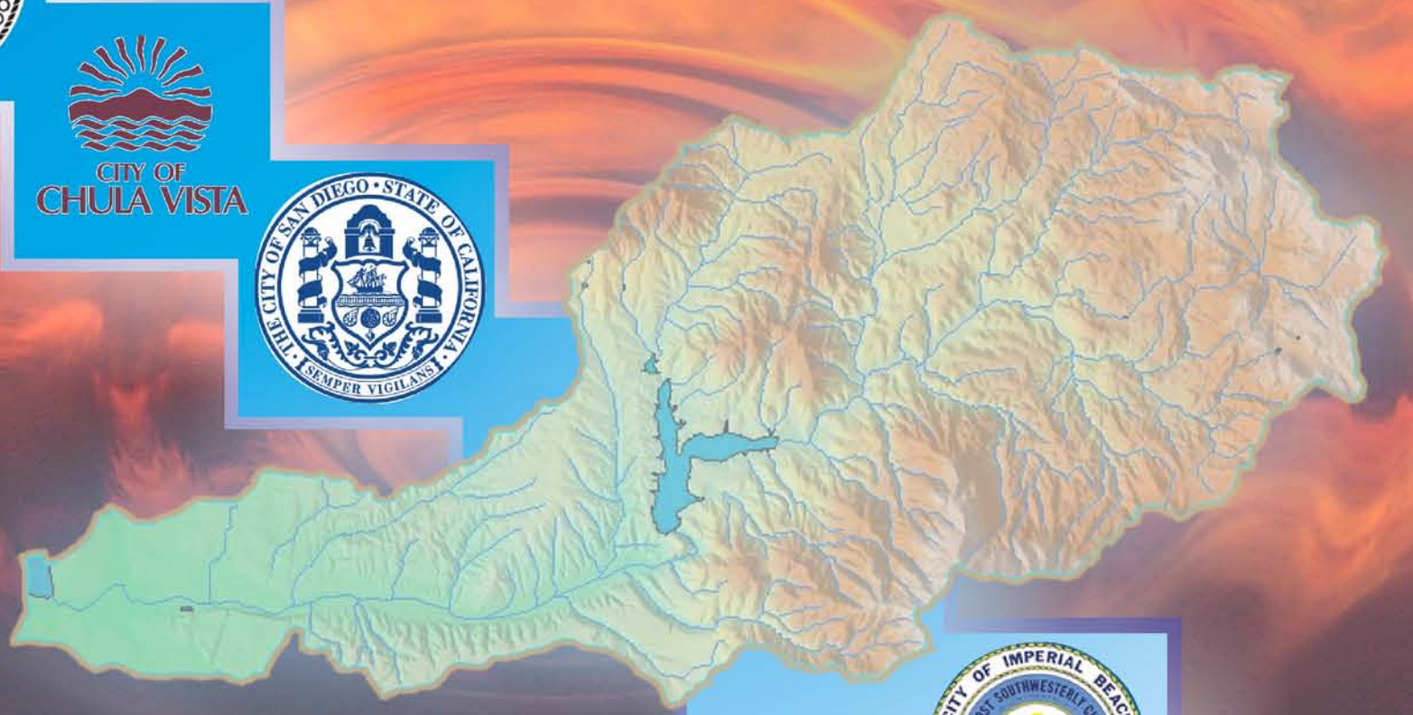
Otay River Watershed Management Plan

DRAFT FINAL

Prepared for:



Prepared by:

Aspen Environmental Group

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Final Draft

Otay River Watershed Management Plan

Prepared For:

Otay River Watershed Management Plan
Joint Exercise of Powers Agreement Public Agencies

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May 2006

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EXECUTIVE SUMMARY

As with much of southern California, the Otay River watershed is a rapidly urbanizing coastal watershed, with development concentrated along the flatter coastal plain and less development occurring in the higher, inland elevations. The population and housing in this watershed are expected to nearly double in the next 25 years, which will contribute to loss of undeveloped and agricultural land (40 percent) and put additional strain on this dynamic ecosystem.

This watershed has a long history of human occupation and use, beginning with the earliest inhabitants almost 9,000 years ago. Settlement by Europeans began in the 1700s with the arrival of the Spanish soldiers, settlers, and missionaries. Today, this area has a rich diversity of inhabitants and cultural heritage. It has developed over time to meet the needs of its inhabitants, from hunting and gathering; to agriculture and grazing; and recently to more urbanized residential, commercial, and industrial development.

The need for a reliable source of drinking water to sustain these growing populations has been at the forefront of development. Upper and Lower Otay Reservoirs have served as drinking water sources since the 1890s, and will continue to serve the San Diego Region, including the western portion of this watershed, well into the future. For more than 100 years the watershed lands tributary to Upper and Lower Otay Reservoirs have been rural and largely undeveloped, and water quality in the reservoirs was good.

Among the significant series of events in the watershed was the construction, failure, and reconstruction of Lower Otay Dam and Reservoir during the late 19th and early 20th centuries; and the construction of Upper Otay Dam and Reservoir at the turn of the 20th century. The reservoir provided water storage to sustain the early developing communities in the watershed; and the dam failure contributed to the destruction of the Otay community; and again supported development in the watershed after reconstruction of the Lower Otay Dam and Reservoir and the construction of the Upper Otay Dam and Reservoir. Today, the reservoirs effectively block sediment transport and surface-water connections between the upper and lower watershed, and they limit use of the Otay River as a wildlife movement corridor. However, they provide much of the water to the western portion of the watershed and elsewhere in the San Diego region, and they are an important part of the expanding recreational system. Also, they have mostly eliminated flooding on the mainstem of the Otay River; with localized flooding occurring along tributaries in older urbanized areas in the lower watershed and in a few upper watershed locations.

Achieving a balance between existing and future land uses and resources is critically important to the long-term sustainable health of the watershed including source water protection, in terms of its rich and diverse upland and aquatic (surface and subsurface) resources. Many plans, programs, and permits are in development or have been implemented seeking to achieve this balance, while protecting, enhancing, and restoring key natural resources. The Otay River Watershed Management Plan offers a critical tool that can build upon and integrate major efforts benefiting multiple uses in this watershed, such as the Multiple Species Conservation Program, the Otay Valley Regional Park, and the San Diego National Wildlife Refuge Complex.

As shown in this document, planning for this watershed's future must consider that the physical and biological conditions shaping the watershed vary across its landscape; and the protection, enhancement, restoration, and management strategies ultimately implemented need to consider how these differences will affect the ecosystem as the landscape changes. Moreover, watersheds in this region are exceedingly complicated systems, and additional water quality and other data will be needed to maximize the effectiveness of the implemented strategies in meeting identified objectives and goals.

As a programmatic advisory document, the ORWMP recommends several strategies to implement for meeting its identified goals, including a recommended implementation schedule. Ultimately, however, the decision-makers will determine which strategies to implement and their timing. Furthermore, for most strategies, implementation would require acquiring more specific information, completing detailed plans and environmental documentation, securing required permits and funding, and addressing other logistical considerations.

Because there are many unknowns, it is vitally important to develop a monitoring and evaluation program. This program should include watershed-wide and strategy-specific monitoring to establish a comprehensive baseline for comparison, to identify trends, and to evaluate whether specific actions are effectively protecting and benefiting watershed resources. If necessary, remedial actions should be undertaken to maximize realization of the Otay River Watershed Management Plan in achieving its stated goals. As discussed in the Otay River Watershed Management Plan, it will be essential to establish and convene a permanent group of decision-makers to periodically and as necessary evaluate whether revisions to the document are warranted in light of changes in conditions and the regulatory environment. Therefore, reexamination of the Otay River Watershed Management Plan will be necessary, more frequently the first several years, to ensure that it continues to reflect the current conditions and interests and remains a “living” document.

A. INTRODUCTION

A.1 OVERVIEW OF WATERSHED MANAGEMENT PLANNING

Watershed management planning offers a comprehensive approach to the protection, enhancement, and restoration as well as the uses of surface and groundwater (quality and quantity), floodplains, and estuaries within a logical landscape unit. The landscape within the boundaries of each watershed is hydrologically connected, because it drains (surface or subsurface) all the water it receives to a common outlet, such as the San Diego Bay. Watershed management plans typically consist of:

- Characterization of the watershed's natural resources, uses, and problems;
- Identification of goals to meet natural resource and land use needs;
- Assessment and prioritization of problems and development of implementation strategies to address them; and
- Development of monitoring strategies and protocols for evaluating the effectiveness of implemented strategies and updating of the watershed management plan, as necessary.

To maximize the implementation and success of a watershed management plan, it is essential that the watershed's stakeholders are involved throughout the plan-development process. After all, these are the individuals, agencies, and other entities that have an interest in the watershed. It is also essential that a watershed management plan be developed as a "living document," which can be updated periodically to consider changes in watershed conditions, the regulatory requirements, and to incorporate the lessons learned from watershed monitoring and evaluation. Toward this end, a permanent group of decision makers should be established and regularly convene to evaluate progress, resolve inconsistencies or conflicts, and make any changes necessary to achieve stated goals. Recommended implementation and monitoring strategies for the Otay River watershed are discussed in Sections C and D of this document.

A.2 THE PURPOSE AND USES OF THE OTAY RIVER WATERSHED MANAGEMENT PLAN

The Otay River watershed is an approximately 145-mi^2 watershed (92,920 acres)[1] located in southern San Diego County, near the international border with Mexico (Figure A-1). This watershed, which drains into southern San Diego Bay, includes unincorporated County land, as well as land within the jurisdictions of the Cities of Chula Vista, San Diego, Imperial Beach, Coronado, and National City (Figure A-2). As with other coastal watersheds in southern California, and consistent with the watershed's physical characteristics and topography, the landscape along the coastal plain in proximity to the watershed's outlet has rapidly developed, with less development occurring within the mountainous inland areas. Pursuant to the land use and regulatory plans of the encompassed jurisdictions, urbanization and other land uses are anticipated to continue, as are efforts to protect, enhance, and restore the remaining upland and aquatic resources within this watershed. It is important to recognize that some of the land use changes, including the Otay Reservoirs and dam construction and reconstruction in the late nineteenth and early twentieth centuries, have significantly altered the natural processes in this system. As such, activities should focus on protecting the remaining watershed resources in their current context: protecting resources within existing and planned urban areas (primarily through the application of best management practices); protecting source waters; and

[1] The 160-mi^2 Otay Hydrologic Unit (910.0), as defined by the State Water Resource Control Board, consists of the Coronado (910.1), Otay Valley (910.2), and Dulzura (910.3) Hydrologic Areas. However, the Coronado Hydrologic Area drains into San Diego Bay and is, therefore, not considered part of the Otay River watershed for the purpose of developing the Otay River Watershed Management Plan. An approximately 200-acre portion of the City of Coronado does drain into the Otay River and is considered part of the Otay River watershed. This portion of Coronado is covered by water or is open space. Neither the City of Coronado nor the City of National City is participating in the development of the Otay River Watershed Management Plan.

protecting, enhancing, and restoring resources where possible, especially in non-urbanized areas of the watershed.

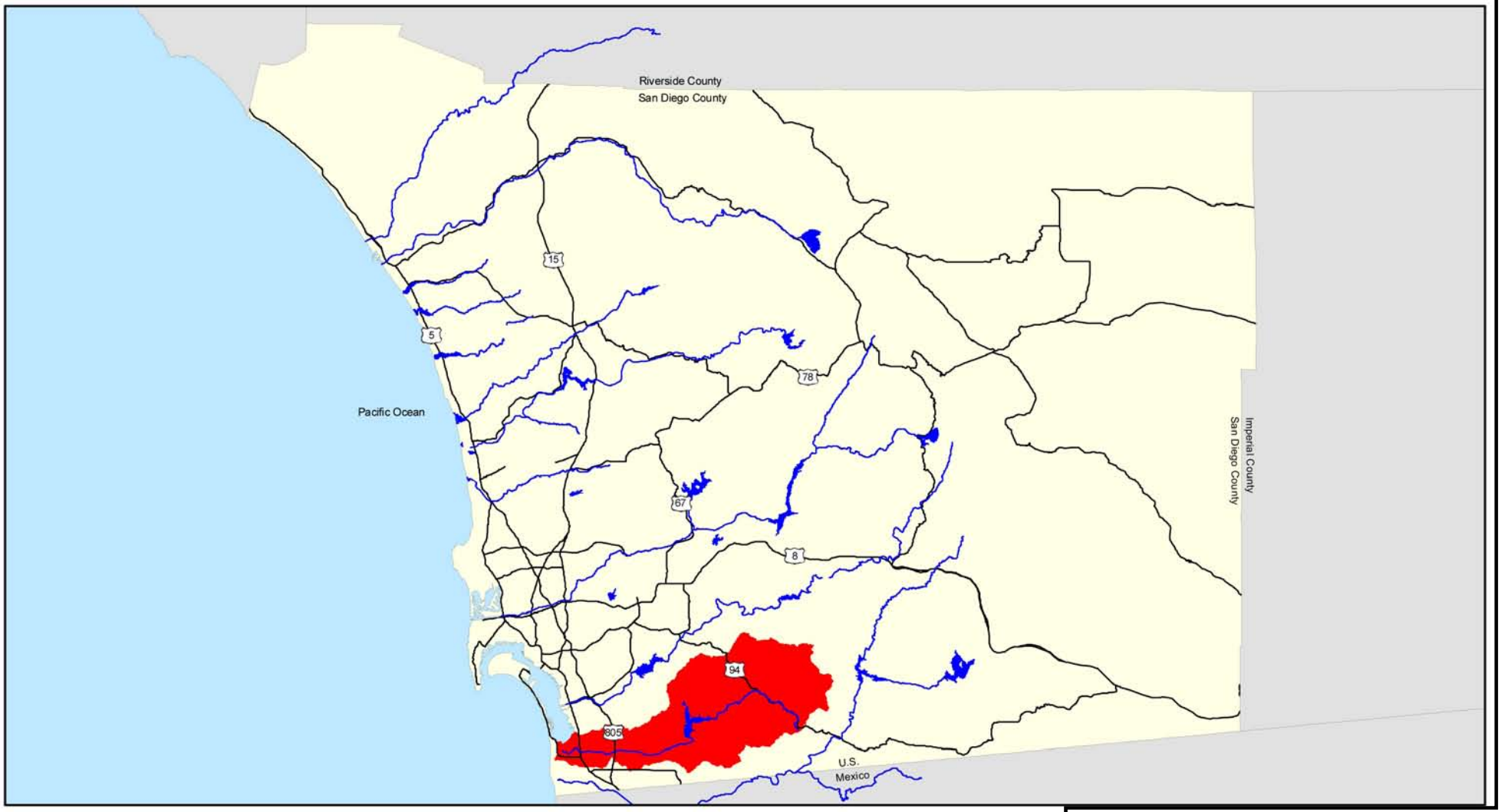
The purpose of the Otay River Watershed Management Plan (ORWMP) is to develop a comprehensive framework management plan to guide this watershed's future. With the population and housing in this watershed expected to nearly double in the next 25 years (SANDAG, 2004a), there will be a variety of land use changes. The ORWMP, in consideration of the applicable general plans and other resource and land-use plans and programs, provides a key vehicle for planning for on-going watershed uses, source water protection, and other resource protection, enhancement, and restoration. To achieve this purpose, the ORWMP consists of several elements:

- Characterizing the watershed's various natural resources and land uses;
- Identifying key goals;
- Assessing and prioritizing threats to existing beneficial uses and natural resources;
- Identifying strategies for the protection, enhancement, and restoration of beneficial uses and natural resources in the watershed, including source water protection, and a water quality monitoring strategy;
- Providing adaptive management strategies and objectives to monitor and evaluate the effectiveness of the strategies and propose potential remedial actions; and
- Preparing the ORWMP so that it can be easily updated to reflect changes in physical, biological, chemical, land use, and regulatory conditions.

At its inception and over time, the ORWMP is intended to be consistent with the applicable local General Plans, local resource plans and programs, the Otay River Watershed Special Area Management Plan (SAMP), the Municipal Permit (San Diego Region National Pollutant Discharge Elimination System [NPDES] General Permit Order No. 2001-01). Specifically, the ORWMP provides implementation strategies intended to assure high water quality standards and to protect aquatic and upland resources in this watershed. Unlike the SAMP, the ORWMP is not meant to provide regulatory mechanisms; rather, it is to serve as a programmatic advisory document for decision-makers to use as a tool. Each participating jurisdiction may have different needs and land use considerations, and therefore, the ORWMP strategies are only recommendations that may need to be refined further for each jurisdiction.

A.3 OVERVIEW OF EXISTING LAND USE AND CONSERVATION PLANS, PROGRAMS, AND REGULATORY MECHANISMS

The primary controls of development in this watershed are the General Plans adopted by each of the responsible jurisdictions (i.e., County of San Diego, City of Chula Vista, City of San Diego, City of Imperial Beach, City of Coronado, City of National City) and the San Diego Unified Port District Master Plan, the boundaries of which overlap small portions of the western edge of the Otay River watershed. These plans guide the physical development of their respective jurisdictions by striking a balance among the multitude of uses and resources. With the rapid development of the region during the last several decades that is expected to continue, these plans have focused on providing the housing, infrastructure, facilities, and services necessary to support the growing population, and maintaining economic stability. Pressures that this urbanization has brought to habitat and species regionwide, prompted the development of natural resource conservation programs such as the Multiple Species Conservation Program (MSCP).



