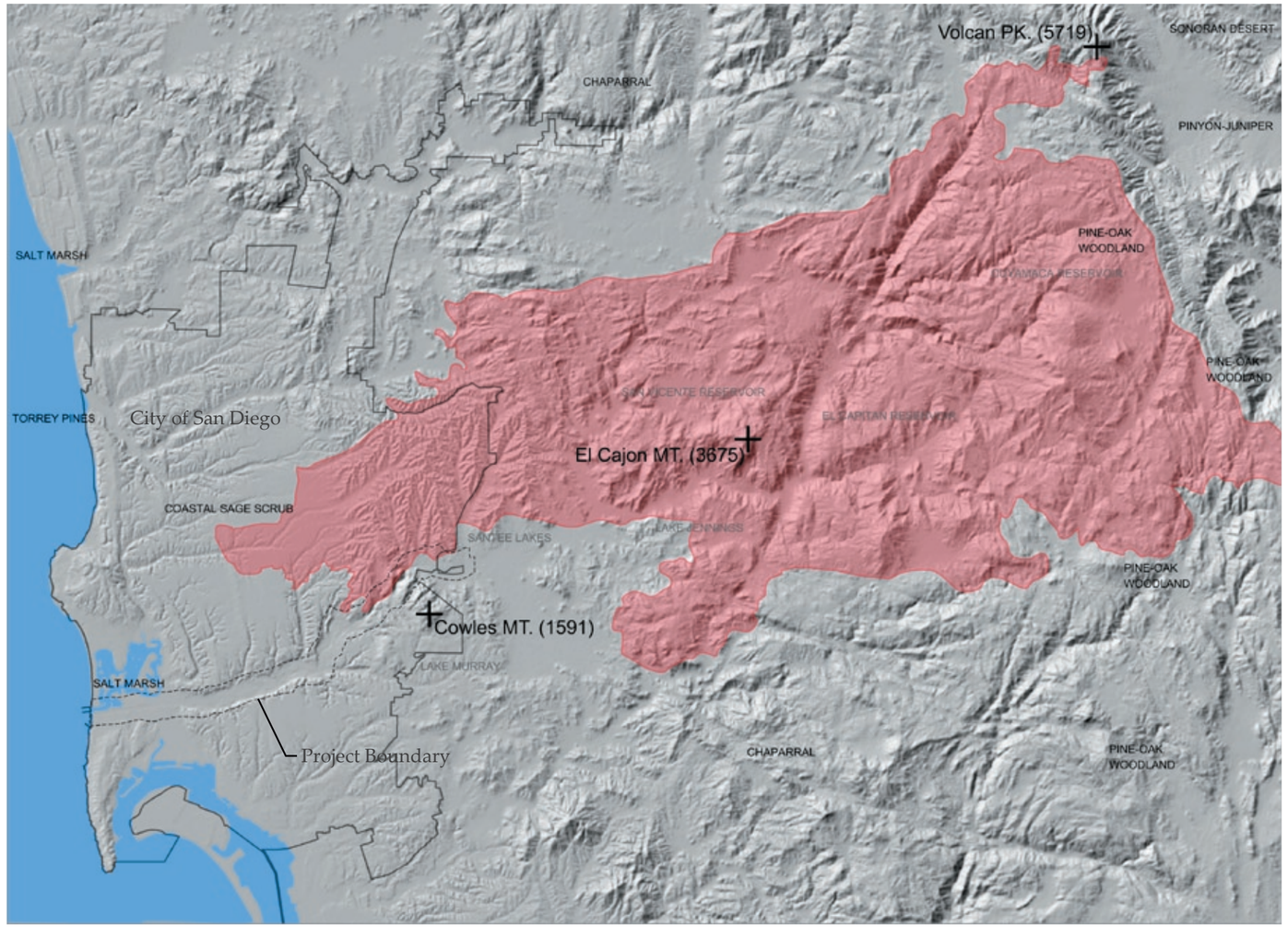
With the large-scale destruction of 2003, fire has reasserted its prominence in the public eye and its influence on the ecology of the San Diego River watershed. The Cedar fire burned 95% of the upper watershed and 74% of the entire watershed. Within the study area the Cedar fire burned most if not all of the native chaparral and coastal sage scrub (CSS) northeast of the river within Mission Trails Regional Park. The wind eased as the fire reached the riparian corridor of the river, limiting damage to the riparian vegetation and beyond to the southeastern part of the park. Fire is a key process for maintaining the overall health of the CSS and Chaparral plant communities, promoting new growth and in the case of small fires, improving the diversity of seral (successional) stages within the plant community. Fire suppression prolonged the inevitability and possibly exacerbated the intensity of the fire by allowing fuels to accumulate. Fire suppression results in conditions where large contiguous stands of mature vegetation are contrasted with watersheds bare of vegetation due to recent burns. The vegetation affected by the fire is expected to recover fully, but short-term impacts include: the loss of a large area of adjacent upland vegetation, the reduction of adjacent habitat and cover, soil erosion and river siltation, and potential colonization by exotic plant species. Long-term effects include: potential stand heterogeneity of the plant community (under fire suppression) with a corresponding reduction in biodiversity.

Plant Communities

The condition of native vegetation and associated plant communities within the study area falls into three general categories. In the first category are relatively healthy native plant communities in undisturbed areas. The second category consists of developed or disturbed areas with native vegetation, showing some reduction in species diversity. These areas also include exotic invasive species. The third category covers urban or developed areas, which do not host any functioning native plant communities; some natives may be present as landscape elements only. Within the San Diego River Natural Resources Management Plan Study Area, the healthy native plant communities are generally coincident with the areas identified for preservation under the City's Multiple Species Conservation Program (MSCP) Subarea Plan (see habitat conservation). These areas include: Mission Trails Regional Park (MTRP), sections of the San Diego River riparian corridor west of MTRP, tributary canyons to Mission Valley, and sections of the Mission Valley side slopes.

Disturbed areas are identified on the species of concern map; these areas generally correspond to locations where intense activity through land use or management occurs within or immediately adjacent to the channel. These areas include: current and historic resource extraction at Superior Mine, abandoned gravel pits adjacent to Admiral Baker Golf Course and downstream to I-5, Riverwalk Golf Course, Admiral Baker Golf Course, Carleton Oaks Golf Course, and sections of the floodway zone through Mission Valley. Areas classified as urban/developed on the species of concern map on page 125 are the dominant category of "plant community" in the study area. These areas typically consist of a combination of hardscape elements and irrigated landscaping.

Development encroaches on the river for much of its length, with the only significant area of contiguous quality habitat being Mission Trails Regional Park. Below MTRP, the only areas that still support native plant communities and continue to function as habitat are lands that were historically unbuildable, such as the immediate river floodway, the steep side slopes of Mission Valley, and the steep side canyons. The valley floor, the historic floodplain and estuary, and the mesa tops are all developed, no longer functioning as habitat and effectively isolating most of the remaining patches of functional native habitat.