Legend

- Otay Watershed
- Rivers
- Lake/Reservoir/Lagoon

N

0 10 20

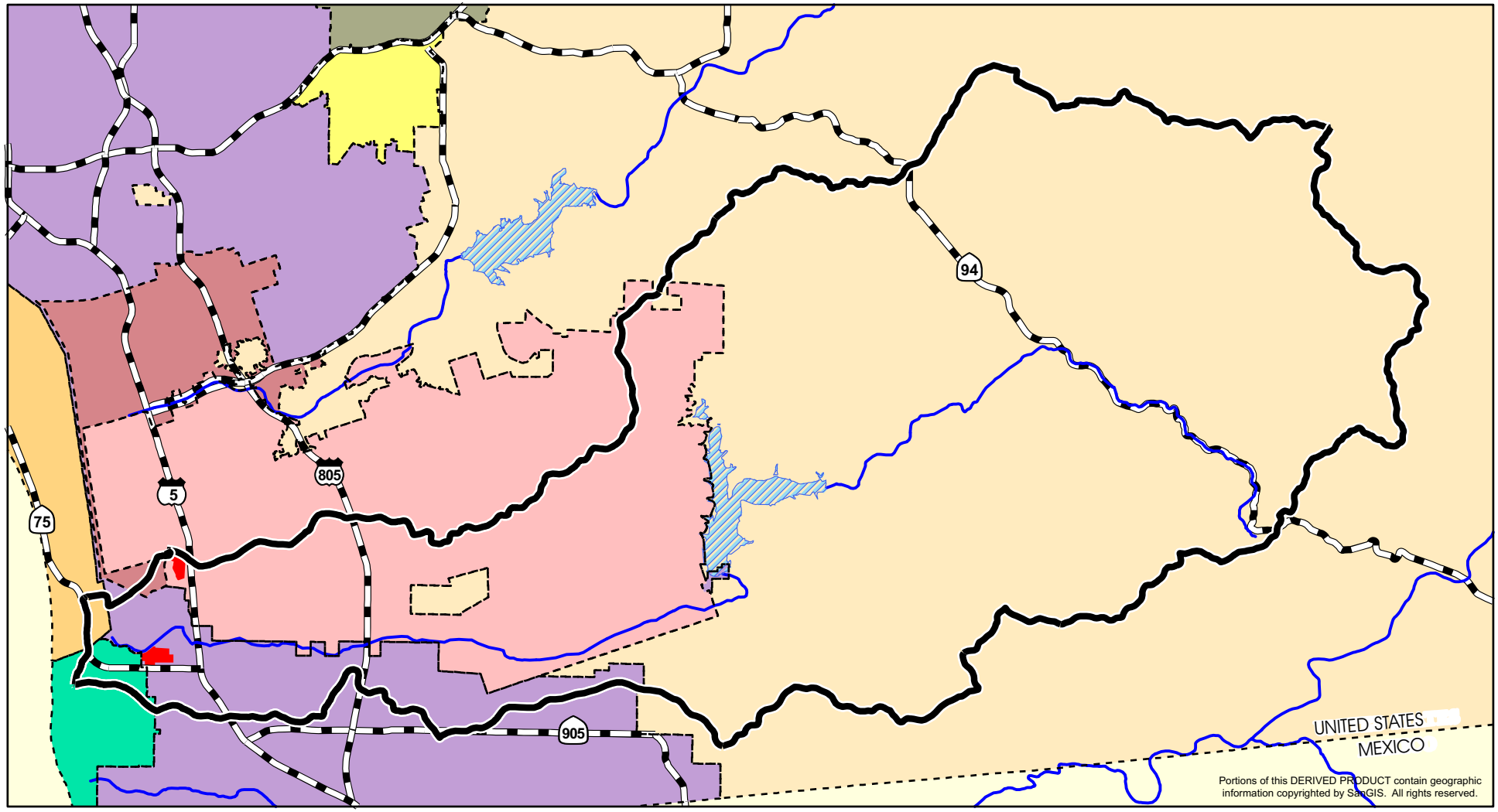
Scale in Miles

Otay River Watershed Management Plan

Figure A-1

Regional Vicinity Map Including the Otay River Watershed

Aspen Environmental Group



Legend

- CHULA VISTA
- CORONADO
- IMPERIAL BEACH
- LA MESA
- LEMON GROVE
- NATIONAL CITY
- S.D. COUNTY
- CITY OF SAN DIEGO
- PORT OF SAN DIEGO

Basemap Legend

- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes

N

0 1.25 2.5 5

Scale in Miles

Source: TAIC, 2005

Otay River Watershed Management Plan

Figure A-2

Otay River Watershed Jurisdictional Boundaries

Aspen Environmental Group

In the Otay River watershed, the MSCP conserves large blocks of habitat and species in balance with planned urban development (e.g., Otay Ranch). The County of San Diego, City of Chula Vista, City of San Diego, all with jurisdiction in this watershed, have prepared and implemented individual MSCP Subarea Plans and entered into Implementing Agreements with the U.S. Fish and Wildlife Service and California Department of Fish and Game to obtain permits under the Federal and State Endangered Species Acts. The City of Chula Vista's MSCP Subarea Plan also includes a Wetlands Protection Program, focused on conserving wetlands and requiring mitigation for any wetland impacts to ensure no net loss of wetland quantity or quality.

Similarly, through the regulation of non-point source pollution, the Municipal Permit focuses on protecting and enhancing the variety of beneficial uses in the regional watersheds. Pursuant to this permit, each Copermittee is required to prepare a Jurisdictional Urban Runoff Management Program (JURMP) and Standard Urban Storm Water Mitigation Plan (SUSMP), and to work collaboratively with the other Copermittees on Watershed Urban Runoff Management Programs (WURMPs). These documents not only provide background information but serve to coordinate land use planning efforts at the project, jurisdictional, and watershed levels that are necessary to protect and enhance beneficial uses. However, compliance with federal, State Water Resources Control Board, and Regional Water Quality Control Board water quality objectives will not ensure that impacts to drinking source waters will not be significant. This is because federal, State Water Resources Control Board, and Regional Water Quality Control Board water quality objectives are not specific to the pollutants of concern (nitrogen or phosphorus, total organic carbon, and salts) for drinking water sources. Recent Sanitary Surveys (2000, 2005) have identified non-point source runoff from residential and commercial development as the most significant source of pollutants to the Otay Reservoirs. Therefore, it is important that the City of San Diego's *Source Water Protection Guidelines for New Development* (2004) be included as part of any new development proposals and permit processes involving watershed areas draining into the reservoirs. These reservoirs are also part of the City of San Diego's Cornerstone Lands for its MSCP compliance.

Recognizing the changing conditions and needs, the County of San Diego, the City of Chula Vista, and the City of San Diego are currently completing updates to their General Plans. The local jurisdictions have already modified their storm water and grading ordinances to implement the requirements of the Municipal Permit (e.g., the County's Watershed Protection Ordinance, City of Chula Vista's Storm Water Management and Discharge Control Ordinance), which if properly adhered to and enforced, should protect and could benefit the quality of water in this watershed and the adjoining San Diego Bay from storm water pollutants. In addition, the City of San Diego has prepared the *Source Water Protection Guidelines for New Development*, 2004, to address pollutants of concern for drinking water sources, as discussed above.

The jurisdictions in this watershed also have other resource-oriented policies and ordinances. For example, the County of San Diego has a Resource Protection Ordinance that protects floodplains, wetlands, vernal pools, and steep slopes and requires no net loss of wetland functions and values. Moreover, the County's Biological Mitigation Ordinance implements the MSCP on unincorporated County lands. Similarly, the City of Chula Vista has adopted a Habitat Loss and Incidental Take (HLIT) ordinance, which is intended to implement the City of Chula Vista's MSCP Subarea Plan and to protect both upland and aquatic resources. The City of Imperial Beach General Plan Policy CO-7 requires the City to manage urban runoff and flood waters to curtail pollution in the beach area, Tijuana River, and San Diego Bay; Policy S-3 recommends primary areas subject to flooding be left as

permanent open space; and Policy S-7 requires the City to take necessary actions to adopt policies to prevent encroachment on existing water courses.

The Otay Ranch General Development Plan (GDP)/Subregional Plan (SRP) and Resource Management Plan (RMP) are the comprehensive plans controlling development and preservation within the approximately 23,000-acre Otay Ranch area, located primarily in this watershed and under the joint purview of the City of Chula Vista and the County of San Diego. The RMP includes policies and guidelines focused on natural and cultural resource protection, enhancement, and management, including the protection of the Preserve from adjacent land uses.

There are several local and regional regulatory plans, programs, and permits that apply to activities in this watershed, as listed in Table A-1.

Table A-1: Existing Local and Regional Regulatory Plans, Programs, Permits

Jurisdiction	Existing Regulatory Plans, Programs, Permits
City of Chula Vista	• City of Chula Vista General Plan • Eastern Territories/Montgomery/Bayfront Area Plans • Otay Ranch GDP/SRP and RMP • City of Chula Vista MSCP Subarea Plan • City of Chula Vista JURMP • City of Chula Vista SUSMP
City of Imperial Beach	• City of Imperial Beach General Plan and Coastal Plan • City of Imperial Beach JURMP • City of Imperial Beach SUSMP
City of San Diego	• City of San Diego Progress Guide and General Plan • Otay Mesa and Otay Mesa/Nestor Community Plans • City of San Diego MSCP Subarea Plan • City of San Diego JURMP • City of San Diego SUSMP
San Diego County	• San Diego County General Plan • Otay Subregional Plan • Jamul/Dulzura Subregional Plan • East Otay Mesa Specific Plan SubArea 1 • County of San Diego MSCP Subarea Plan • County of San Diego JURMP • County of San Diego SUSMP
San Diego Unified Port District	• Port Master Plan: San Diego Unified Port District • San Diego Unified Port District JURMP • San Diego Unified Port District SUSMP
Regional (U.S. Fish and Wildlife Service and California Department of Fish and Game with Regional Jurisdictions in Southwestern San Diego County)	• MSCP Subregional Plan
Regional (San Diego Regional Water Quality Control Board and Regional Copermittees)	• Municipal Permit
Regional (San Diego Regional Water Quality Control Board and Regional Jurisdictions)	• Basin Plan
Regional (Jurisdictions in watersheds flowing into San Diego Bay)	• San Diego Bay WURMP

Consistency with Local Plans, Programs, and Permits

It is important that there is coordination and consistency between what is being proposed and implemented under the ORWMP and the other local and regional regulatory plans, programs, and permits. Given that the ORWMP is an advisory document, adopted local and regional plans, programs, and permits (listed in Table A-1) would supersede the ORWMP. The ORWMP is not intended to duplicate or conflict with existing adopted plans, programs, and permits, but rather to complement and identify gaps where existing protections can be enhanced. It is anticipated that subsequent watershed planning efforts such as the SAMP will include a thorough gap analysis and comparison of existing plans, programs, and permits with ORWMP recommendations and proposed SAMP regulatory requirements. Moreover, implementation of particular ORWMP-recommended strategies will include a thorough gap analysis of relevant plans, programs, and permits. This gap analysis should identify any inconsistencies, conflicts or duplication with existing plans, programs, or permits, and if necessary, recommend revised strategies and approaches. Some potential areas that may need to be further evaluated may include but not be limited to issues such as impervious cover, buffers and setbacks, and remedial action measures. In such instances that recommended strategies are found to be inconsistent with existing plans, programs, or permits, jurisdictions shall have the discretion as to whether or not those should be amended, the ORWMP should be revised, or both.

Coodination with Other Conservation Efforts

Within the watershed, the County, City of Chula Vista, City of San Diego, and Citizens Advisory Committee (CAC) have been working collaboratively on the Otay Valley Regional Park (OVRP), a 13-mile park along the Otay River corridor from the salt ponds near the Otay River's outlet upstream to and around the Otay Reservoirs. Property acquisition, trash and debris cleanup, and enhancement and restoration planning along this corridor are already underway, as are efforts to facilitate environmentally sensitive recreation and education. Key plans focused on guiding these activities in the OVRP include the OVRP Concept Plan (2001), Draft Western OVRP Natural Resource Management Plan (2002), OVRP Trail Guidelines (2003), and Draft Habitat Restoration and Exotic/Non-Native Plant Removal Plan - OVRP (2005).

Several other acquisition, enhancement, and restoration programs are ongoing that are benefiting this watershed, including:

- San Diego National Wildlife Refuge Complex (South San Diego Bay Unit of the San Diego Bay National Wildlife Refuge near the outlet and the Otay-Sweetwater and Vernal Pool Units of the San Diego National Wildlife Refuge, in the central portion of the watershed and in proximity to the Otay Reservoirs and East Otay Mesa, respectively);
- California Department of Fish and Game's Rancho Jamul Ecological Reserve (including Wildlands' Rancho Jamul Mitigation Bank), Hollenbeck Canyon Wildlife Area, and Otay Mountain Ecological Reserve;
- Bureau of Land Management's multiple holdings including the Otay Mountain Wilderness Area;
- U.S. Forest Service's Lyons Peak and Barber Mountain parcels;
- City of San Diego's Dennery Canyon vernal pool preserve; and
- Caltrans' Johnson Canyon preserve.

These current regulatory mechanisms and existing and planned conservation efforts provide an important foundation for protecting the beneficial uses in this watershed as changes in land use continue. The ORWMP offers a comprehensive approach for evaluating and coordinating these numerous activities to identify the nature, locations, and magnitudes of watershed stressors; strategies

for protecting, enhancing, and restoring natural resources; and approaches to evaluating progress toward meeting goals, including as-needed changes.

The ORWMP recommends several strategies to implement for meeting its identified goals, including a recommended implementation schedule (Tables C.9-2 and C.9-3). Ultimately, however, the decision-makers will determine which strategies to implement and their timing. Furthermore, for most strategies, implementation would require acquiring more specific information, completing detailed plans and environmental documentation, securing required permits and funding, and addressing other logistical considerations.

A.4 ORWMP DEVELOPMENT BACKGROUND

The County of San Diego and their partners have been engaged in the ORWMP-development process since 2002. Prompting the development of this document was recognition of the numerous resources and uses in this watershed as well as the need to meet the requirements of the Municipal Permit and the *Water Quality Control Plan for the San Diego Basin* (Basin Plan). Toward this end, the County of San Diego obtained a Proposition 13 grant from the State Water Resources Control Board on August 27, 2002, to complete the ORWMP. Although the contract between the County of San Diego and the State Water Resources Control Board was terminated in August of 2004, the intent of the ORWMP, as stated in the Proposition 13 grant, is to serve as a framework management plan/program that is consistent with the local General Plans and the Municipal Permit. A 2004 Joint Exercise of Powers Agreement (JEPA) among the County of San Diego, City of Chula Vista, City of Imperial Beach, City of San Diego, and the San Diego Unified Port District formalized their intent to develop and adopt the ORWMP (Appendix 1). Once the ORWMP is prepared and approved, it is anticipated that future efforts will focus on securing funding to implement feasible priority activities, Best Management Practices, and projects that will help the stakeholders realize the goals specified in the ORWMP.

The Municipal Permit defined urban runoff as a waste that degrades the quality of receiving waters and impairs the beneficial uses of those waters. It requires that measures be taken to reduce storm water pollutants to the Maximum Extent Practicable, and it effectively prohibits non-storm water discharges into Municipal Separate Storm Sewer System (MS4s). Furthermore, the Municipal Permit encourages jurisdictions to work collaboratively to identify and mitigate the highest priority water quality pollutants in the region's watersheds, including the Otay River watershed.

In this region, the beneficial uses to be protected are designated by the Basin Plan. First adopted in 1974 and reviewed every three years, the Basin Plan specifically designates beneficial uses for surface waters and groundwater in the San Diego Region, and it establishes water quality objectives and implementation plans to protect those beneficial uses. Table A-2 identifies the Otay River watershed's (Hydrologic Unit 910.00) beneficial uses for the inland surface waters, groundwater, and adjoining coastal waters of San Diego Bay. The last six beneficial uses listed are limited to coastal waters.

As discussed in Section B of this Plan, several water quality objectives have been developed for the inland surface waters and the groundwater in different hydrologic subareas in this watershed to protect the most sensitive beneficial uses designated for each water body. Protection of these beneficial uses will also protect the beneficial uses of San Diego Bay (i.e., IND, COMM, NAV, REC-1, REC-2, BIOL, EST, WILD, RARE, MAR, MIGR, SHELL), which receives flow from the Otay River watershed.

Table A-2. Identified Beneficial Uses for Surface Waters, Groundwater, and Adjoining Coastal Waters

Beneficial Uses (Abbreviation)	Definition
Contact Water Recreation (REC-1)	Includes uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and SCUBA diving, surfing, white water activities, fishing, or use of natural hot springs.
Non-Contact Water Recreation (REC-2)	Includes the uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.
Municipal and Domestic Supply (MUN)	Includes uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.
Industrial Process Supply (PROC)	Includes uses of water for industrial activities that depend primarily on water quality.
Industrial Service Supply (IND)	Includes uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well re-pressurization.
Agricultural Supply (AGR)	Includes uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.
Warm Freshwater Habitat (WARM)	Includes uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish or wildlife, including invertebrates.
Cold Freshwater Habitat (COLD)	Cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish or wildlife, including invertebrates.
Wildlife Habitat (WILD)	Includes uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.
Rare, Threatened, or Endangered Species (RARE)	Habitats necessary, at least in part, for the survival and successful maintenance of plant and animal species established under state or federal law as rare, threatened, or endangered.
Preservation of Biological Habitats of Special Significance (BIOL)	Designated areas or habitats such as established refuges, parks, sanctuaries, ecological reserves, or Areas of Special Biological Significance (ASBS), where the preservation or enhancement of natural resources requires special protection.
Commercial and Sport Fishing (COMM)	Commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.
Navigation (NAV)	Navigation. Shipping, travel, or other transportation by private, military, or commercial vessels.
Migration of Aquatic Organisms (MIGR)	Habitats necessary for migration, acclimatization between fresh and salt water, or other temporary activities by aquatic organisms, such as anadromous fish.
Shellfish Harvesting (SHELL)	Habitats suitable for the collection of filter-feeding shellfish (e.g. clams, oysters, and mussels) for human consumption, commercial, or sport purposes.

Beneficial Uses (Abbreviation)	Definition
Estuarine Habitat (EST)	Estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds).
Marine Habitat (MAR)	Marine Habitat. Marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation such as kelp, fish, shellfish, or wildlife (e.g. marine mammals, shorebirds).

A.5 ORWMP VISION AND GOALS

Each stakeholder engaged in watershed management planning is likely to have a slightly different vision for what the plan should be and provide. The vision offers the overall direction for the plan, with goals providing more specific interests to be met. A simple and broad vision that applies to the ORWMP is:

To plan and work toward an environmentally and economically healthy watershed that benefits those who live, will live, or work in the community.

Representatives from the County of San Diego, the Cities of Chula Vista, Imperial Beach, and San Diego, and the San Diego Unified Port District have been working with other stakeholders to identify key goals for the ORWMP to achieve this vision. The Cities of Coronado and National City are not participating in this process, because their lands within this watershed are small, are under water, and/or are owned by the State of California. The participating public agencies have held monthly working group meetings since June 22, 2004 to involve stakeholders in the ORWMP-development process. A consensus list of goals was approved by the stakeholders at the May 4, 2005 Working Group meeting. The goals are intended to provide the overall outcomes or targets desired. The five goals currently guiding the development of the ORWMP are:

Goal 1. Protect, Enhance, and Restore Watershed Resources

Goal 2. Ensure Reasonable, Sustainable, and Compatible Economic Development

Goal 3. Provide Educational and Recreational Opportunities

Goal 4. Ensure Public Health and Safety

Goal 5. Maximize Integration of Existing Programs and Plans that Affect Resources of this Watershed

A.6 ROLES AND RESPONSIBILITIES IN DEVELOPING AND IMPLEMENTING THE ORWMP

On March 24, 2004, the County of San Diego, City of Chula Vista, City of Imperial Beach, and the San Diego Unified Port District entered into a JEPA, which specifies the purpose and decision-making structure for developing the ORWMP, including the roles and responsibilities of the participants. On December 7, 2004, the City of San Diego approved entering into the JEPA. The JEPA further specifies that the signatory agencies (Public Agencies) will jointly develop the ORWMP to be consistent with their respective General Plans, to meet water quality standards, to protect aquatic and upland resources, and to provide flood protection, public recreation, and essential public facilities, such as utilities and other infrastructure, as well as an implementation program describing how the Public Agencies could implement the ORWMP. The County of San Diego is acting as the lead for the purpose of scheduling meetings, providing notice of meetings, preparing agendas, recording minutes, maintaining records, entering into and administering contracts approved by the Policy Committee, and reporting to the San

Diego Regional Water Quality Control Board and other appropriate federal and State of California agencies on the status and progress of the ORWMP.

The Policy Committee, comprised of individual representatives (i.e., councilmember, supervisor, or commissioner) appointed by each of the Public Agencies, has the authority to approve the ORWMP or to provide direction to the Project Team, consisting of Public Agency staff, about how to change the ORWMP. Policy Committee meetings are open to the public, and unanimity is required for the Policy Committee to take action. Each Public Agency may adopt the ORWMP or recommend changes to the Policy Committee. Pursuant to Section 6 of the JEPA, the Policy Committee has established through appointment a Stakeholder Committee/Working Group, which serves at the pleasure of the Policy Committee. The Policy Committee has appointed four members and one alternative for each interest group (i.e., current interest groups: Recreation, Otay Valley Regional Park Citizens Advisory Committee, Environmental, Regulatory, and Property Owners and Business Owners) participating in the monthly Working Group meetings. This committee advises the Policy Committee and the Project Team on the development of the ORWMP.

An Executive Committee was established under the Cooperative Agreement (CA) among the County of San Diego, the Cities of Chula Vista and Imperial Beach, and the U.S. Army Corps of Engineers for the development of the Otay River watershed SAMP. The SAMP is to be a comprehensive plan for identifying, conserving, restoring, and managing aquatic resources in this watershed, while providing for the permitting of reasonable economic development and other activities. The SAMP is to include:

- A long-term permitting process for projects in the watershed subject to the U.S. Army Corps of Engineers permit authority under Section 404 of the Clean Water Act and the California Department of Fish and Game permit authority under California Fish and Game Code Section 1600 et seq.; and
- A comprehensive aquatic conservation and restoration program for the protection, restoration, and management of aquatic resources within the watershed.