Cedar Fire Disturbance Area

Exotic Invasive Vegetation

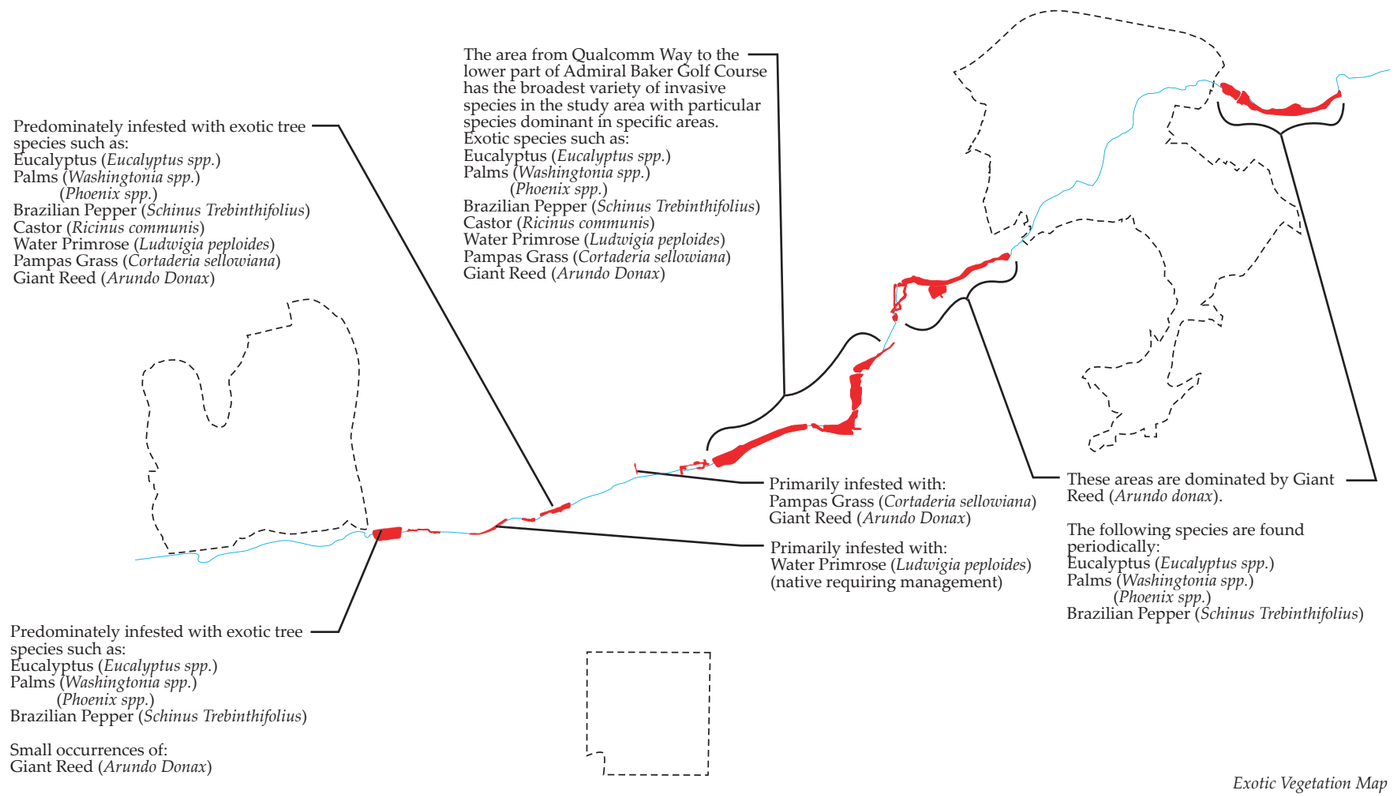
Exotic vegetation was mapped and inventoried in 2002 as part of the San Diego River Invasive Exotic Weed Eradication Master Plan. The map included in this report is based on this plan, identifying areas of heavy infestation. Invasive species include Eucalyptus (Eucalyptus spp), Mexican Fan Palm (Washingtonia robusta), Canary Island Palm (Phoenix canariensis), Brazilian Pepper (Schinus terebinthifolius), Castor (Ricinus communis), Pampas Grass (Cortaderia sellowiana), Giant Reed (Arundo donax), Tamarisk (Tamarix aphylia) and the native Water Primrose (Ludwigia peploides). Three species of particular concern in the San Diego River Natural Resources Management Plan area are Pampas Grass, Giant Reed, and Tamarisk. The aggressive colonization habits of these species have a significant impact on habitat quality. In the case of Giant Reed and Tamarisk, colonization, coupled with their prodigious water uptake, allows them to change soil moisture and water table levels to conditions that favor them at the expense of native riparian species.