Thus, the SAMP is a regulatory-driven document, in contrast to the ORWMP. Despite this distinction, the Public Agencies do not expect the ORWMP to conflict with the SAMP, but the Policy Committee and Executive Committee would seek to resolve any conflicts that arise to be consistent with the JEPA and the CA. The Policy Committee may notify the Executive Committee of any potential conflicts between the SAMP and ORWMP in need of resolution.

The County and their partners have held numerous meetings with watershed stakeholders since August 2003. Initial activities focused on dissemination of information on the ORWMP and SAMP, requests for public input in order to address concerns, explanation of existing management practices, recognition and organization of the members of different interest groups within the Working Group, and appointment of the Stakeholder Committee. The ORWMP Policy Committee hosted an Otay River "Going with the Flow" Watershed Tour in January 2005. The tour provided members of the Policy Committee, Executive Committee, Working Group, and public with an opportunity to view the scope and beauty of the watershed and its resources, obtain a better understanding of the relevant issues, and meet other people interested in becoming involved in the ORWMP process

More recent activities have focused on reviewing ORWMP products and providing feedback to the rest of the Working Group, Project Team, and Policy Committee. JEPA staff has provided presentations on the status of the ORWMP and requested input from community planning and other interest groups on the Draft ORWMP. Appendix 2 includes diagrams focusing on the Working Group and Project Team roles in the ORWMP-development process, as well as a table with the dates and locations of public

meetings, presentations, Working Group-Project Team meetings, and Policy Committee meetings that have been open to the public and noticed per the Brown Act.

Ultimately, it will be essential to establish a permanent group (e.g., Watershed Council) to implement the ORWMP. This group of decision-makers would need to meet at regular intervals and as-needed to:

- Implement strategies and evaluate their effectiveness;
- Consider changes in watershed conditions and regulatory requirements;
- Resolve any relevant conflicts or inconsistencies that might arise; and
- Determine whether revisions to the ORWMP are necessary to ensure identified goals are achieved in a timely and effective manner.

The JEPA participants would need to determine the group's composition and operating guidelines and execute the steps to establish this group. This group could be a logical outgrowth of the existing ORWMP Policy Committee, Executive Committee, and Working Group.

A.7 ORGANIZATION OF THE OTAY RIVER WATERSHED MANAGEMENT PLAN

The remainder of the ORWMP is organized into six sections and appendices, which can be individually replaced with updated versions as the need arises:

Section B Watershed Characterization

This section characterizes the past, present, and anticipated conditions in the Otay River watershed in terms of land use and socioeconomics, geologic resources, water resources (surface and groundwater), and biological resources. A brief assessment is provided of how the different sub-basins within this watershed, based on their physical and biological characteristics, are anticipated to respond to changes in land use. It concludes with an overview of data gaps in protecting, enhancing, restoring, and managing watershed resources.

Section C Watershed Stressors and Strategies for the Protecting, Enhancing, Restoring, and Managing Watershed Resources

This section consists of a discussion of watershed stressors, including anthropogenic and natural stressors, and concludes with a presentation of various strategies recommended to protect, enhance, restore, and manage the natural resources in consideration of the multitude of uses expected to continue in this watershed. These strategies provide a framework focused on protecting and benefiting the functions and values in this watershed in consideration of the region. Ultimately, the decision-makers will need to determine which strategies are worthwhile and feasible, and to pursue their implementation. Decision-makers might need to complete additional studies and analyses before choosing whether to implement a particular strategy.

Section D Monitoring and Evaluation Program

This section offers a program to monitor water quality in this watershed and the effectiveness of the Section C strategies. It includes indicators that can be monitored and evaluated relative to objectives, a recommended monitoring schedule, and potential remedial actions to undertake if strategies or indicators are ineffective. It also includes the approach to evaluating progress and updating the ORWMP to ensure it is a "living" document.

Section E References

This section provides references for the various data sources cited and used to prepare the ORWMP.

Section F List of Acronyms and Abbreviations

This section lists the numerous acronyms and abbreviations used in the ORWMP so readers can refer to one location for a reminder.

Section G List of Preparers and Contributors

This section lists the consultants who prepared the ORWMP and the various individuals, representing their own interests or those of an agency or other organization, who contributed to the development of the ORWMP.

Appendices

The appendices, included at the end of the Plan, provide some of the supporting documents referenced and used to prepare the ORWMP:

1 – The original JEPA among the County of San Diego, the Cities of Chula Vista and Imperial Beach, and the San Diego Unified Port District, signed March 2004; and the December 2004 addendum, which added the City of San Diego as a party to the JEPA

2 – Three diagrams of the Working Group and Project Team roles in the ORWMP-development including individual participants; Guidelines for the Working Group; and a table of public meetings held

3 - The January 2005 Otay Watershed Pollutant Loading Tool: Development and Application Report, which describes the spreadsheet-based modeling tool developed to predict pollutant loading in different parts of this watershed

4 – The July 2005 Draft Technical Memorandum: Storm Water Management BMPs for the Otay River Watershed, which discusses potential BMPs that could protect the watershed and their expected effectiveness

5 – A funding matrix, which consists of various available funding sources, their requirements, and which strategies described in Section C could qualify for each

6 – The three August 2004 baseline indicator reports, which identify and describe water quality, geomorphic, biologic, socioeconomic, and land use indicators that could be used ultimately to monitor and evaluate the progress and success of implemented protection, enhancement, restoration, and management strategies.

B. WATERSHED CHARACTERIZATION

B.1 WATERSHED SETTING

B.1.1 Regional and Local Setting

The Otay River watershed encompasses an approximately 145-mi^2 (92,920 acres) area within San Diego County, California (Figure A-1). It is situated between the Sweetwater River watershed to the north and the Tijuana River watershed to the south, the latter of which extends over the international border with Mexico. In addition to the County, other jurisdictions within the watershed include portions of the City of Chula Vista, City of San Diego, City of Imperial Beach, City of Coronado, and National City (Figure A-2).

B.1.2 Topography

As with many coastal watersheds in southern California, the Otay River watershed is characterized by a low-elevation coastal plain near the outlet that rises gradually to steep mountainous areas inland. Elevations range from sea level at its western extent to approximately 1,140 meters (3,740 feet) at Lyons Peak in the northeast corner of the watershed (Figures B.1-1 and B.1-2). The uplands to the east are cut by southwesterly trending canyons that open onto an alluvial plain. Located along the drainages on the alluvial plain are a series of fluvial terraces composed of coarse channel deposits. The alluvial plain thins to the west as marine deposits that are partially covered by younger alluvial fan deposits appear. The San Ysidro Mountains to the south have almost the same maximum elevation as the uplands to the east and are cut by north-south trending canyons that open onto the terraced alluvial plain.

B.1.3 Climate

The regional climate in the Otay River watershed is classified as Mediterranean, with warm, dry summers and mild, wet winters. Precipitation averages range from 25.4 cm. (10 in.) along the coast to 45.7 cm. (18 in.) in the eastern mountains (Figure B.1-3), with low to high intensity storms occurring mostly in the winter and spring. Frosts are light and infrequent, with the growing season ranging from 345 to 360 days, depending on distance from the ocean. The average annual temperature is about 63 ºF (17.2 ºC), with an average daily high of 71ºF (21.7ºC) and an average daily low of 53ºF (11.7ºC).

The major influences on the regional climate are the Eastern Pacific High, a strong persistent anticyclone, and the moderating effects of the cool Pacific Ocean (U.S. Army Corps of Engineers, 1998). During the summer, the Eastern Pacific High dominates the Eastern Pacific Ocean, creating fair weather and producing a temperature inversion. Thermal low-pressure systems that typically develop over the inland deserts draw cool marine air onto the land, moderating the daytime temperatures. This marine air frequently condenses into fog and stratus clouds below the inversion layer during the evening but dissipates during the following day as the land mass warms. Summer precipitation associated with tropical air masses is generally infrequent and light.

During winter and spring, polar storm systems pass through the region as the Eastern Pacific High weakens and shifts south. Most regional precipitation occurs during this period. Excessive rainfall can occur when the jet stream maintains a position over southern California and carries multiple storms across the region. Moderate to major flooding events for this region typically occur December to March and have been documented for the following years during the 20th century: 1906, 1916, 1921, 1927, 1937, 1938, 1969, 1978, 1980, 1983, 1993, 1995, 1998, and 2005. The worst flooding observed in the Otay River watershed occurred in 1916, when catastrophic flooding beyond the level of a 100-year

flood burst the Otay Reservoir Dam, destroying all structures and killing several people in the valley below.

A strong east to northeastern wind, known as the "Santa Ana Winds," begins throughout southern California in the fall and can occur at any time throughout the winter months. These "Santa Ana Winds" carry warm dry air from the deserts to the coast, dramatically increasing temperatures and decreasing relative humidity levels. These factors, combined with potentially strong winds, create the perfect environment for fire to initiate and spread.

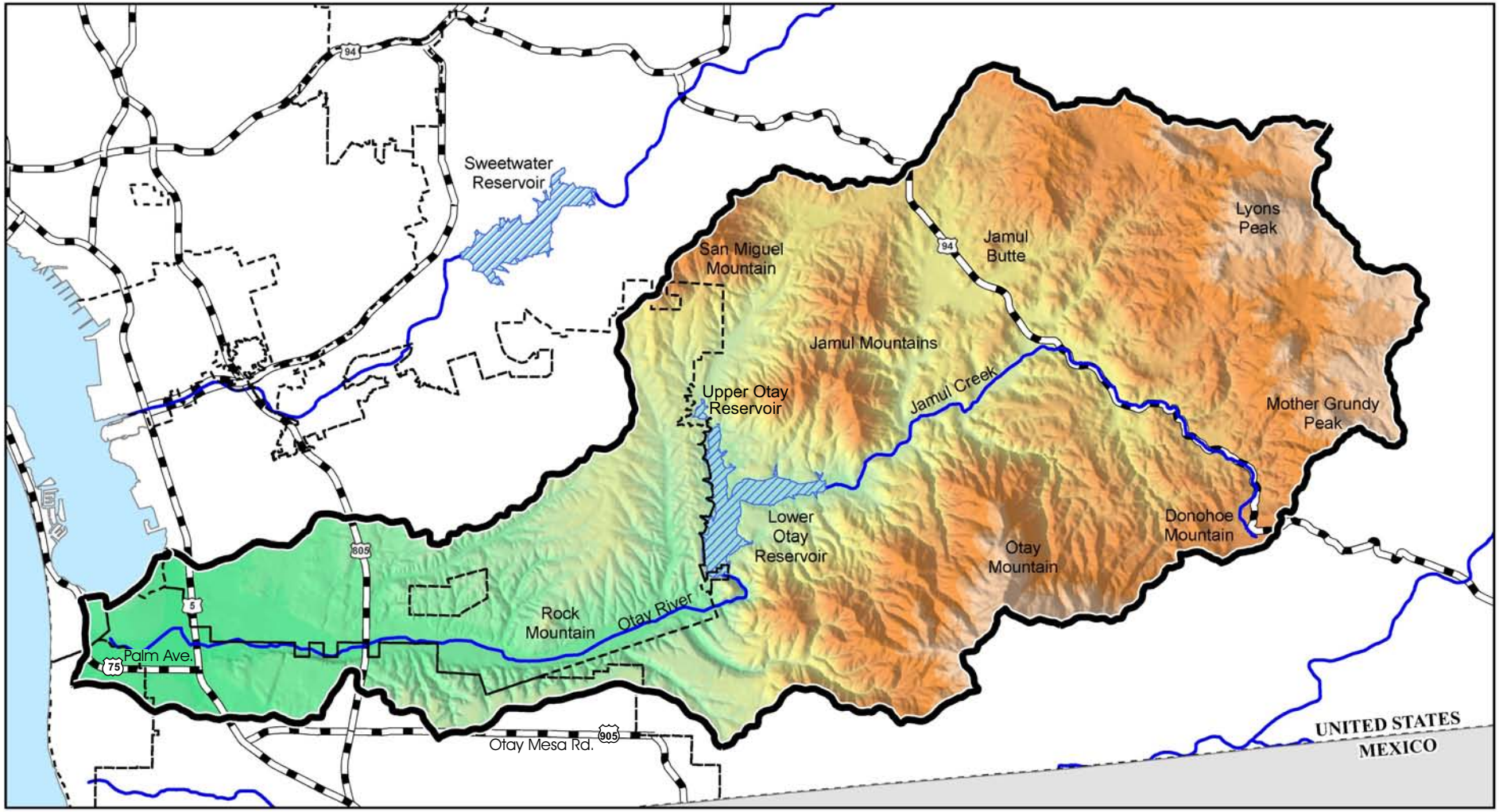
B.1.4 Fire History

The Otay River watershed is predominantly California shrubland, including coastal sage scrub, chaparral, and grassland communities in the uplands, with riparian habitat occurring along the narrow valley bottoms and streams (Figure B.1-4). Mediterranean-climate shrublands are one of the most fire-prone landscapes in North America. The combination of dense, contiguous fuels, summer drought, dry winds, and an extensive urban/wildland interface contribute to this situation. Since at least the middle of the twentieth century, property losses from wildfires have increased every decade, despite the increase in fire suppression expenditures. In recent years, there have been several wildfires that have each exceeded $1 billion in losses (Keeley, 2002). The most common ignition source historically was lightning associated with storms. Man-caused ignitions are now responsible for most fires in southern California and have shifted the fire season to the drier late summer/early fall period when vegetation is driest.

Although wildfires pose a threat to human populations, fires are an important component of many ecological systems. In ecosystems such as the chaparral shrublands of California, fires have been a strong force guiding the evolution of local plant life and a constant regulator of ecological communities. Upon plant reproduction, many species drop seeds that remain dormant in the soil until fire creates favorable growth conditions. When the area burns, these seeds receive a number of signals that may cause them to germinate. In some species, smoke alone is sufficient to trigger seed germination, and thus, induce growth (USGS, 1999). In fact, researchers recently isolated a compound from smoke that is sufficient to trigger seed germination.

While fires may trigger revegetation, post-fire effects on a watershed system can be significant. Wildfires directly modify hydrologic and geomorphic dynamics in drainage basins (watersheds), particularly water and sediment production and yield. The removal of plant cover modifies the processes of interception and evapotranspiration, significantly affecting the hydrological cycle. Fires can also affect hydrological processes indirectly, altering the physical and chemical properties of the soil, converting organic ground cover to soluble ash, and giving rise to phenomena such as water repellency. Water repellency results from the coating of soil particles with organic substances and is an important factor that increases water runoff, especially in soils affected by high-intensity fires. Water repellency presents a barrier to water infiltration, which results in high water surface runoff in affected areas. As water surface runoff is increased, soil erosion is also increased. Soil erosion can lead to sedimentation in stream channels as well as channel scouring and bank erosion, modifying the geomorphology of a channel, and eventually, the drainage basin (Batalla, 2001).

Fires have been seen as incompatible with both human land-use practices and aesthetics, resulting in active suppression throughout the West. In many areas, disruption of the natural fire regime has produced overcrowded forests with vast accumulations of dry fuel. In some cases, blazes that break out under these conditions may be far more destructive than fires originating in areas where fire suppression is not active. Much debate exists over fire-suppression effects, especially for shrublands in southern California, involving the assumption of aging fuels and the increasing of fire probabilities.



Basemap Legend

- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes

N

0 2.5 5
Scale in Miles

Legend

Sea Level — 3,700 Feet

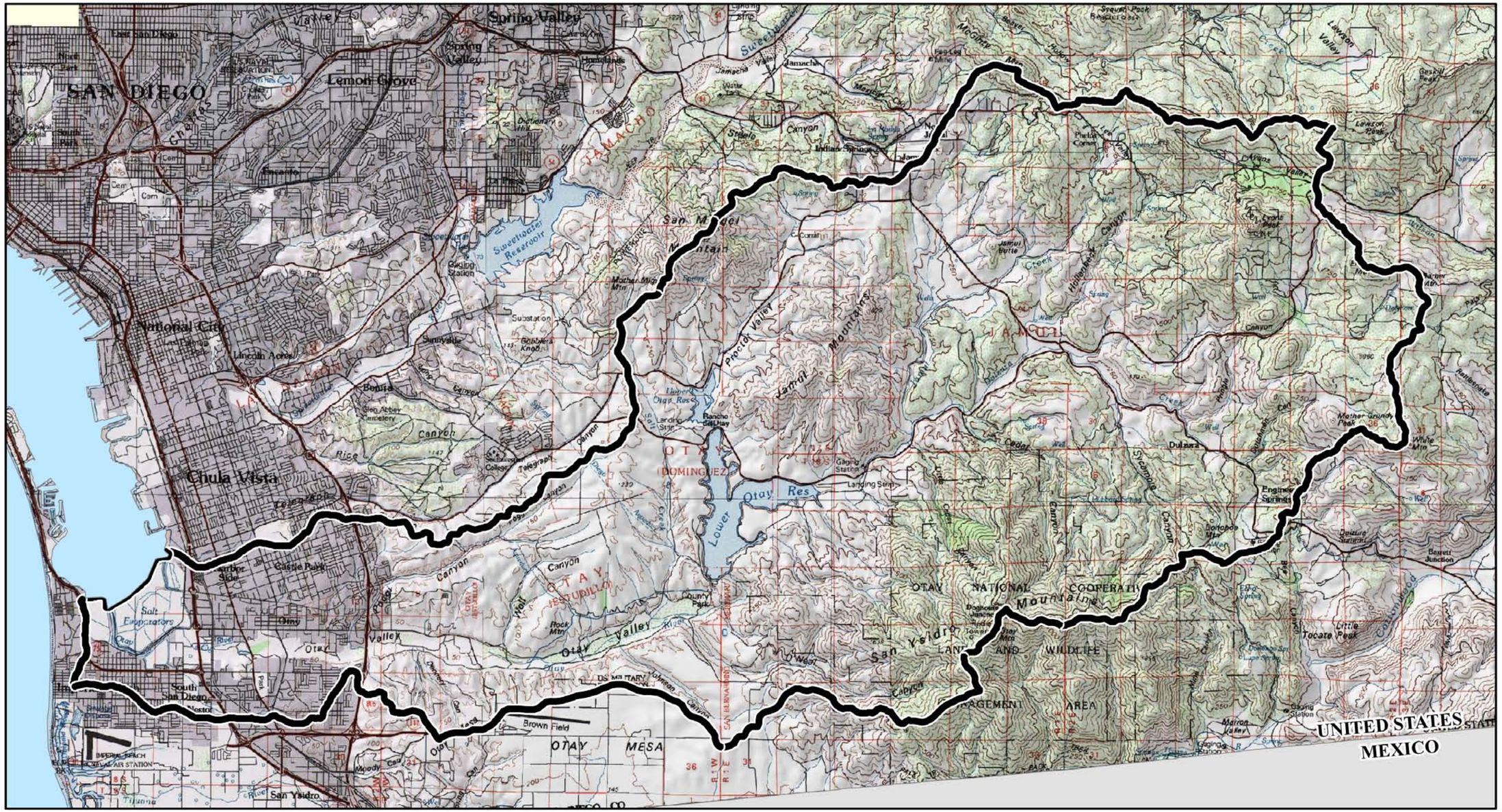
Source: TAIC, 2005

Otay River Watershed Management Plan

Figure B.1-1

Shaded Relief

Aspen Environmental Group



Basemap Legend

Otay River Watershed Boundary

0 2.5 5

Scale in Miles

N

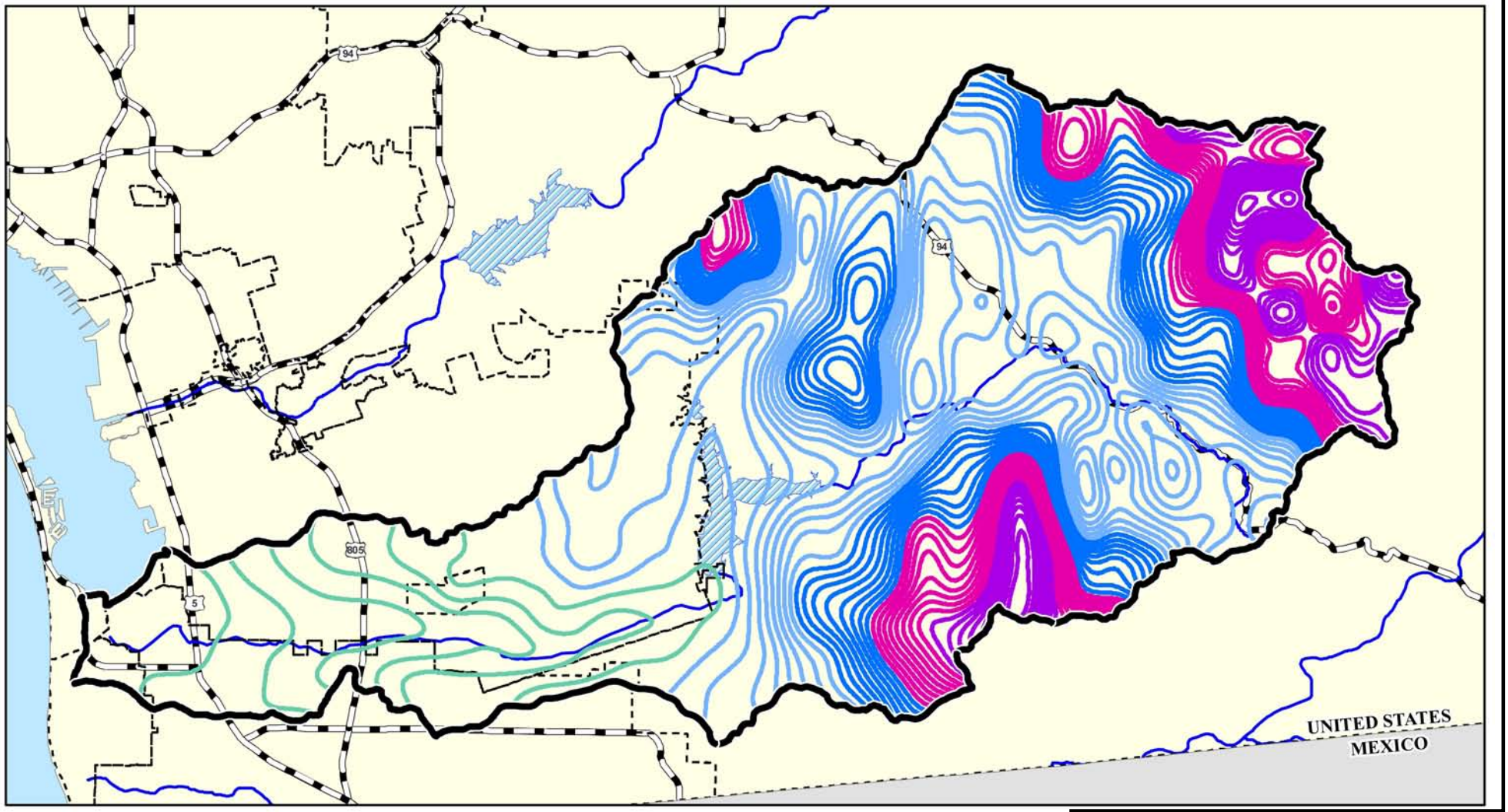
Source: TAIC, 2004

Otay River Watershed Management Plan

Figure B.1-2

USGS 100,000 Scale Topographic Map

Aspen Environmental Group



Legend

- 9.75 to 11 Inches
- 11.25 to 13 Inches
- 13.25 to 15 Inches
- 15.25 to 17 Inches
- 17.25 to 19.75 Inches

Average annual precipitation developed at UCSB from historic weather station data and weather modeling.

Basemap Legend

- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes

N

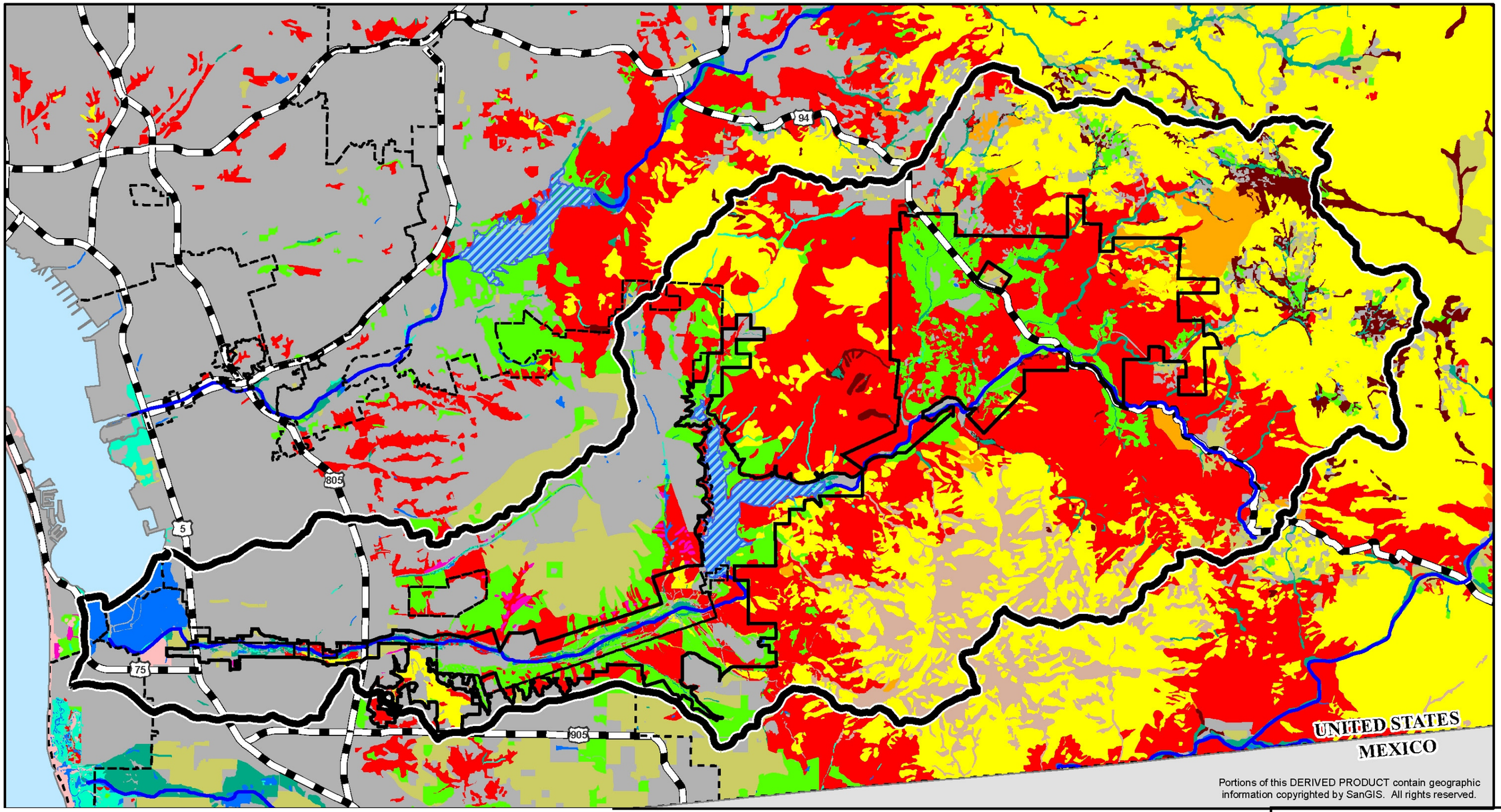
0 2.5 5
Scale in Miles

Otay River Watershed Management Plan

Figure B.1-3

Average Annual Precipitation

Aspen Environmental Group



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Legend

- Agricultural Land
- Chaparral
- Coastal Dunes and Beaches
- Coastal Sage Scrub
- Coastal Sage Scrub/Chaparral
- Developed/Disturbed Land/Eucalyptus
- Grassland
- Maritime Succulent Scrub
- Meadow and Marsh
- Montane Coniferous Forest
- Ocean
- Open Water
- Riparian Scrub/Woodland/Forest
- Woodlands
- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes

Source: SANDAG, 1995; Updated by TAIC, 2005

N

0 2.5 5

Scale in Miles

Otay River Watershed Management Plan

Figure B.1-4
Vegetation Communities

Aspen Environmental Group

However, given the debate, clear effects of fire suppression are still unknown and further research is needed (USGS, 1999).

San Diego Wildfires of 2003

The costs of fire suppression in southern California have continued to rise over the past several decades, and there have been increasing losses of property and human life due to wildfires. The multiple fires of late October 2003 burned over 300,000 acres in a single week. The flames were driven by the hot, dry winds, which burned through entire neighborhoods at points along the urban-wildland interface.

Within San Diego County, three fires, the Paradise, Otay, and Cedar Fires, broke out during the week of October 26, 2003. The Paradise Fire, located east-northeast of the City of Escondido, destroyed approximately 56,700 acres. This fire resulted in 24 injuries and two deaths, and destroyed over 400 structures and vehicles (SBFIJIC, 2004). The Otay Fire burned more than 46,000 acres in the area around the community of Otay Mesa. The Cedar Fire, considered to be the largest fire in the last several decades in California, started in Cleveland National Forest and burned over 273,000 acres. The Cedar Fire contributed to 113 injuries and 14 deaths, and damaged or destroyed over 2,800 homes, commercial properties, and other structures (SBFIJIC, 2004).

In addition to property and human loss, the 2003 wildfires had a significant effect on the vegetation communities and land covers of the region. The Burned Area Emergency Response (BAER) team has conducted extensive research on the effects of wildfires in different watersheds in San Diego County, including the Otay River watershed. Table B.1-1 summarizes the vegetation mortality caused by wildfires in the Otay River watershed through November 2003 (BAER, 2003).

Table B.1-1 Assessment of Burn Impacts in Otay River Watershed

Land Cover	Acres Burned
Coastal Sage Scrub	16,685
Coastal Sage Scrub/Chaparral	308.6
Chaparral	6,861
Southern Maritime Chaparral	0
Maritime Succulent Scrub	0
Grassland	1,037
Riparian Scrub/Woodland/Forest	220
Woodlands	221
Montane Coniferous Forest	2,208
Meadow and Marsh	131
Open Water	76
Coastal Dunes and Beaches	0
Total	27,748

Source: BAER, 2003 (based on BAER Vegetation mortality – released 11/10/03).

Wildfire destroys surface vegetation and coats the land surfaces with water-repellant ash, so that water potentially available for soil infiltration and groundwater recharge instead runs off into surface waters. As such, wildfires can increase streamflow and create earlier and larger peak flows. In addition, the elimination of vegetation and litter increases the erosion potential of surface soils.

With the October 2003 wildfires in the San Diego region, it is expected that the region, and thus, portions of the Otay River watershed, will experience accelerated erosion and sedimentation into nearby

streams and communities. In fact, staff from Jones & Stokes Associates observed significant sedimentation in upper Otay River watershed streams this past winter (Ken Schwarz, personal communication). Large influxes of sediment are expected to continue to enter the system, altering surface and groundwater quantity and quality. For the former, reduced infiltration and increased runoff will affect water quantity during the system's recovery. Regarding the latter, the high nutrient content of the ash is likely to increase the risk of solubilized nutrients reaching both surface and groundwater. In addition, stream temperatures may increase where riparian shade is reduced. Large influxes of sediment also alter channel morphology, as recently observed in this watershed (e.g., stream aggradation, filled culverts).

Similarly, these loads could deposit in downstream or downslope detention and debris basins. The deposition of this material and the loss of channel and basin capacity could require excavation and other flood control activities within these receiving areas.

Given the fire-prone nature of these systems (86 fires have affected this watershed between 1910 and 2003), fire-related effects are expected to be recurring in the Otay River watershed, as they are throughout southern California. This includes the physical, biological, chemical, land-use, and socioeconomic effects associated with these fires, as well as the post-fire maintenance activities. As such, it will be important to consider the role and effects of fires and their intensity in the Otay River watershed. As shown in Figure B.1-5, the fire frequency has been particularly high for areas east of the Otay Lakes, which are mostly covered by chaparral and sage scrub habitat. With the muted hydrologic connection between the upper and lower watershed (due to Savage Dam), the upper watershed will probably continue to experience most of the post-fire effects.

B.2 HISTORICAL OVERVIEW OF THE WATERSHED

This section provides a historical overview of the region in which the Otay River watershed is located. In particular, this section provides ethnographic and historical background information for the area.

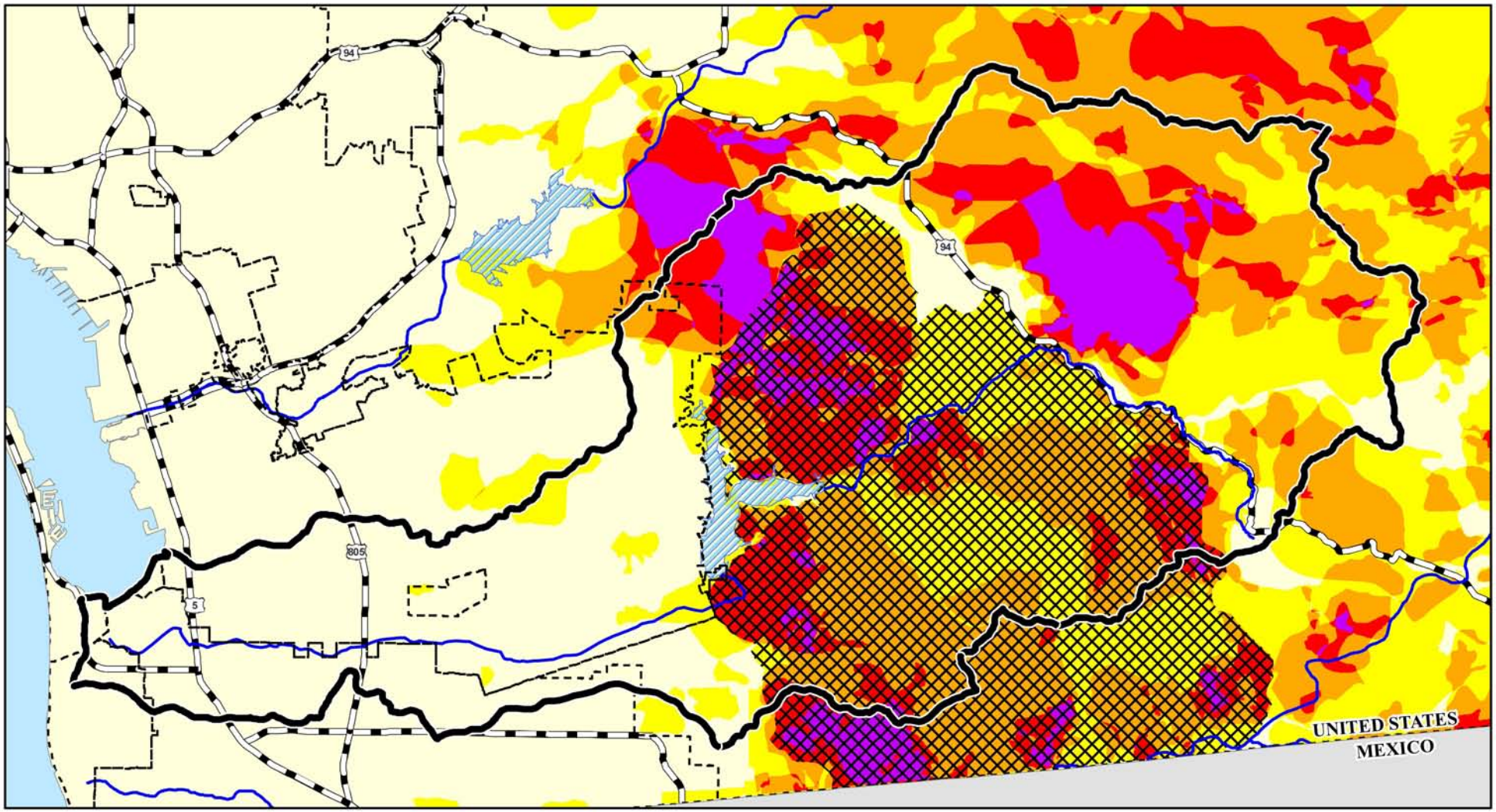
B.2.1 Ethnographic Background

The Otay River Valley contains a rich history of human occupation and resources use. The watershed is located in the southwestern portion of San Diego County within the historical territory of the Kumeyaay inhabitants. Prior to European contact, Kumeyaay territory may have extended as far north as the San Luis Rey River. To the north of the Kumeyaay lived the Takic-speaking Luiseño and Cahuilla, and to the east and south were other inhabitants who spoke a variety of distinct languages belonging to the Yuman language family (Loumala, 1978).

The Kumeyaay have been known by and referred to as the Diegueño. The standard practice during the Spanish colonial era in California was to name all native people within the sphere of influences of a particular mission district after that mission; hence, the native people living around the mission of San Diego de Alcalá came to be known as the Diegueño (Loumala, 1978).

On the basis of linguistic and archeological evidence, it has been suggested that the ancestors of the present-day Kumeyaay arrived in this part of California sometime between 1000 B.C and A.D. 1000. By adding new cultural traditions and habits to the earlier patterns, the ancestral Kumeyaay seemed to have assimilated with the earlier inhabitants rather than displacing them.

The Kumeyaay were organized into autonomous bands. Each band usually occupied a main village and several smaller inhabitations. One of the main villages occupied by the Kumeyaay was the village of Otay, located on the north and adjacent to the Otay River. However, these settlements were temporary,



Legend

- No Record of Burn
- Burned Once
- Burned Twice
- Burned Three Times
- Burned More than Three Times
- 2003 Otay Fire

Source: U.S Forest Service Fire Database.

Basemap Legend

- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes

N

0 2.5 5
Scale in Miles

Otay River Watershed Management Plan

Figure B.1-5

Fire Frequency

Aspen Environmental Group

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as the community would disband seasonally into smaller groups, which would allow them to establish camps to gather, process, and cache seasonally available resources. Each territorial group, with a population of between 200 and 1,000 persons, controlled approximately 20 miles of river drainage (depending upon the width and richness of the valley) from their winter home. Subgroups within the tribe spoke individual dialects and lived a loosely connected lifestyle intermarrying among them (Royo, 1999).

The Kumeyaay were seasonal hunters and gatherers whose individual bands ranged along waterways from the San Diego coastal region, east through the Cuyamaca and Laguna Mountains, to beyond the Salton Sea in the east, and south beyond current-day Ensenada in Mexico (Royo, 1999). They practiced a fairly typical California hunting-and-gathering subsistence routine based on a variety of locally abundant terrestrial and aquatic resources. The Kumeyaay diet was heavily dependent on harvesting wild plant foods, with a strong emphasis on acorns. In addition to acorns, their diet included many different kinds of seeds, bulbs, and other plants. Meat was procured through hunting of small game, including rabbits, squirrels, and various reptiles. Besides abundant plants, the inhabitants living in the coastal zone had access to rich marine environments, which provided abundant shellfish, fish, and sea mammals (Loumala, 1978).

Interaction with neighboring tribes was maintained through extensive trade networks involving the movement of goods and information from diverse ecological zones. Kumeyaay in the San Diego area appear to have maintained stronger trade relationships with their neighbors to the east than with groups to the north and south. This is suggested by a lively trade between the seacoast and inland areas as far east as the Colorado River (Loumala, 1978). Acorns, dried seafood, ornamental marine seashell, and other materials moved eastward from the coast and uplands, and salt, seeds, and mesquite beans (staple foods from the neighboring inhabitants) moved in the opposite direction (Davis, 1974:20; Loumala, 1978).