The plant communities identified within the limits of study area—one half mile to either side of the river—are listed below. The descriptions follow the format used by SANGIS, which used the Holland 1995 classification for this dataset. This classification has a broad range of descriptions, including categories that are not plant communities in the traditional sense, but more as a cover or use designation. These categories include: beach, subtidal, extensive agriculture, shallow bay, urban/developed. An in-depth description of these communities can be found in the San Diego River Natural Resources Management Plan.

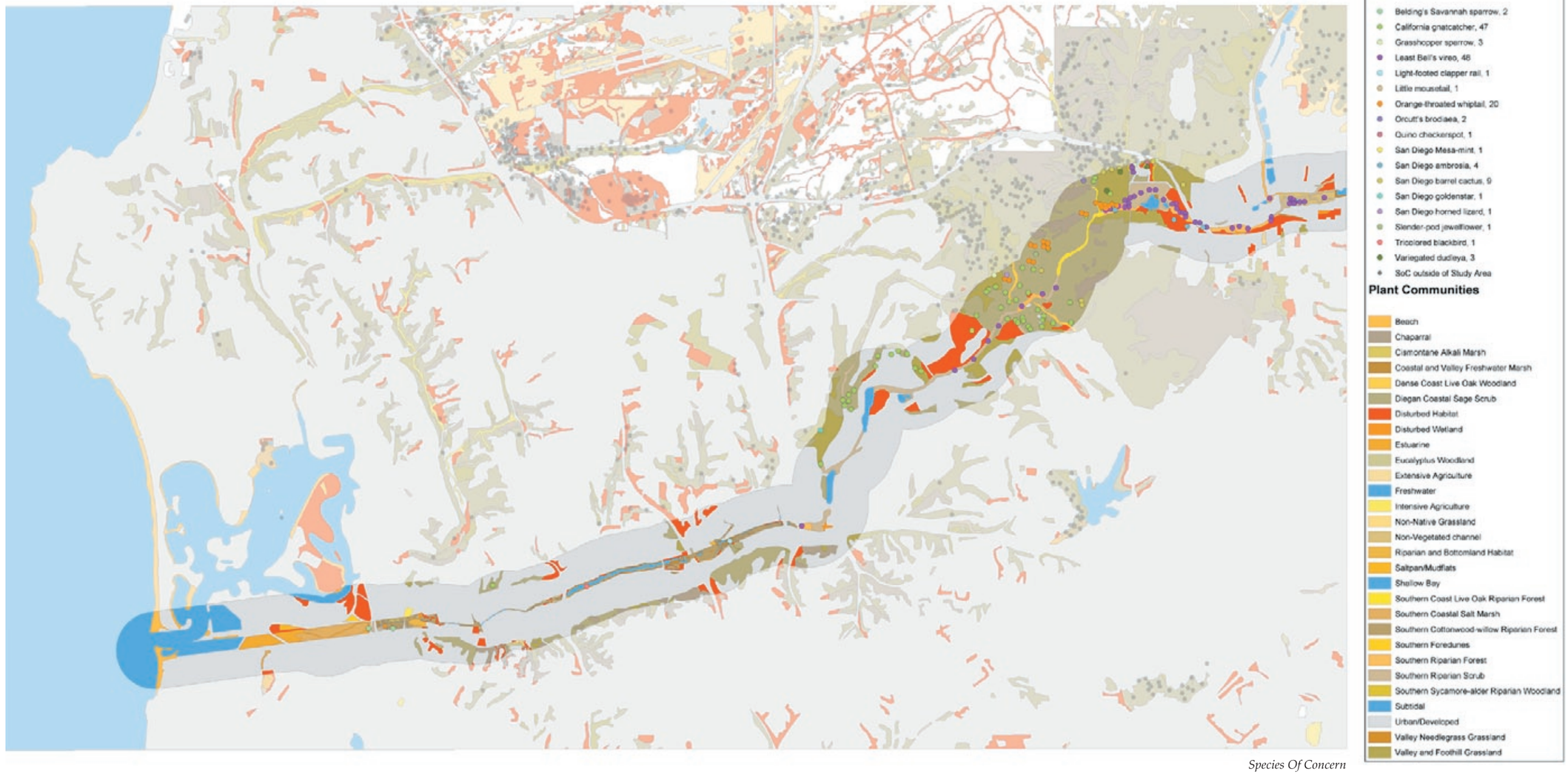
Plant communities within the study area

Beach
Chaparral
Cismontane Alkali Marsh*
Coastal and Valley Freshwater Marsh*
Dense Coast Live Oak Woodland
Diegan Coastal Sage Scrub*
Disturbed Habitat*
Disturbed Wetland*
Estuarine
Eucalyptus Woodland*
Extensive Agriculture
Freshwater*
Intensive Agriculture
Non-Native Grassland*
Non-Vegetated channel/Floodway/Lakeshore Fringe*
Riparian and Bottomland Habitat
Saltpan/Mudflats
Shallow Bay
Southern Coast Live Oak Riparian Forest
Southern Coastal Salt Marsh
Southern Cottonwood-willow Riparian Forest*
Southern Foredunes
Southern Riparian Forest
Southern Riparian Scrub*
Southern Sycamore-alder Riparian Woodland
Subtidal
Urban/Developed*
Valley Needlegrass Grassland
Valley and Foothill Grassland

* Denotes communities that are also in the San Diego River Natural Resources Management Plan



Exotic Vegetation Map



Species Of Concern

Wildlife

Shrinking habitat area and reduced habitat diversity limit the number of species within the study area. The species that are present are limited to those that can rely entirely on the remaining natural habitat to meet their needs, and the generalists who meet their needs through a combination of native habitat and resources available in developed areas.

In the upper reaches of the study area, the size, quality and connectivity of habitat areas is adequate to support a full complement of wildlife species, including large predators. The Mountain lion (Felis concolor) and the Bobcat (Lynx rufus) are large predators typically associated with the chaparral and coastal sage scrub habitat types that dominate Mission Trail Regional Park.

Habitat in the lower reaches is not adequate to support large predators. For this reason, the lower reaches have an ecosystem with a modified food web that almost completely excludes the top predators. In these areas, mesopredator populations (middle predators) such as Coyote (Canis latrans) or Raccoon (Procyon lotor) have expanded to fill the void left by the absence of top predators. This modified population profile is acceptable for this section of the study area because of the proximity of development and attendant concerns of safety.

Studies of wildlife movement and resident populations (Integrated Natural Resources Management Plan for Marine Corps Air Station Miramar) suggest that a corridor width of 300' is generally adequate to support resident species of birds and small mammals, while a corridor width of 500' is generally optimum to allow movement of larger, as well as increased resident populations of birds and small mammals. The City of San Diego Land Development Code – Biology Guidelines, Section III Biological Impact Analysis and Mitigation Procedures, recommends that areas of native vegetation that are less than 400 feet wide for a length greater than 500' are considered isolated (p.21). The guidelines further reference the MSCP recommendation that at urban interface edge conditions range from 200 to 600 feet depending on adjacent land uses (p. 21).

Within the areas that cannot accommodate the needs of large predators, there still are smaller animals that have specific habitat needs and are sensitive to changes to their environment. Some of these sensitive species are covered by the San Diego MSCP Subarea Plan, which provides guidelines for their protection. These species are listed in the following section. Other sensitive species not covered by the San Diego Multiple Species Conservation Program Subarea Plan are listed in the San Diego River Natural Resource Management Plan. Detailed inventories of all wildlife species have been prepared as part of various Natural Resource Management Plans completed for sections of the study area. These include the Mission Bay Natural Resource Management Plan, the San Diego River Natural Resource Management Plan, and the First San Diego River Improvement Project (FSDRIP) Natural Resource Management Plan. The stretch of river covered in these plans extends from the Pacific Ocean to Mission Trails Regional Park, excluding the Riverwalk Golf Course.