Ethnographic data have contributed to the understanding of why Native Americans were originally drawn to the Otay region. Although their attraction to this area was primarily for the plant and animal resources, the Otay region was a bountiful environment and an optimal place to live.

Native Americans used the plant resources for food, medicine, ceremony, and utilitarian purposes. Plants that were used as food sources were either eaten fresh or prepared in some fashion. The leaves of some plants were cooked, baked, parched, dried, or sometimes ground and made into a meal. Generally, beverages were made from some of the plants and others were used to extract honey, sugar, and/or salt (Gallegos, 1998).

Native American medicinal use of plants covers a wide range of ailments from serious internal problems, including problems with the heart, kidneys, liver, bladder, lungs; to common ones such as colds, coughs, sore throat, asthma, fever, toothaches, and headaches. Some plants were used as a blood purifier, as well as to assist with childbirth. Antiseptic washes, teas, and decoctions were used for skin problems, infections, sores, burns, wounds, ulcers, poison oak, poisonous bites, and as bathing solution for newborn babies. Medicinal plants were also used to treat syphilis, smallpox, and tuberculosis. These three diseases have not been diagnosed in the prehistoric human remains in San Diego County and are presumed to have been introduced by European settlers (Gallegos, 1998).

Although the information about Native American ceremonial use of plants is limited, it is known that plants were used in making tattoos, in the girl's puberty ceremony, in the boy's tolache ceremony, for purification, and for paint/dye in rock art. The utilitarian use of plants included house construction, mats, acorn granaries, basketry, bows and arrows, mortars, cordage, string, nets, wooden tools, and

cradleboard frames. Plants were also used to fumigate houses, to stupefy fish, for adhesives, torches, and firewood. Personal items manufactured for personal uses included women's skirts, bags, brushes, combs, soaps, and hair wash (Gallegos, 1998).

B.2.2 Historical Background

European Settlers

The historical period began in the San Diego area with the voyage of Juan Rodríguez Cabrillo, who landed near Point Loma in September 1542. At this time, contact and interaction between the Kumeyaay and the Europeans was initiated; however, it was not until the founding of Mission San Diego Alcalá in 1769 that the cultural interaction developed. After 1542, several expeditions were sent to explore the Alta California, but for nearly two centuries following Cabrillo's voyage, the Spanish showed little interest in the region, focusing instead on the Mexican mainland and on Baja California (Loumala, 1978).

The Kumeyaay culture was not as severely impacted by Spanish colonization as some other California tribes; however, its socio-political structure was drastically disrupted during the Mission period and later. Those living closest to the mission were hardest affected by the European civilization, whereas groups living in the mountains were less traumatized by the cultural interaction (Loumala, 1978).

The colonization goals of Spaniards were to convert the native people to Christianity. For this purpose, the church worked diligently at converting the local population by gathering as many Kumeyaay into the missions as possible. Once there, the neophytes were held captive while they received religious instruction and provided free labor for the mission (often forcibly). These effects upon the local natives were devastating. The reorganization of their traditional life-style alienated them from their traditions, and European disease, for which the Kumeyaay had no immunities, reached epidemic levels resulting in a decrease in the Kumeyaay population.

The secularization of the California missions in 1832 followed the Mexican independence from Spain in 1821. Between the time period of 1833 and 1845, the newly formed Mexican government began to divide the large church holdings into land grants, forming ranches. By 1840, ranches and farms were being established throughout the El Cajon Valley, along the Sweetwater River and nearby areas. The Estudillo family, who initiated the Euro-American settlement in the Otay River Valley, received a property title to the Janal grant (Janal Ranch) and the Rancho Otay. Both ranches consisted of 11,093 acres, and were collectively referred to as Otay Ranch. Over time, the ranches changed hands and expanded in size to roughly 22,000 acres (Gallegos, 2000). The Janal Ranch would later become the site for both the Upper and Lower Otay Reservoirs, built in the early 1900s for the Southern California Water Company.

The American Period

When Mexico relinquished California to the U.S. with the Treaty of Guadalupe Hidalgo in 1848, growth in the region came rapidly as a result of subsequent gold rushes, land booms, and transportation development. San Diego County was created in 1850, the same year that the City of San Diego was incorporated (with a population of 650). Over the next 20 years, the County's population increased by six-fold, and the City population more than tripled (San Diego Historical Society, 2004).

Most of the mountain Kumeyaay, especially those along the emigrant trails, were seriously affected by the entrance of American settlers. By the time gold was discovered, shortly after the Civil War, the Spanish, Mexican, and American governments and settlers had significantly changed the Kumeyaay's

way of life. In 1875, the inland Kumeyaay were expelled from their ancestral homes and their land was expropriated. Their plight was ignored until publicity generated by the Indian Rights Association and the Sequoia League forced the Bureau of Indian Affairs (BIA) to set aside lands of the Cuyamaca, La Posta, Manzanita, and Laguna Mountains earlier in the 20th century. The Kumeyaay population finally began to revive after 1910. Currently, there are about 20,000 Kumeyaay descendants in San Diego County, about 10 percent of whom live on its 18 reservations, more than in any other county in the United States (Royo, 1999).

The first European settlers to arrive in the region were primarily farming families. As the farming communities began to develop, the need for water became increasingly apparent. Between 1895 and 1922, San Diego's water system transitioned from being privately owned, to a system owned by the City of San Diego. After building the Upper and Lower Otay Reservoirs in the late 1800s, E.S. Babcock merged interests with John Spreckles, to combine the water rights of the Tecarte Mountain Water Company and the Otay Water Company. The merger formed the Southern California Mountain Water Company, which was ultimately sold to the City of San Diego. The City eventually bought the entire water system from Morena to Otay (Eastlake, 2004).

In 1916, torrential rains caused the lower Otay dam to overflow and rupture, spilling over 13 billion gallons of water down the valley and destroying the town of Otay. The following year, the Sweetwater Reservoir Dam, located northwest of the Otay reservoir, also ruptured, releasing approximately 16 billions gallons of water and flooding the Sweetwater Valley. The flood destroyed all the farms below and a portion of the Santa Fe Railroad. The town of Otay was never rebuilt. The lower Otay dam was rebuilt in 1919.

Immediately after the establishment of San Diego County in 1850, William Heath Davis, a San Francisco business man, and Alonzo Horton, a wealthy trader and landowner, formed a partnership and bought 160 acres of land for approximately $2,300. Davis built a wharf and the U.S. government built some supply warehouses, the first industrial development in the area. However, late the following year, a fire in San Francisco eliminated all of Davis' wealth, and San Diego's development temporarily ended. Shortly thereafter, in 1867, Alonzo Horton purchased 960 acres of waterfront acres, which ultimately became and established new San Diego.

About 1870, solar salt production in the southeast corner of San Diego Bay began with the development of the 60-acre La Punta Salt Works (Union Tribune, May 17, 1897). This facility subsequently closed in 1901. In 1902, Graham Babcock established the Western Salt Company approximately a quarter mile northeast from the approximate location of the La Punta Salt Works (Gustafson and Gregory, 2001). And in 1911, E.S. Babcock took over the Western Salt Works operation and began purchasing much of the land along the south end of the bay in order to expand the facility. As the facility expanded, the historic salt marsh and intertidal mudflats were eliminated by the formation of diked evaporation ponds. By 1916, the facility extended across the entire end of the South Bay. The flood of 1916, described previously, severely damaged the facility, but reconstruction began immediately and continued through 1918. In 1922, the facility was purchased by H.G. Fenton and remained under the ownership of H.G. Fenton Company until the majority (approximately 964 acres) of the salt works was incorporated into the San Diego Bay National Wildlife Refuge's South San Diego Bay Unit in 1999.

Between 1867 and 1887, San Diego developed and grew, with an economy built principally on land acquisition and real estate. This period was fueled by a rail line, which connected San Diego to the east through Barstow. In the 1860s and 1870s, San Diego reached a population of 35,000. However, San Diego's new rail line did not flourish as expected. The busy traffic went through San Diego and into Los Angeles, resulting in slow development, which was not able to support the thousands of new

comers. In 1890, from a population peak of 40,000 in 1887, San Diego's population dropped to approximately 16,150 (San Diego History, 2004).

In the early 1900s, San Diego's population recovered in large part due to John Spreckles' significant investments in the San Diego area. Spreckles owned the streetcar system, two of the town's three newspapers (The San Diego Union and the Evening Tribune), most of Coronado and North Island, and the landmark Hotel Coronado. In 1906, Spreckles and local businesses formed a corporation to build the San Diego and Arizona Railroad, and nearly twenty years later, the San Diego and Arizona Railroad was completed.

While railroads and commercial shipping brought industrial development and labor force into the area over the next decade, the military irrevocably shaped the area's future. The area became of strategic importance for the Spanish-American war, and was a point of attraction for the military for its clear flying weather and natural harbors. When Congress declared war on Germany in 1917, San Diego was chosen as the site for the War Department's Army Division in the Southwest, and Camp Kearny was established. By the end of the war, over 400 officers and enlisted men had moved into the area (San Diego History, 2004).

Meanwhile, tourism began to emerge as a factor in San Diego's economy and its future. In 1915 and 1916, the City's 1,400-acre Balboa Park was established, which brought a significant number of visitors, many of whom never left. A movie industry began to evolve, and the renowned Scripps Institution of Oceanography was established in La Jolla (San Diego History, 2004).

With World War II, San Diego's military population boomed. The San Diego area became the home of the 11th Naval District Headquarters, the Naval Training Center, Miramar Naval Air Station, the Marine Corps Recruit Depot, and Camp Pendleton. By 1950, San Diego's population reached approximately 334,300. By the end of the war, many veterans had discovered San Diego and made San Diego their permanent residence. Many of them found jobs in the City's growing defense and aerospace industry, fueling San Diego's economy for the next two decades. By this time, the main ranchos and farmland of the mid-1800s had been converted into military training centers, industrial areas, and residential communities.

The rapid development of the San Diego region during this period greatly stressed the adjacent San Diego Bay, which was considered the solution for the disposal of bilge water, garbage, and sewage (SDUPD, 2000). Waste disposal of collected sewage into San Diego Bay was first attempted in 1887–1888 when the City's population was less than 16,000 (San Diego Regional Water Pollution Control Board, 1952). Industrial wastes were mainly from the food processing industry in the early part of this century. Before the first sewage treatment plant was constructed by the City of San Diego in 1940, high coliform counts indicated sewage contamination in all parts of San Diego Bay. However, rapid population growth during and after World War II overwhelmed the capacity of the few sewage plants, which used primary treatment and usually no chlorination.

By 1952, at least 50 million gallons of sewage and industrial wastes were disposed of daily in San Diego Bay (SDUPD, 2000). By 1955, the California Department of Public Health (CDPH) found that the waters of the central portion of the Bay had deteriorated since 1951 and were now "sufficiently contaminated by sewage wastes to be hazardous to public health," particularly for recreational uses (CDPH, 1955). In December 1955, CDPH placed a quarantine on the beaches and shorelines in the central Bay area (SDUPD, 1995b). The San Diego Regional Water Quality Pollution Board (renamed the San Diego Regional Water Quality Control Board in 1967) adopted its first water quality criteria for San Diego Bay that same year. Finally, in August 1963, the San Diego Metropolitan Sewerage System went into operation, and by February 1964, all domestic sewage discharges and those from the Naval

Amphibious Base were connected (Delaney, 1966). Treated effluent from this system was, and continues to be, discharged through an ocean outfall off Point Loma. With the cessation of sewage dumping, San Diego Bay showed rapid recovery, with higher water clarity, increased dissolved oxygen, reductions in several contaminants, and the return of marine life (SDUPD, 2000).

In 1962, the California legislature created and area voters approved the San Diego Unified Port District (SDUPD), which is a special-purpose unit of government. It was established to manage the harbor, operate the international airport at Lindbergh Field, and administer the public tidelands around San Diego Bay "in order to further the development of commerce, navigation, fisheries and recreation" (SDUPD, 1995a). The SDUPD's stated mission is to balance regional economic benefits, environmental stewardship, recreational opportunities, and public safety while protecting Tidelands Trust resources on behalf of the citizens of California.

The SDUPD's enabling legislation includes furthering sport and commercial fishing in San Diego Bay. Sport fishing does occur in the Bay, but continues to be less popular than deep sea fishing. Commercial fishing grew with the region through the 1800s and included whaling within and outside of San Diego Bay (SDUPD, 2000). Fishing in general declined significantly with the continued deterioration of San Diego Bay through the mid-1900s. Fishing in San Diego Bay has remained at lower levels, which could be attributable to several factors, including logistical and legal restrictions in using nets in the Bay, more desirable fish in deeper ocean waters, reductions in fish populations generally, and concerns over runoff-related effects on Bay fish (SDUPD, 2000).

Real estate development in the San Diego region continued through the 1960s and 1970s, which coupled with an ever-growing tourism industry and military presence, spawned continued growth and redevelopment through the 1990s. In 1990, San Diego population reached 1.2 million (San Diego History, 2004).

Development of the San Diego area during the decade of the 1980s reflected the State's urban development patterns, which were characterized by rapid population and housing growth. The pace of development, driven by growth in jobs, population and housing was well above the national rate, exceeding even California's overall rapid rate of growth. In the 1990s, a significant acceleration toward economic diversification and high job growth in San Diego occurred. This led to a rapid increase in population, two-thirds of which came from in-migration during the1980s. During this decade, the region's population grew by 35 percent (City of San Diego, 1990).

The economy of the San Diego area achieved major increases in the 1980s in terms of both its size and its diversity. New jobs were created at a very high rate starting in 1984, signaling the end of the 1982 recession. The high job creation, spurred by defense-related, high tech, and biomedical increases, resulted in an average of over 45,000 new jobs per year from 1984 through 1989. For the first time, the service sector, stimulated by the growth in basic industry jobs, emerged as the largest category of employment. Service employment, which was San Diego's third largest sector in the 1970s, surpassed both government and retail/wholesale trade during the 1980s. This high level of job creation sustained the high level of population growth (City of San Diego, 1990).

Significant shifts in land-use types came with the urban and economic development experienced in the 1980s and 1990s. Between 1992 and 2002 in San Diego County, agricultural land decreased by approximately 21,000 acres, while urbanized land increased by approximately 35,000 acres (DOC, 2002).

More recently, the County and other jurisdictions have made a strong commitment to balance habitat preservation and restoration with reasonable economic development and other uses in this watershed

and elsewhere in the region. San Diego County, the City of San Diego, the City of Chula Vista, and other jurisdictions have worked together with State of California and federal wildlife agencies to develop the Multiple Species Conservation Program (MSCP), a comprehensive, long-term habitat conservation plan that addresses the needs of multiple species and the preservation of natural vegetation communities. The MSCP Subregional Plan and the associated Subarea plans for each jurisdiction established comprehensive measures to ensure the long-term conservation of a range of rare and endangered species and their habitats, including many species in the Otay River watershed, while allowing for reasonable economic development. In June 1997, after nearly a decade of work, the Cities of San Diego and Chula Vista, and the County of San Diego adopted the Otay Valley Regional Park Concept Plan (OVRPCP). The OVRPCP serves as a roadmap for acquiring and managing land around the Otay Lakes and the lower Otay River, to provide a mix of recreation and educational opportunities while protecting open space, environmentally sensitive areas, wildlife, culture, historic, agriculture, archeological, and scenic resources. The Otay River Watershed Management Plan (ORWMP) provides another means for jurisdictions and other watershed stakeholders to balance and coordinate natural resource protection, enhancement, and restoration, and reasonable development and other uses within the entire watershed.

Local History

European settlement in the Otay region began approximately in the 1870s. Many of the early pioneers were German immigrants, who acquired land under the Homestead Act of 1862. Acquisition of land through homesteading involved payment of a minimal fee upon filing an application, followed by five years of residence and active cultivation. Once these requirements were met, qualified individuals could obtain up to 160 acres of land (Gallegos, 2000).

Other settlers gained title to land through a timber-culture bill that became law in March 1873, and was repealed in March 1891. Under the initial enactment of the bill, an individual could acquire 160 acres of land by planting trees on 40 acres. In 1878, the law was amended to reflect less stringent planting requirements, and decreased the number of required acres on which to plant trees from 40 to 10 acres (Gallegos, 2000).

The community of Otay began to settle in the 1870s and 1880s, and endured beyond the turn of the century. These settlements were primarily comprised of farming and ranching families, who shared a similar environmental setting and were socially, economically, and politically united within a common school district. Settlers considered the construction of a schoolhouse a top priority after building a family dwelling, which served as a church and a community center for social gatherings. Such social activities played an important role in communication among people living in remote agricultural settlement, as it provided temporary relief from the hard work required to farm. Before the turn of the century, a church had been built it the community of Otay, and a cemetery had been established on church property (Gallegos, 2000). Although as many as 28 families lived in the community of Otay by 1900, the population gradually decreased because of periodic droughts and the effects of the Great Depression in the 1930s. By the late 1930s, only four or five of the pioneering families remained. As the early residents moved out and sold their property, the land continued to be used for agricultural purposes. In recent years, urban development has increased significantly, particularly near the coast, and some farmland continues to lay fallow (Gallegos, 2000). Larger-scale ranching has given way to smaller ranchettes in the eastern watershed.

With the long history of occupation and use of the Otay area and the greater San Diego region, it is expected that substantial and varied cultural resources exist within this watershed. In addition to Native American artifacts, it is expected that there would be resources related to the early European

settlements, such as farm structures and implements, as well as more recent items of potential historical importance. Some recognized sites include: Barrett House, circa 1890, central Jamul; La Follet House, circa 1895, off Jefferson; Rock House, circa 1895, on Hillside Drive; Jamul School House; Lawson Valley School in Lee Valley; Schnell house, west of intersection of Lawson Valley Road and Skyline Truck Trail; Bratton House, circa 1900, Deerhorn Valley Road; Wats House, Mother Grundy Truck Trail; Jamul Rancho building site east of Pio Pico Park; Plumers House, circa 1915, north of Dulzura Café; Dulzura Café, circa 1900; Clark Ranch, rebuilt 1900, on Dulzura Creek; Hagenback House, near Forestry Station; Schekler House, east of Highway 94 at Marron Valley Road; and the Winnetka Ranch House.

B.3 GENERAL LAND USE PATTERNS AND SOCIOECONOMIC FACTORS

This section characterizes the overall land use patterns in the Otay River watershed and describes the applicable land use plans and policies of jurisdictions within the watershed. In addition, basic population and demographic data are provided to describe the socioeconomic characteristics of the watershed. This section also briefly discusses recreational and scenic resources within the watershed.

B.3.1 Land Uses

The Otay River watershed encompasses approximately 92,920 acres (145 square miles) in southwestern San Diego County. The western portion of the watershed is predominantly incorporated, while the eastern area is largely unincorporated. Incorporated areas include portions of the cities of Chula Vista, San Diego, Imperial Beach, Coronado, and National City.

Table B.3-1 presents a summary of the jurisdictions and acreages within Otay River watershed. Figure A-2 provides a map of the jurisdictions located within the watershed.

Table B.3-1 Percentages of Lands within Otay River Watershed

Jurisdiction	Acres	Percentage of Otay River Watershed
City of National City	124.3	0.1 %
City of Coronado	200.2	0.2 %
City of Imperial Beach	557.5	0.6 %
City of San Diego	6,179.0	6.6 %
City of Chula Vista	17,558.3	18.9 %
County of San Diego (unincorporated)	68,301.02	73.5 %
Total	92,920.3	100 %

Source: TAIC, 2004.
Notes: The watershed lands presented in this table include privately owned land as well as land owned by local, State, and federal governments (see Table B.3-6). The San Diego Unified Port District owns approximately 182.4 near the outlet of the watershed. Due to overlapping jurisdiction with the State of California, for the purposes of the ORWMP, the Port's exclusive control is limited to 167.4 acres near the outlet.

Existing Land-Use Patterns

A number of different land use types exist in each jurisdiction within the Otay River watershed. Figure B.3-1 provides a graphic representation of existing land uses in the watershed. Land use types for each jurisdiction have been grouped into broader categories (described in Table B.3-2) to provide a uniform characterization of development patterns in the watershed area.

Table B.3-3 presents a summary of land-use types within the Otay River watershed, based on this categorization. As shown in Table B.3-3, the predominant land use in the watershed is open space/vacant/water (78.9 percent), followed by permanent residential (9.6 percent), and transportation

(3.7 percent). The majority of the open space/vacant/water areas are located north, south, and east of the Otay Lakes, while most of the urban land uses occur west of the Otay Lakes.

Table B.3-2 Existing Land Use Types by Category

Land Use Category	Description
Permanent Residential	Single and multi-family residential, rural residential, and any residential under construction.
Temporary Residential	Mobile home parks, hotels-motels and other lodging or quartering facilities.
Light Industrial and Industrial	Industrial parks, general light industrials, warehousing & public storage, extractive industry (e.g., mining), and junkyard/dump/landfill.
Commercial	Wholesale trade, community and neighborhood shopping centers, arterial commercial, automobile dealerships, retail trade and offices.
Recreation	Golf courses, marinas, Olympic training center, parks, landscape open space, residential recreation, commercial recreation, and other recreation areas.
Open Space/Vacant/Water	Open space reserves/preserves, undeveloped land and land with less than 1 dwelling unit per 10 acres, bays and lagoons, and lakes/reservoirs/large ponds
Public Facility	Libraries, churches, fire/police stations, hospital, health care facilities, airstrips, airports, jails/prisons, and other public health services.
Public Utility	Communication and utilities rights-of-way.
Transportation	Rail stations and transit centers, railroad rights-of-way, freeways, and other transportation.
Schools	High Schools, Junior High, Elementary Schools, district offices, and other schools, including schools under construction.
Agriculture	Orchards and vineyards, intensive/extensive agriculture, and field crops.

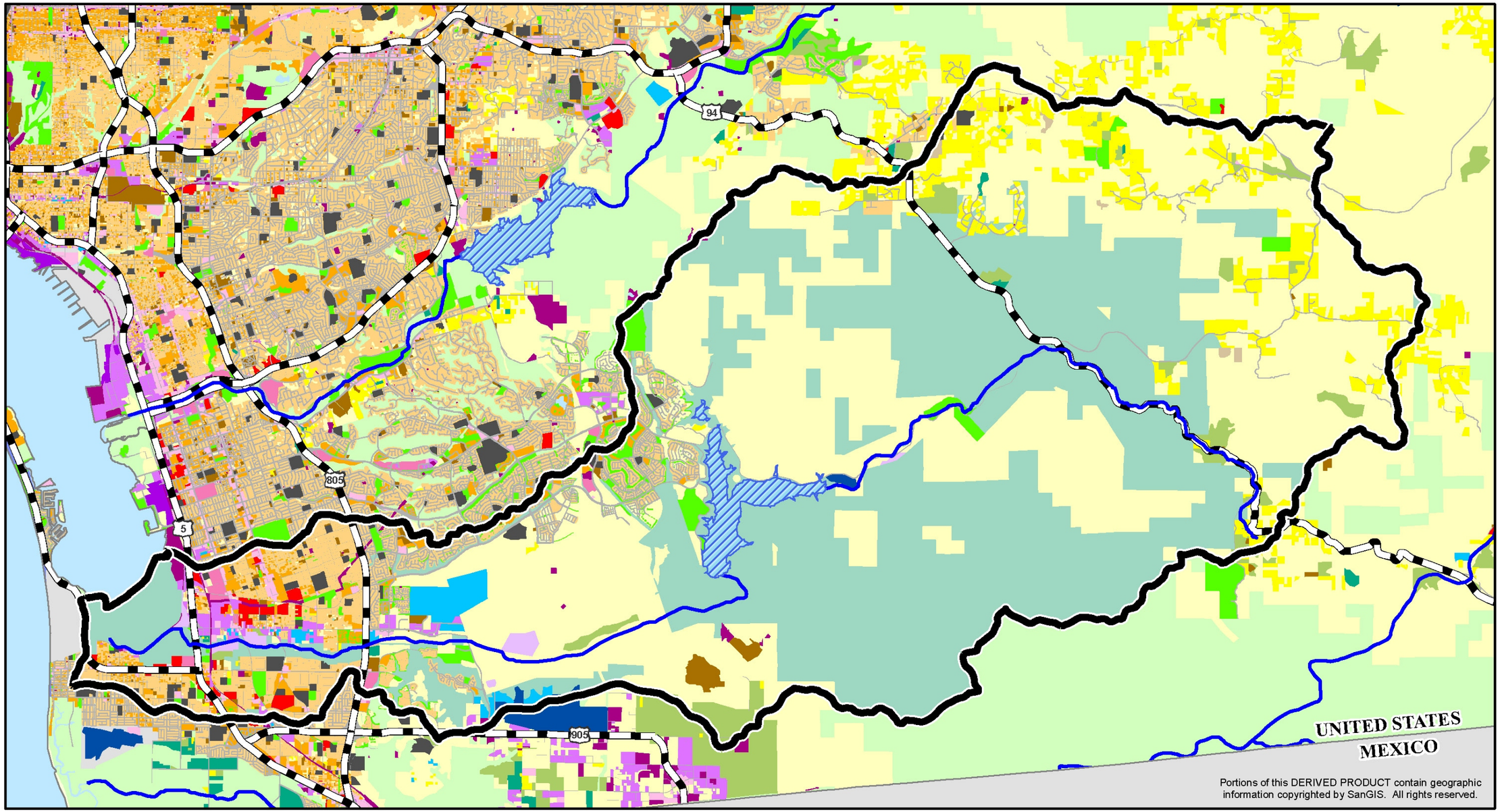
Source: TAIC, 2005, using data from the San Diego Association of Governments (SANDAG).

Table B.3-3 Existing Land Uses within the Otay River Watershed

Land Use Type	Acres	Percentage of Total Watershed Area
Public Utility	265.1	0.3 %
Public Facility	492.8	0.5 %
Temporary Residential	416	0.4 %
Commercial	503.7	0.5 %
Schools	586.1	0.6 %
Agriculture	1,740.5	1.9 %
Light Industrial and Industrial	1,544.2	1.7 %
Transportation	3,437.5	3.7 %
Permanent Residential	8,957.6	9.6 %
Recreation	1,627.4	1.8 %
Open Space/Vacant/Water	73,349.4	78.9%
Total	92,920.3	100 %

Source: TAIC, 2005, using data from SANDAG.

Table B.3-4 provides a detailed breakdown of land-use types by jurisdiction in the watershed. The first numbers are percentages, while the numbers in parentheses indicate the approximate acreage within each jurisdiction. The largest portion of land designated open space/vacant/water in the Otay River watershed falls in the unincorporated area of San Diego County (approximately 65.1 percent), while the second largest falls within the City of Chula Vista (approximately 10.4 percent). Similarly, the unincorporated area of San Diego County contributes the largest portion of land designated as permanent residential (4.7 percent of the watershed), while the City of Chula Vista contributes 3.3 percent, which is the second largest. The City of San Diego's primary land-use types in the watershed



Legend

- Airports
- Commercial Recreation
- Commercial and Office
- Education
- Extensive Agriculture
- Extractive Industry
- Freeway-Roads
- Heavy Industry
- Institutions
- Intensive Agriculture
- Junkyard/Dump/Landfill
- Light Industry
- Military
- Mobile Homes
- Multiple Family
- Open Space Preserves
- Parks
- Shopping Centers
- Single Family
- Spaced Rural
- Transportation/Communication
- Undeveloped
- Water

N

0 2.5
Scale in Miles

Basemap Legend

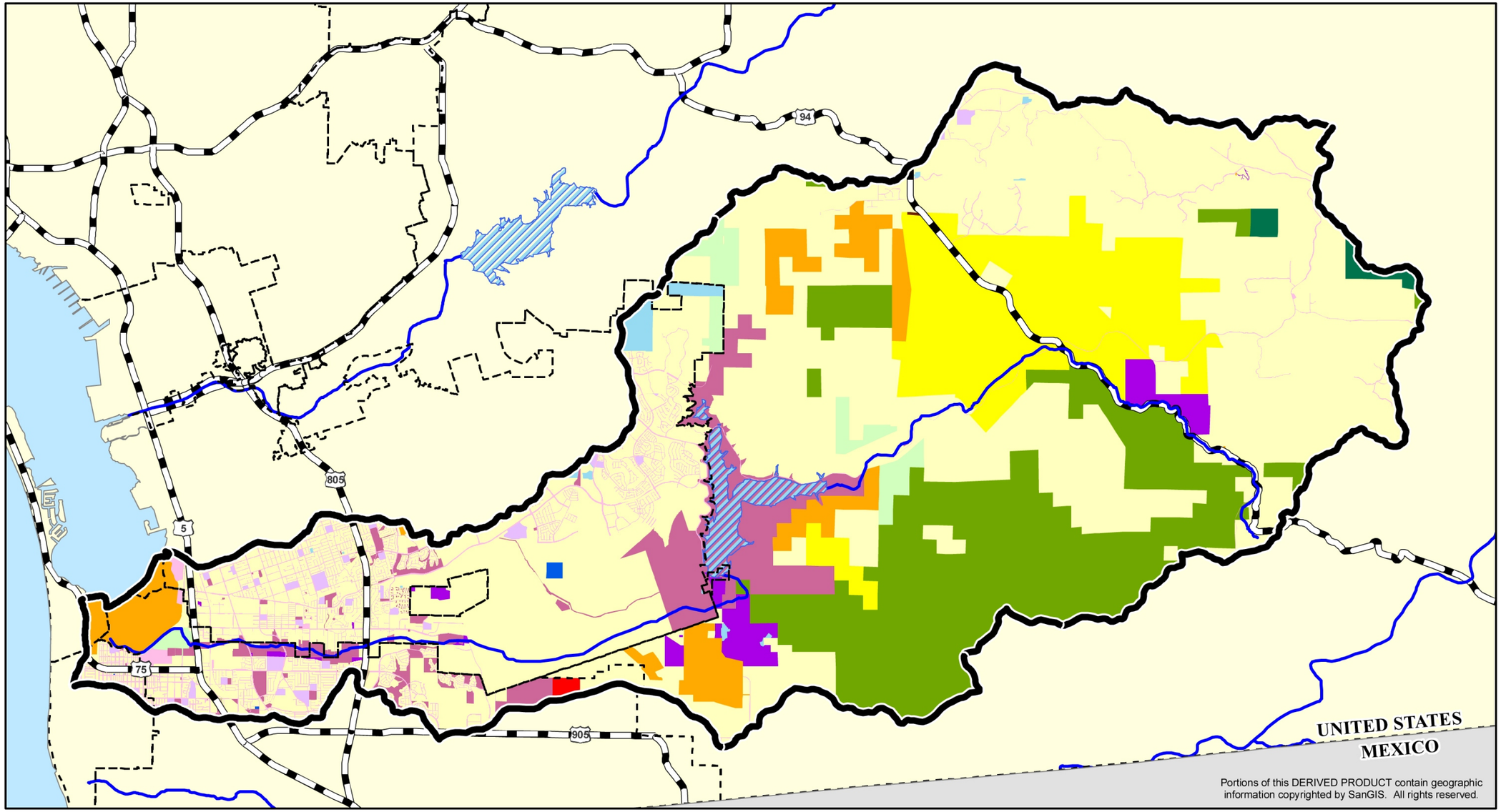
- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes

Source: SANDAG, 2004

Otay River Watershed Management Plan

Figure B.3-1
Existing Land Use Within the Watershed (data from 2004)

Aspen Environmental Group



Legend

- BUREAU OF LAND MANAGEMENT
- CALIFORNIA DEPT. OF FISH AND GAME
- CALTRANS
- CITY
- COUNTY
- INDIAN RESERVATIONS
- MILITARY
- OTHER FEDERAL LANDS
- OTHER LOCAL LANDS
- OTHER STATE LANDS
- PRIVATELY OWNED LANDS
- SCHOOL DISTRICTS
- STATE PARK
- U.S. FISH AND WILDLIFE SERVICE
- U.S. FOREST SERVICE
- WATER AND SANITATION DISTRICTS

Basemap Legend

- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes

N

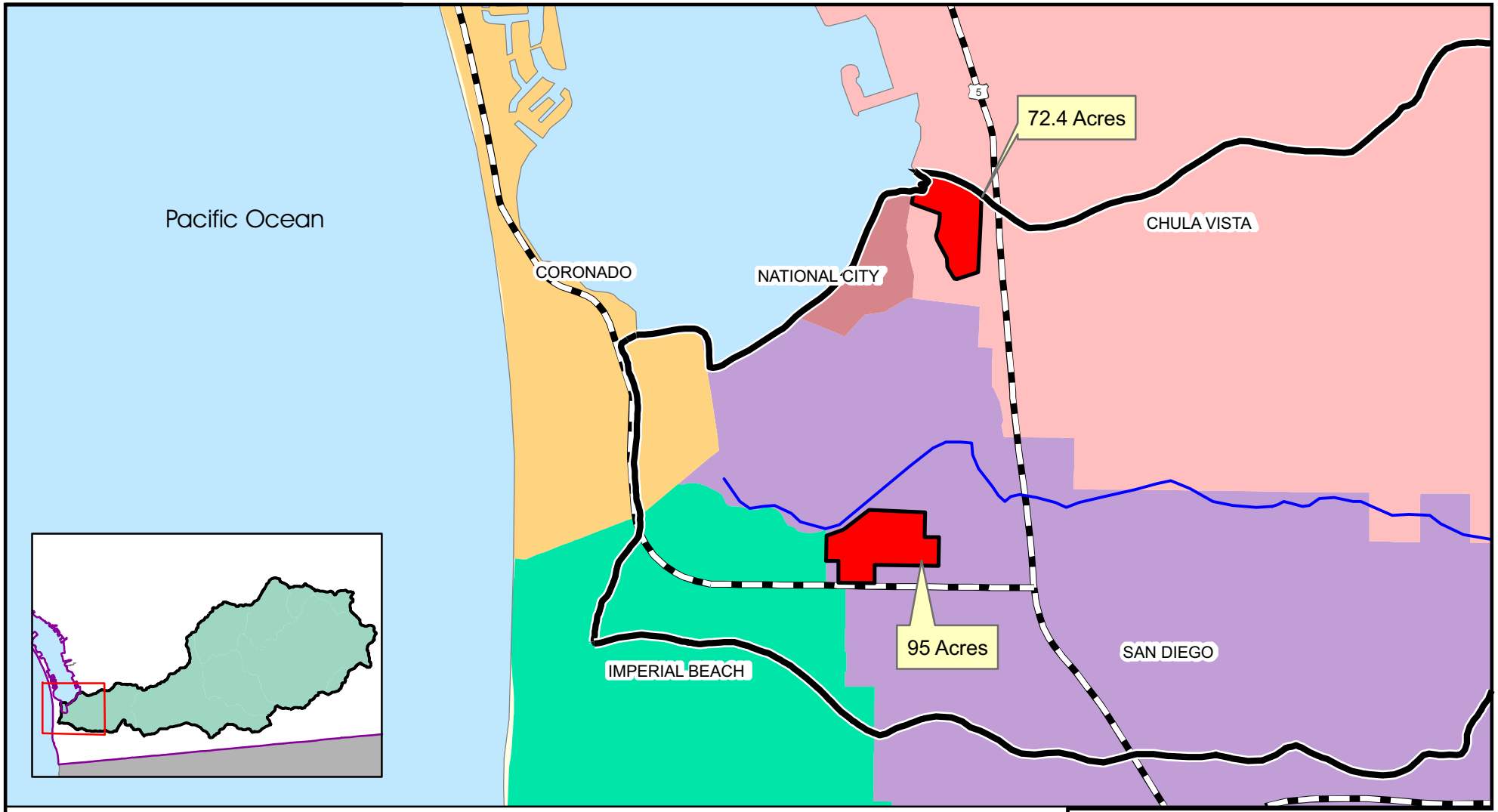
0 2.5 5
Scale in Miles

Source: TAIC, 2005

Otay River Watershed Management Plan

Figure B.3-2
Generalized Ownership

Aspen Environmental Group



Legend

Port of San Diego Jurisdiction

Jurisdictional Boundaries

- Chula Vista
- Coronado
- Imperial Beach
- National City
- City of San Diego

Basemap Legend

- Otay Watershed
- Water
- Otay River

N

0 2000 4000
Scale in Feet

Source: Unified Port of San Diego, 2005

Otay River Watershed Management Plan

Figure B.3-3
Unified Port District of San Diego Jurisdiction Within the Otay River Watershed

Aspen Environmental Group

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are open space/vacant/water (3.1 percent), permanent residential (1.4 percent), and transportation (1 percent), while the City of Imperial Beach's primary land-use types in the watershed are permanent residential (0.3 percent) and transportation (0.2 percent). Watershed land within the Cities of National City and Coronado is open space/vacant/water, except for 0.4 acres of transportation in City of Coronado.

Table B.3-4 Existing Land Use Within the Otay River Watershed by Jurisdiction

Jurisdiction	Permanent Residential	Temporary Residential	Commercial	Light Industrial/ Industrial	Recreation	Open Space/Vacant/Water	Public Facility	Public Utility	Transportation	Schools	Agriculture	Total
	Percent Land Area											
National City	0.0 % (0)	0.0 % (0)	0.0 % (0)	0.0 % (0)	0.0 % (0)	0.1% (124.3)	0.0 % (0)	0.0 % (0)	0.0 % (0)	0.0 % (0)	0.0 % (0)	0.1 % (124.3)
City of Coronado	0.0 % (0)	0.0 % (0)	0.0 % (0)	0.0 % (0)	0.0 % (0.0)	0.2% (199.8)	0.0 % (0)	0.0 % (0)	0.0 % (0.4)	0.0 % (0)	0.0 % (0)	0.2 % (200.2)
City of Imperial Beach	0.3 % (270.4)	0.0 % (16.2)	0.0 % (39)	0.0 % (5.7)	0.0 % (5.5)	0.0 % (25.6)	0.0 % (6.3)	0.0 % (0.0)	0.2 % (173)	0.0 % (15.8)	0.0 % (0.0)	0.6 % (557.5)
City of San Diego	1.4 % (1,273.4)	0.2 % (161.7)	0.2 % (143.8)	0.3% (314)	0.2 % (195.8)	3.1 % (2,843.6)	0.1 % (66.7)	0.0 % (12.8)	1.0 % (935)	0.2 % (191.2)	0.0 % (41.3)	6.6 % (6,179)
City of Chula Vista	3.3 % (3,089.3)	0.3 % (238.1)	0.3 % (313.4)	0.8 % (698.7)	1.1 % (1,052)	10.4 % (9,623.9)	0.1 % (124.9)	0.2 % (172.9)	1.9 % (1,789.9)	0.3 % (316.5)	0.1 % (138.7)	18.9 % (17,558.3)
San Diego County (unincorporated)	4.7 % (4,324.6)	0.0 % (0)	0.0 % (7.6)	0.6 % (525.8)	0.4 % (374.2)	65.1 % (60,532.1)	0.3 % (294.9)	0.1 % (79.4)	0.6 % (539.4)	0.1 % (62.6)	1.7 % (1,560.6)	73.5 % (68,301)
Total	9.6 % (8,957.6)	0.4 % (416)	0.5 % (503.7)	1.7 % (1,544.2)	1.8 % (1,627.4)	78.9 % (73,349.4)	0.5 % (492.8)	0.3 % (265.1)	3.7 % (3,437.5)	0.6 % (586.1)	1.9 % (1,740.5)	100 % (92,920.3)

Source: TAIC, 2005, using data from SANDAG.
Note: The San Diego Unified Port District owns 182.4 acres near the outlet of the watershed. Due to overlapping jurisdiction with the State of California, for the purposes of the ORWMP, the Port's exclusive control is limited to 167.4 acres.