Habitat Conservation - Multiple Species Conservation Program

The State of California passed the California Natural Communities Conservation Planning (NCCP) Act in 1992 to facilitate an ecosystem-based approach to preserving and protecting the state's remaining natural habitats and biodiversity. Plans are developed at the regional, subregional, and subarea level to meet the conservation goals of the NCCP Act. The United States Fish and Wildlife Service and the California Department of Fish and Game are the two natural resource agencies charged with reviewing plans to ensure compliance with the NCCP Act. The San Diego County Multiple Species Conservation Program Final Plan is one of eleven subregional plans within the Coastal Sage Scrub Region. Within this subregion, the City of San Diego is one of twelve subareas, and has developed an approved Subarea Plan. Approval of the plan conserves resources at the regional level while allowing the city to issue permits for incidental take of habitat at the local level. To ensure the conservation of resources, the City of San Diego Subarea Plan provides both general and specific guidelines, policies, and directives to minimize impacts to species and habitats. The City has also included clear guidelines for permitting of environmentally sensitive lands in their Land Development Code Biology Guidelines.

The San Diego County Multiple Species Conservation Program Final Plan identifies Mission Trail Regional Park and the East Elliott area as one of sixteen biological core areas and the San Diego River riparian corridor west of Mission Trails Regional Park as a linkage between them and to the Pacific Ocean. The Mission Valley side slopes and the tributary canyons are identified in the City of San Diego Multiple Species Conservation Program Subarea Plan as urban habitat areas, which in the study area are not included as part of any of the major planned areas in the Multiple Species Conservation Program Subarea Plan. The majority of urban habitat areas consist of canyons with native habitats in relative proximity to other Multiple Species Conservation Program areas providing habitat. These areas contribute in some form to the Multiple Habitat Planning Areas (MHPA), either by providing habitat for native species to continue to reproduce and find new territories, or by providing necessary shelter and forage for migrating species (mostly birds). These areas contain a mix of habitats including coastal sage scrub, grasslands, riparian/wetlands, chaparral, and oak woodland. The lands are managed pursuant to existing Natural Resource Management Plans, Landscape Maintenance Districts, as conditions of permit approval, or are currently not managed. The areas also contribute to the public's experience of nature and the local native environment.

Courtesy M. B. Stowe

The list below catalogues plant and animal species with specific guidelines in the Multiple Species Conservation Program Subarea Plan identified as occurring or likely to occur in the study area. Species were identified through SANGIS data and the San Diego River Natural Resource Management Plan.

Belding's Savannah sparrow	Passerculas sandwichensis beldingi
California gnatcatcher	Polioptila californica
California Least Tern	Sterna antillarum browni
Cooper's hawk	Accipiter cooperi
Grasshopper sparrow	Ammodramus savannarum
Least Bell's vireo	Vireo bellii pusillus
Light-footed clapper rail	Rallus longirostris levipes
Little mousetail	Myosurus minimus ssp. apus
Orange-throated whiptail	Cnemidophorushyperythrus beldingi
Orcutt's brodiaea	Brodiaea orcuttii
Quino checkerspot	Euphydryas editha quino
San Diego Mesa-mint	Pogogyne abramsii
San Diego ambrosia	Ambrosia pumila
San Diego barrel cactus	Ferocactus viridescens
San Diego goldenstar	Muilla clevelandii
San Diego horned lizard	Phrynosomacoronatum blainvillei
Slender-pod jewelflower	Caulanthus stenocarpus
Southwestern pond turtle	Clemmys marmorata pallida
Southwestern willow flycatcher	Empidonax extimus traillii
Tricolored blackbird	Agelaius tricolor
Variegated dudleya	Dudleya variegate
White-faced ibis	Plegadis chihi