Table B.3-5 summarizes the distribution of developed and undeveloped land by jurisdiction within the watershed. Within the Otay River watershed, there are approximately 75,090 acres of undeveloped lands, which encompass all areas designated as open space/vacant/water or agriculture. The remaining acreage (approximately 17,830 acres) includes all other designations and is considered to be developed land. Considering the jurisdictions controlling at least 0.5 percent of the watershed area, the unincorporated County areas in this watershed have the lowest percentage of development (9 percent).

Figure B.3-2 provides a graphic representation of land ownership in the Otay River watershed, while Table B.3-6 summarizes the land ownership data. Private landowners own most of the land in the Otay River watershed (55 percent). As shown, the federal government and State of California also own significant land area in the watershed. The SDUPD owns 182.4 acres near the outlet, although overlap with the State of California limits the Port's exclusive control to 167.4 acres.

Table B.3-5 Developed and Undeveloped Land within the Otay River Watershed

Jurisdiction	Acres Developed	Acres Undeveloped	Total Acreage within Otay River Watershed	Percentage Developed Lands
National City	0	124.3	124.3	0.0 %
Coronado	0.4	199.9	200.2	0.2%
Imperial Beach	531.9	25.6	557.5	95.4 %
City of San Diego	3,294.2	2,884.8	6,179.0	53.3 %
Chula Vista	7,795.6	9,762.6	17,558.3	44.4 %
San Diego County (Unincorporated)	6,208.3	62,092.7	68,301.0	9.1 %
Total	17,830.4	75,089.9	92,920.3	19.2 %

Source: TAIC, 2005, using data from SANDAG.
Note: The San Diego Unified Port District owns 182.4 acres near the outlet of the watershed. Due to overlapping jurisdiction with the State of California, for the purposes of the ORWMP, the Port's exclusive control is limited to 167.4 acres. All of this land is considered undeveloped.

Table B.3-6 Land Ownership within the Otay River Watershed

Landowner	Total Acres Owned	Percent of Total Watershed Area
City of National City		
Other State Land	3.65	<0.01%
Port of San Diego	0.00	0.00%
U.S. Fish and Wildlife	120.64	0.13%
City of Coronado		
Military	9.72	0.01%
Other State Lands	190.00	0.20%
Private	0.14	<0.01%
Road Right of Way	0.39	<0.01%
City of Imperial Beach		
City of Imperial Beach	4.76	0.01%
Other Federal Lands	0.45	0.01%
Other State Lands	21.57	0.02%
Port of San Diego	1.55	<0.01%
Private	339.57	0.37%
Road Right of Way	170.16	0.18
School Districts	19.43	0.02%
City of San Diego		
California Department of Transportation	142.35	0.15%
City of San Diego	1,032.22	1.11%
San Diego County	46.54	0.05%
Military	114.25	0.12%
Other Federal Lands	2.17	<0.01%
Other Special Districts	3.89	<0.01%
Other State Lands	17.70	0.02%
Port of San Diego	108.16	0.12%
Private	3,072.46	3.31%
Road Right of Way	619.25	0.67
School District	176.83	0.19%
State of California	751.89	0.81%
U.S. Fish and Wildlife Service	91.00	0.10%

Landowner	Total Acres Owned	Percent of Total Watershed Area
City of Chula Vista		
California Department of Transportation	165.12	0.18%
City of San Diego	1,631.48	1.76%
County of San Diego	15.88	0.02%
Other Federal Lands	51.65	0.06%
Other Special Districts	6.41	0.01%
Port of San Diego	72.71	0.08%
Private	13,024.78	14.02%
Road Right of Way	1,546.02	1.66
School Districts	310.27	0.33%
State of California	79.19	0.09%
U.S. Fish and Wildlife Service	175.83	0.19%
Water Districts	478.92	0.52%
County of San Diego Unincorporated Area		
Bureau of Land Management	14,438.78	15.54%
California Department of Fish and Game	9,529.27	10.26%
City of San Diego	3,204.94	3.45%
County of San Diego	1,336.46	1.44%
Fire Districts	2.66	<0.01%
Indian Reservations	7.07	0.01%
Private	34,815.24	37.47%
Road Right of Way	482.36	0.52%
School Districts	62.59	0.07%
State of California	2,859.29	3.08%
U.S. Fish and Wildlife Service	1,071.09	1.15%

Source: TAIC, 2005 using data from SANDAG.

Nearly all of Otay River watershed lands within the Cities of National City and Coronado are publicly owned open space land and water. However, in the Cities of Imperial Beach, San Diego, Chula Vista and the unincorporated area of San Diego County, private owners hold the majority of Otay River watershed lands.

Planned Land-Use Patterns

Land Use Policy Plans

Each jurisdiction prescribes future land use patterns through the plans and policies set forth in its General Plan and other applicable land use policy plans. This section briefly describes the primary land use plans that control land use and development patterns in the Otay River watershed. Specifically, this section evaluates the General Plans for the Cities of Chula Vista, Imperial Beach, San Diego, and San Diego County,[1] as well as the San Diego Unified Port District Master Plan, the boundaries of which overlay a small section of the western edge of the Otay River watershed (Figure B.3-3). Table B.3-7 provides a list of applicable plans and policies.

[1] Land use policies for the Cities of Coronado and National City are not evaluated in this section, because these two jurisdictions occupy a very small part of this watershed (less than 0.5 percent) and are not part of the Joint Exercise of Powers Agreement to develop and adopt the Otay River Watershed Management Plan.

Table B.3-7 Applicable Land Use Plans by Jurisdiction

Jurisdiction	Plans and Policies
City of Chula Vista	• City of Chula Vista General Plan • Eastern Territories/Montgomery/Bayfront Area Plans • Otay Ranch General Development Plan/Subregional Plan
City of Imperial Beach	• City of Imperial Beach General Plan and Coastal Plan
City of San Diego	• City of San Diego Progress Guide and General Plan • Otay Mesa and Otay Mesa/Nestor Community Plans
San Diego County	• San Diego County General Plan • Otay Subregional Plan • Jamul/Dulzura Subregional Plan • East Otay Mesa Specific Plan SubArea 1
San Diego Unified Port District	• Port Master Plan: San Diego Unified Port District

City of Chula Vista

City of Chula Vista General Plan. The General Plan for the City of Chula Vista sets forth land use policies that guide the development and use of all lands within its planning area. Land use policies are implemented through a classification of different land use types and designation of all lands in the planning area according to these land use types. Each land use category includes clear standards for the density of population and intensity of development in each particular area. Due to the varied development patterns within the City, the City of Chula Vista divides its planning region into five community plan areas, of which the Eastern Territories Area Plan, Montgomery Area Plan, and Bayfront Master Plan Area fall within the Otay River watershed.

In addition, the General Plan provides the City with the necessary direction for the preservation and enhancement of the planning area's natural environment, and also establishes guidelines for the development of the City's park system and recreation facilities. As part of this effort, the City has developed the Chula Vista Greenbelt, which forms a 28-mile open space and park system around the City. Developed parks are located along the Greenbelt, and the majority of the acreage is designated as undeveloped open space. Commercial recreation uses within the Greenbelt, such as golf courses and the Olympic Training Facility, are compatible with the Greenbelt's policies and guidelines (Chula Vista, 1995; City of Chula Vista, 2003). Approximately seventy-five percent of the Chula Vista Greenbelt is located within the Otay River watershed.

Approved in May 2003 and formally adopted as an element of the current General Plan, the City of Chula Vista MSCP Subarea Plan establishes a framework for habitat planning and specifically identifies areas of conservation and development within the Chula Vista MSCP Subarea (described in more detail in Section B.6.4). Approximately 2,742 acres within Otay Ranch will be preserved within the Subarea boundaries (approximately 2,617 acres of which represents undisturbed habitat types).

Currently, about 3,089 acres of land in Chula Vista's portion of the watershed are in permanent residential use. Under the current General Plan, the amount of land planned for residential use in the watershed is 5,676 acres, which is about an 84 percent increase compared to current conditions. Land area devoted to commercial and industrial uses in the watershed would also increase substantially compared to current conditions (about 108 percent and 81 percent, respectively). Land devoted to recreation in the watershed would increase from a current total of about 1,052 acres to a planned total of 1,248 acres. Open space/vacant/water use in the watershed would decline from a current total of about 9,624 acres to a planned total of 5,141 acres, which represents a 47 percent loss. Also, agricultural land would decrease from approximately 139 acres to 126 acres, which is a decrease of approximately 9 percent.

General Plan Update

The City of Chula Vista adopted a comprehensive update of their General Plan on December 13, 2005. The updated General Plan focuses growth within the City to subareas where mixed-use development integrated with transit is encouraged. The Chula Vista Vision 2020 General Plan provides guidance for the City's growth and development/redevelopment over the next 25 years, and acknowledges the ongoing protection of environmental resources and the provision of recreational facilities as integral parts of the long-term planning process.

General Plan Update objectives and policies relevant to the ORWMP include:

- Protect and improve water quality within surface water bodies and groundwater resources within and downstream of Chula Vista (Objective EE 2).
- Ensure safely swimmable and fishable surface waters through careful management of land uses and activities within Chula Vista. (Policy EE 2.1)
- Pursue safe alternatives to traditional pest management methods in order to reduce toxics in urban runoff and large open uses of land (e.g., golf courses, parks, agricultural lands). (Policy EE 2.2)
- Educate residents, business owners, and city departments about feasible methods to minimize the discharge of pollutants into natural drainages and the municipal storm drainage system. (Policy EE 2.3)
- Ensure compliance with current federal and State water quality regulations, including the implementation of applicable NPDES requirements and the City's Pollution Prevention Policy. (Policy EE 2.4)
- Encourage and facilitate construction and land development techniques that minimize water quality impacts from urban development. (Policy EE 2.5)
- Maximize the protection of potable water supply resources from pollutants. Utilize the *Source Water Protection Guidelines for New Development* (Policy EE 2.6)
- Collaborate with other applicable jurisdictions in the development and funding of regional watershed management plans. (Policy EE 2.7)
- Ensure adjacent land uses are compatible with one another (Objective LUT 4)
- Ensure that any land uses that handles, generates, and/or transports hazardous substances, as defined by state or federal regulations, will not negatively impact existing sensitive receptors/land uses. (Policy LUT 4.8)
- Coordinate and work closely with the City of San Diego in the Otay Valley Regional Park and the Sweetwater/Bonita areas to participate in the development review processes of projects proposed in these areas. Work to ensure that such development takes City of Chula Vista standards into consideration, as appropriate. (Policy LUT 4.10)
- Increase efficiencies in water use, wastewater generation and its re-use, and handling of storm water runoff throughout the city through use of alternative technologies (Objective PFS 2)
- Promote and encourage local water resource development and explore all opportunities for viable water supplies, including desalination. If appropriate, reserve suitable land areas to accommodate such potentially viable facilities and to protect groundwater sources and water storage aquifers. (PFS 2.1)
- As part of project construction and design, assure that drainage facilities in new development incorporate storm water runoff and sediment control, including state-of-the-art technologies where appropriate and utilization of the *Source Water Protection Guidelines for New Development*. (PFS 2.2)
- In designing water, wastewater, and drainage facilities, limit the disruption of natural landforms and water bodies. Encourage the use of natural channels that simulate natural drainage ways while protecting property. (PFS 2.3)

- Develop active and passive recreational uses within portions of the Otay Valley Regional Park located within the City of Chula Vista, in accordance with the MSCP (Objective PFS 16)
- Continue to actively participate in the planning and development of the Otay Valley Regional Park through implementation of the Otay Valley Regional Park Concept Plan and coordination with the County of San Diego and City of San Diego. (PFS 16.1)
- Pursue federal and State grant funding for the acquisition, development, maintenance, and operation of the Otay Valley Regional Park (PFS 16.2)
- Establish development guidelines and standards for new development projects adjacent to the Otay Valley Regional Park that recognize and protect the natural resources and enhance user experiences of the park.

What follows is an overview of the current area plans that pertain to the Otay River watershed. These area plans are expected to change with the formal approval of the comprehensive update to the General Plan. In fact, revisions are currently being proposed for the Bayfront Specific Plan, as discussed below:

Eastern Territories Area Plan

The Eastern Territories Area Plan covers approximately 37,600 acres, of which 23,400 acres or 62 percent are considered unsuitable for urban development (i.e., reservoirs, steep slopes, mountains, canyons, flood plains). Approximately 90 percent of this unsuitable land falls within the Otay River watershed. The plan defines and delineates the long-term development near the Upper and Lower Otay Reservoirs and Proctor Valley. Proctor Valley is located north of the Upper Otay Reservoir, east of the San Miguel Mountains, west of the Jamul Mountains, and south of the existing unincorporated rural community of Jamul. The Lower Otay Reservoir borders the City of Chula Vista to the east, and it is located approximately in the middle of Otay River watershed. Planned land use development near the Lower Otay Reservoir is further categorized into subregions. Each subregion has restrictions that pertain to allowable land-use development.

Existing Land Use

Approximately 1,300 acres are in existing use, with another 14,200 acres available for land development. Existing urban uses consist of residential developments in scattered areas and industrial developments along Otay Valley Road. There is also an active rock quarrying and crushing operation at the southwest base of Rock Mountain. The Otay Landfill and an inactive hazardous waste landfill are also located in the area. Most of the developable land in Eastern Territories is currently held in a few ownerships, including future phases of EastLake and Sunbow developments. Approximately 60 percent of the planning area is part of Otay Ranch.

Proposed Land Use

Approximately 10,800 acres is proposed for low- to high-density residential land use. Of this total, 9,750 acres (90 percent) are recommended for low and low/medium density single-family detached homes at densities of 0.5 to 3.0 units per acre and 3.0 to 6.0 units per acre, respectively. Proposed commercial land use, consisting of retail and resort, is approximately 690 acres. Proposed industrial use is 819 acres. Proposed public, quasi-public and open space is approximately 25,250 acres. The proposed open space use would decrease from the current total of 34,796 acres to 20,607 acres.

The Eastern Territories Area Plan also identifies a transit route parallel to or within SR-125 from SR-54 southerly to an intersection with the east/west route.

Montgomery Area Plan

The Montgomery Area Plan covers approximately 3.5 square miles in the southwesterly part of the City of Chula Vista. It borders Interstate-5 on the west, "L" street on the north, Interstate-805 on the east and San Diego City limits on the south. The southern portion of Montgomery is located almost entirely within the Otay River watershed.

Montgomery is a low-profile, medium-density, sub-urban community, which is substantially developed. The population in this area is approaching its target buildout of 50,000. It is characterized by its mixed land-use pattern, strip commercial, incomplete infrastructure, and a scarcity of park sites. The area covers approximately 1,769 acres. The residential land use area consists of single family and mobile homes and covers approximately 878 acres. Commercial land use covers approximately 144 acres. Industrial land use covers approximately 309 acres. Public-Quasi Public, golf courses, and vacant and other land uses cover 301 acres.

Montgomery is located on the low coastal plain, which forms the eastern shore of San Diego Bay. Its terrain is gently undulating, with low hills to the north and east, which slope downward to the south and west. The major geographical features of the community are the Otay River and the San Diego Bay. The Otay River is also the southerly boundary of the Montgomery Specific Planning Area. The Otay River separates Montgomery from the South Bay section of the City of San Diego.

Overall, this area of the City is due for significant redevelopment and investment. In the process, many of the historical problems with noxious uses and missing or inadequate infrastructure, including drainage facilities, poor maintenance, and a lack of parks and open space, are likely to be improved through capital improvement plans by the City as well as redevelopment. Additional development and redevelopment are anticipated to increase land coverage and the volume of storm water runoff. However, the addition and improvement of infrastructure meeting current standards is likely to improve the quality of storm water runoff.

Drainage System

Montgomery's drainage system is comprised of the Judson, Palm Road, Southwest, and Telegraph Canyon Creek hydrologic sub-basins. The Judson, Palm Road, and Southwest sub-basins drain into the Otay River. The Telegraph Canyon Creek sub-basin drains directly into San Diego Bay.

Physically, the system consists of unimproved drainage ways, improved open channels, and underground conduits. Surface water runoff generated by severe winter storms sometimes overloads the individual systems, and as a result, some areas of Montgomery are periodically flooded.

Water, Sewer, Drainage, and Lighting Facilities

Storm-drain construction and maintenance in Montgomery will be accelerated and improved. Consequently, flooding potential in the community will decrease. A comprehensive drainage plan and capital improvement program will be prepared for the area.

Environmental Concerns

There are several environmental concerns in the Montgomery area. These include coastal zone protection, air pollution, toxic waste disposal, and protection of wildlife and riparian habitat, and the disposal of waste products from the recycling centers and auto wrecking yards. The Otay River floodplain, which is a major wildlife and riparian habitat, forms the southerly boundary of the project area. It is subject to both federal and State regulations, which severely limit its use. Any specific plan proposal for the floodplain, therefore, must be closely coordinated with the State and federal

authorities. The recycling centers and auto wrecking operations generate non-reusable by-products, which can be environmentally significant. These include battery acid, rubber tires, auto interior trim, oil and, other automotive fluids. The improper disposal of such by-products could pose a serious threat to human life, and to plant and animal life as well.

Conservation and Open Space

The Montgomery Community at the present time has a critical scarcity of public parks. This deficit will need to be addressed in the City's Capital Improvement Program over the next ten-year period.

Vacant, marginal territory located in the Otay River floodplain and its associated wetlands could be used to relieve the present shortage of parkland. Although there are physical and regulatory constraints, which could preclude or impede the use of the floodplain for parks, this area provides the City the best opportunity to reduce the parkland deficit in the Montgomery Community and adjacent territory. It is forecast that the Otay River floodplain will, in fact, be preserved for park and open space purposes.

Bayfront Master Plan and Local Coastal Program

The City of Chula Vista is in the process of revising the existing Bayfront Specific Plan with an updated plan known as the Chula Vista Bayfront Master Plan (CVBMP). The CVBMP is expected to be approved in the first quarter of 2006. The CVBMP planning area is located within the City of Chula Vista, situated on the southeastern edge of the San Diego Bay, and is approximately one and a half miles west of the traditional commercial downtown area (Third Avenue) of the City. The planning area is generally bounded by the Sweetwater Marsh Unit of the San Diego Bay National Wildlife Refuge (NWR), the mouth of the Sweetwater River, and jurisdictional boundary of National City to the north; Interstate 5 (I-5), Bay Boulevard, and commercial development along Bay Boulevard to the east; Palomar Street, the salt evaporation ponds which are included within the South Bay Unit of the San Diego Bay NWR to the south; and San Diego Bay to the west. The proposed planning area encompasses approximately 550 acres, which includes approximately 490 acres of land area and 60 acres of water area. The project area has been divided into three distinct districts – Sweetwater, Harbor, and Otay. The Sweetwater District, approximately 128 acres, includes the northern section between the southern boundary of the Sweetwater Marsh Unit and the South Bay Boatyard (SBBY) site. The Harbor District, approximately 271 acres, includes the central section of the project area between the SBBY and J Street/ Marina Parkway. The Otay District, approximately 149 acres, includes the southern section of the CVBMP study area, between J Street and the former LNG site.

The Otay River watershed overlaps a small area of the southern portion of the planning area within the Otay District. The Otay District includes medium-intensity development and consists of a mix of uses such as residential, general industrial and/or energy/utility zone uses, such as power generation and distribution facilities (relocation of the power plant and switchyard), low-cost visitor-serving recreational uses (such as a recreational vehicle park, a new “South Park,” and other open space areas), an ecological buffer, and new roadways.

The Otay River watershed includes areas in the coastal zone where the Otay River flows into the Pacific Ocean. The CVBMP sets forth requirements for development in the Coastal Zone. The CVBMP implements the City of Chula Vista’s local coast program (LCP). The CVBMP requires that prior to development in the Coastal Zone, the project applicant shall obtain a coastal development permit unless the applicant receives a waiver or the project is exempt from the permit requirement. Pursuant to §19.83.005, a project applicant may receive a waiver for development that is considered de minimis. A proposed development is de minimis if the development involves no potential for any adverse effect on coastal resources.

City of Imperial Beach General Plan and Coastal Plan

The City of Imperial Beach is 4.5 square miles (2,880 acres) in size, of which 19 percent (558 acres) lies within the Otay River watershed. This area is only approximately 0.6 percent of the total acreage of the Otay River watershed and it is almost entirely developed, so land use and development changes within Imperial Beach would have less of an impact on the overall watershed than other jurisdictions.

Adopted in 1994, the City of Imperial Beach General Plan states that the City is almost entirely built-out, with only a few vacant parcels. Within the Otay River watershed, the City of Imperial Beach is 94 percent developed (TAIC, 2004). Therefore, most new development will occur within existing developed areas.

Of the undeveloped lands remaining within the City, most are designated open space, the preservation of which the General Plan highlights as a major goal. The City of Imperial Beach General Plan designates public lands and open spaces throughout its jurisdiction with the intent of conserving water and marine resources, as well as environmentally sensitive habitat areas within the City. Land designated as open space within the Otay River watershed but outside the Imperial Beach city limits includes the San Diego Eastern Arizona Railroad right-of-way, the salt evaporation ponds, the shores of the South San Diego Bay, and the San Diego Bay NWR (City of Imperial Beach, 2004a). The San Diego-Eastern Arizona Railroad right-of-way is located at the northern boundary of the City and is an easement that has potential for becoming a recreational corridor, including bicycle and pedestrian routes. The eastern portion of the railroad right-of-way falls within the Otay River watershed. The salt evaporation pond area east of the city limits is designated open space at the southern end of San Diego Bay and is currently used for salt production. The entire salt evaporation pond-area is located within the Otay River watershed. The shores of the South San Diego Bay, (the South San Diego Bayfront) represent the northern boundary of the City of Imperial Beach and the most northwestern boundary of the Otay River watershed. Almost all of the bayfront has been developed and little of the coastal sage/maritime sage vegetation that once dominated the area remains.

Based on the planned land uses set forth in the City of Imperial Beach General Plan, relatively little change is expected within the City's portion of the Otay River watershed. The planned land use pattern calls for a small increase in commercial uses, and very little change in the amount of land area devoted to other types of land uses. The amount of land area permanently dedicated to residential uses (270 acres) is not planned to change. However, a recent City of Imperial Beach Eco-Tourism Study suggested making some land-use changes to accommodate the birding industry. Furthermore, it recommended a committee be formed to make these changes (City of Imperial Beach, 2005).

City of San Diego Progress Guide and General Plan

The City of San Diego Progress Guide and General Plan guides future development patterns within the City of San Diego, and projects these changing patterns for approximately 20 years after its publication in 1990. Like other large, diverse cities, San Diego is divided into multiple planning areas. Two of these areas fall within the Otay River watershed: Otay Mesa (planned urbanizing[2]) and Otay Mesa-Nestor (urbanized[3]). These communities are subject to policies, ordinances, and other regulations that apply within the City of San Diego for drainage, storm water runoff, and watershed protection.

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[2] Planned urbanizing: Includes land that will be opened for urbanization in a staged, contiguous manner through the orderly extension of public facilities and the provision of housing for a variety of income levels.

[3] Urbanized: Includes the most intensive and varied land uses including office-administrative, financial, residential, and entertainment. Also aims to strengthen the viability of the downtown core through renewal, redevelopment, and new construction.

As described below, both community plans designate the Otay River Valley as open space, and they emphasize maintaining natural floodplain and reclaiming portions of the valley degraded by extractive activities. These areas economically benefit from the extraction of salt from ponds near the mouth of the Otay River. These areas include industrial areas, such as Hollister & Palm, Beyer & Iris, Brown Field, and East Otay Mesa, as well as other economic resources, such as extraction industries. The Progress Guide and General Plan proposes to support the San Diego Unified Port District in its efforts to encourage continuation of the local salt production industry. These community plan areas are subject to the City of San Diego's MSCP, a comprehensive habitat-conservation planning program to preserve an open space network (described in more detail in Section B.6.4). The Multiple Habitat Planning Area (MHPA) of the MSCP delineates core resource areas targeted for conservation. The Otay Valley Regional Park (OVRP) designates an open space core/preserve area that is contiguous with the MHPA boundary. The City of San Diego's MSCP Subarea Plan has specific management policies and directives for the Otay River and Reservoirs. These include protecting sensitive species and their habitats, wildlife corridors, and educational outreach. The Otay Reservoir area is one of the City of San Diego's Cornerstone Lands for a natural open space corridor.

Based on the City of San Diego's current Progress Guide and General Plan, the planned land use changes in the City's portion of the Otay River watershed primarily involve residential, open space/vacant/water, and recreation uses. The General Plan and Progress Guide increases the amount of land currently devoted to permanent residential uses in the watershed from 1,273 acres to 1,493 acres (17 percent increase). The planned land use pattern set forth in the General Plan and Progress Guide would result in a decrease in the amount of land area in the watershed devoted to open space/vacant/water uses from 2,844 acres currently to a planned total of 2,446 acres (14 percent decrease). In addition, more modest changes would occur in land area devoted to non-residential land uses. Commercial land uses would increase from 144 acres in the watershed currently to 186 acres (29 percent increase). Industrial land uses would increase from 314 acres currently to a planned total of 416 acres (32 percent increase).

What follows is an overview of the two community planning areas that overlap the Otay River watershed.

Otay Mesa Community Planning Area

The Otay Mesa Community Planning Area is bordered by the Otay River Valley and the City of Chula Vista on the north, the International Border on the south, I-805 on the west, and the San Ysidro Mountains on the east. The total Otay Mesa Community Planning Area is approximately 20,600 acres.

The Otay Mesa Community Plan was prepared to guide future public and private development through the year 2000, and is currently being updated. The plan includes goals and objectives established for the community, consistent with City-wide policies. The plan sets forth proposals for implementation, and does not establish new regulations or legislation.

Guidelines

The Otay Mesa Community Plan includes land use guidelines for plan implementation. The guidelines consider the physical form and natural resources for the planning area, especially the physical landform of the mesa. These guidelines are aimed at carrying out the overall objectives of the community plan. Land Use elements with specific guidelines include:

- Residential Communities and Housing
- Industrial

- Future Growth Areas
- Open Space
- Parks

Residential Communities and Housing

The Otay Mesa Community Plan recommends a mixture of housing types including mobile home parks, multi-family units, garden apartments, condominiums and townhouses, and the incorporation of Planned Residential Development (PRD) zoning overlays. The following guidelines are established with this community plan:

- Preserve privacy and views; avoid unstable soil areas subject to liquefaction, slippage, or earthquake faults;
- Encourage the clustering of housing to preserve maximum amount of open space;
- Encourage development easterly of the I-805;
- Develop the area north of SR-117 (now I-905) and westerly of Dennery Road with a mix of housing types, protecting views and avoiding areas with unstable soils.

Industrial

The revised Industrial element of the Progress Guide and General Plan was adopted by the City Council on July 25, 1979, Resolution No. 221450, and allocates in excess of 3,000 acres to industrial park use in the Otay Mesa area. There are currently several automobile-dismantling yards operating under Conditional Use Permits. All other existing industrial activity in the area is located within Brown Field and is generally associated with the airfield. All industrial proposals are located south of Brown Field, which is south of the Otay River watershed. Although there is no proposed industrial development in the Otay River watershed, the following guidelines for industrial development would apply if there were:

- Each individual proposed industrial development shall require a Planned Industrial Development Permit; and,
- Provide for the proper buffering of land uses, being especially careful at the interface of industrial uses and open space.

Future Growth Areas

Approximately twenty-five percent of the Otay Mesa Community Planning Area is allocated for future growth. This area lies easterly of Brown Field and extends to the foot of the San Ysidro Mountains. Farms are currently located in this area. Although only a small portion of the proposed Future Growth Area lies within the watershed, the following guidelines would apply for development:

- Retain agriculture until development is warranted;
- Review the plan periodically in light of any new circumstances and propose land use adjustments;
- Promote the continuation of agriculture and support soil conservation programs.

Open Space

Open space will provide for a necessary relief in the continuous form of urbanization within the community. Open space can serve as wildlife and biological preserves, provide natural drainage areas, define neighborhood space, and provide additional recreation area. Open space land use guidelines include:

- Open spaces should be maintained in their natural state and future uses should be compatible with the open space concept (hiking, horseback riding, sightseeing, etc.);

- Trails should be developed within the open space corridors linking the community's activity centers with the neighborhoods and the Lower Otay Park;
- At points where streets or other development traverse open space corridors, provisions should be made to provide for a continuous open space linkage; and,
- Transition areas should be established between urban areas and open space areas, along traffic corridors and canyon overlooks, where considered appropriate.

Parks

Development of the OVRP is planned within the Otay River watershed to ultimately link San Diego Bay to the Otay Lakes to provide recreational and educational opportunities for community and regional visitors. The OVRP will ultimately run through a portion of the Otay Mesa Community Planning Area.

The following guidelines are established for the development of parks:

- Encourage the development of private as well as public recreational facilities;
- Designate, dedicate, and develop the neighborhood and community parks in accordance with General Plan guidelines.

The City is currently evaluating and writing a comprehensive update of the Otay Mesa Community Plan. City staff anticipates that the update will be completed in summer 2006. A number of alternatives are being considered, and if approved in totality, would introduce approximately 20,000 additional dwelling units, some of which could be located in areas designated for commercial and industrial development in the current community plan.

Otay Mesa-Nestor Community Plan

The Otay Mesa-Nestor Community Planning Area is located in the southern region of the City of San Diego. The area is bordered on the north by the City of Chula Vista, on the east by the community of Otay Mesa, on the south by the Tijuana River Valley and the San Ysidro community, and on the west by the City of Imperial Beach. The Otay and Tijuana River valleys define the northern and southern boundaries of the planning area, respectively, and are characterized by wetlands and riparian habitats influenced by seasonal rains and stream flow. The community extends about a mile and a half from north to south and four miles from east to west, and totals approximately 4,500 acres.

The community is approximately 95 percent developed, which may represent limitations on applying natural resource-focused principles to future development. Otay Mesa-Nestor is an urbanized community, with over 57 percent of the planning area (excluding the area that supports the salt ponds) covered with residential land uses (estimated 17,000 units). Approximately 5 percent of the land use within the planning area is commercial use and 3 percent of the plan area is comprised of industrial uses. Approximately 20 percent of the planning area supports schools, parks, transit, and other public facilities; and vacant, undeveloped, agricultural, and mineral extraction and processing uses comprise the remaining 15 percent (http://www.sandiego.gov/planning/profiles/otaynestor.shtml).

Approximately 20 percent of this community is located within the coastal zone. In conjunction with the Local Coastal Program (LCP), the Otay Mesa-Nestor Community Plan (May 1997) brings the City's planning process into conformance with the 1976 Coastal Act. The community plan includes planning and development recommendations and guidelines to protect and preserve the State's coastal resources.

The Otay Mesa-Nestor Community Plan is also a component of the City's Progress Guide and General Plan. The Otay Mesa-Nestor Community Plan was created with the intent to serve as a guide for the future development and improvement of the Otay Mesa-Nestor Community Planning Area. The

community plan provides specific strategies to implement many of the goals, guidelines, and standards of the General Plan. The strategies set forth in this plan would be incorporated within all development activities involving this planning area.

Specific topics related to undeveloped land in the Otay River watershed area include:

- OVRP
- Salt Ponds
- Drainage and Flood Control.

OVRP

A portion of the community plan area is within the area proposed for the OVRP. This area is designated as open space on the community land use map. With the approval of the OVRPCP, the OVRP is designated as a Resource-Based Park. Design of future development is intended to be oriented towards and to enhance adjacent natural open space. The following design guidelines would apply to all development within or adjacent to the Otay River Valley:

- Where new public or private streets are proposed or required in projects adjacent to existing or planned open space, development shall incorporate single-loaded streets adjacent to open space;
- Provide trails and trail access through or adjacent to the Otay Valley.

Because the Otay Mesa-Nestor Community Plan is consistent with the General Plan, development of the OVRP would occur in accordance with the regulations regarding development in a watershed area as set forth in the General Plan.

Salt Ponds

The South Bay Salt Works' salt production operations in south San Diego Bay and adjoining areas provide community and regional economic, open space, wildlife habitat, and historic value. The environments located in these areas provide nesting and feeding areas to local and migratory birds, and breeding grounds for many varieties of marine life. Several federally listed threatened and endangered species inhabit this area. In 1999, subsequent to the approval of the Otay Mesa-Nestor Community Plan, the majority of the salt ponds were acquired for inclusion in the South San Diego Bay Unit of the San Diego Bay NWR. The South Bay Salt Works now operates under Special Use Permit from the USFWS and a lease from the San Diego County Regional Airport Authority.

The salt plant and several of the ponds are outside the boundaries of the NWR. Development of these areas would be regulated by the land uses designated for them in the Otay Mesa-Nestor Community Plan. The land use designation is currently Open Space/Special Study Area. Any change of use of this site would require analysis as part of the Special Study. Resource preservation and park improvements are ongoing and are required to be consistent with the OVRP, MSCP and NWR planning and acquisition activities. The Special Study Area should become wholly or partially included in the OVRP, the MSCP Preserve, or the San Diego Bay NWR. Those areas included should be restored and managed as natural resource areas, regional recreational areas, or as part of the salt production industry. Those areas not included should be used in ways that promote development and economic revitalization of the community.

Drainage and Flood Control

Otay Mesa-Nestor is located between two major drainage systems, the Otay River and The Tijuana River. During heavy rains, both of these rivers are prone to flooding. Properties have been damaged as

a result of periodic flooding. A third smaller drainage system, Nestor Creek/Channel, located in the community, is also prone to flooding.

Future land use designations for these flood-prone areas is proposed as open space or public facility. The Plan calls for the application of appropriate zoning and land use designations in these three drainage basins, and calls for the improvement of Nestor Creek/Channel from its source at Lauriston and Paxton Drives to the point where it drains into the Otay River. The Plan calls for the rezoning of all areas prone to flooding to Floodplain Fringe (FPF) or Floodway (FW) zones.

General Plan Update

In 2002, the City Council added the Strategic Framework Element to the General Plan, which guides the first comprehensive update of the General Plan since 1979 under a companion five-year action plan, including future community plan updates and amendments. The Strategic Framework Element offers new policy directions in the areas of (among others) urban form and conservation that, when finalized and adopted, may be complementary to the goals and polices of the ORWMP. It shifts the focus of General Plan policies from developing undeveloped land to revitalizing existing communities, thereby significantly limiting development in vacant areas and providing for the preservation of large tracts of open space within the watershed. Referred to as the City of Villages strategy, this approach is intended to improve existing communities by combining housing, commercial, employment centers, schools and civic uses together in areas where a high level of activity already exists. It also seeks to connect villages through an improved transit system. This development strategy contrasts with an "urban sprawl" approach in which much of the new development extends into previously undeveloped or low-activity areas.

San Diego County

San Diego County General Plan. The San Diego County General Plan applies to the unincorporated areas of San Diego County, which constitute nearly three-quarters of the Otay River watershed. Of this, nearly two-thirds is designated Open Space. The Open Space Element of the General Plan focuses on any parcel or area of land or water that is designated on a local, regional, or State open space plan for the preservation of natural resources; managed production of resources, including agriculture; outdoor recreation; or public health and safety (San Diego County, 2002). The Open Space Element intends to:

- Promote health and safety by regulating development of lands
- Conserve scarce natural resources and lands needed for vital natural processes and the managed protection of resources
- Conserve open spaces needed for recreation, education, and scientific activities
- Encourage and preserve those open space uses that distinguish and separate communities

One-third of unincorporated San Diego County lands within the Otay River watershed are either developed or available to development in accordance with the San Diego County General Plan. Overall, the General Plan guides patterns of development and coordinates changing land uses to ensure orderly and logical conversion of land uses. Land development within the County portion of the watershed is also subject to the Biological Mitigation Ordinance (BMO), which implements the MSCP in the unincorporated areas (described in more detail in Section B.6.4); the Watershed Protection Ordinance (WPO) (Section B.5), which regulates development impacts to water quality and quantity within the watershed and effectively implements the 2001 San Diego Region Municipal Permit; and the Resource Protection Ordinance (RPO), which seeks to protect natural resources by limiting impacts to wetlands, wetland buffers, floodways, floodplains, steep slopes, sensitive habitat lands, and significant prehistoric and historic sites (Section B.5).

Based on the County of San Diego's current General Plan, the amount of land area in the unincorporated portion of the Otay River watershed in residential use will increase substantially. Currently, there are about 4,325 acres of unincorporated land in permanent residential use. The current General Plan designates about 29,654 acres of land for residential use in the unincorporated portion of the watershed. This substantial increase (586 percent) in residential use and smaller increases in non-residential urban uses would result in significant reductions in unincorporated areas currently used for agriculture or open space/vacant/water area.

San Diego County has been involved in a comprehensive update of their General Plan since August 1998. General Plan 2020 (GP 2020) presents an opportunity to integrate goals and policies that offer new direction in the areas of land use and conservation. The end product is intended to protect the environment, accommodate population growth, and link that growth to the provision of required facilities and services. More specifically, GP 2020 emphasizes future growth within the County to areas where development is present (currently lands designated as Rural Towns), allowing for greater conservation of large parcels of rural lands and natural resource and open space areas. Within the Otay River watershed, lands designated residential, estate residential, and agricultural will remain so under the GP 2020 as rural and semi-rural lands, allowing 1du/acre to 1 du/80 acres and concentrating growth in areas where development and public services are intended by the General Plan. A large portion of land within the unincorporated portion of the watershed is owned by the Bureau of Land Management (15.5 percent) and will remain in federal ownership into the foreseeable future, allowing for continued management and utilization of the land for livestock grazing, resource conservation, and recreation.

The Jamul-Dulzura Subregional Plan and Otay Subregional Plans implement the goals and policies of the General Plan within the County portion of the Otay River watershed. The Subregional Plan areas are subject to the County's MSCP (Section B.6), which is aimed at the regional conservation of habitat for creation of an interconnected open space network. A portion of the County lands occur within the OVRP (Section B.6), which designates combined open space/core areas and recreation areas, and represents policy direction for coordinated land acquisition and development for a Regional Park within a framework of private property rights. The Jamul/Dulzura Subregional Plan encompasses approximately 168 square miles, from south of Loveland Reservoir and the Sweetwater River, to north of the international border, and east of the Rancho San Diego land development project. Approximately 40 percent of this subregion plan falls within the Otay River watershed. The plan contains land-use policies that describe specific requirements for development within the watershed, and it designates specific planning areas, historical sites, and resource conservation areas (RCAs) in other to achieve sustainable growth (San Diego County, 2002).

The Otay Subregional Plan aims to protect RCAs within its planning area, including vernal pools, endangered plants, and golden eagle habitat area. For this, it has developed preservation methods that focus on sensitive areas and other special areas designations. In addition, the plan intents to work with the private sector in capitalizing on the unique development opportunities existing near the Mexican border, while concurrently encouraging interim agricultural production that is economically feasible. The Otay Subregional Plan applies to the south-central portion of Otay River watershed.

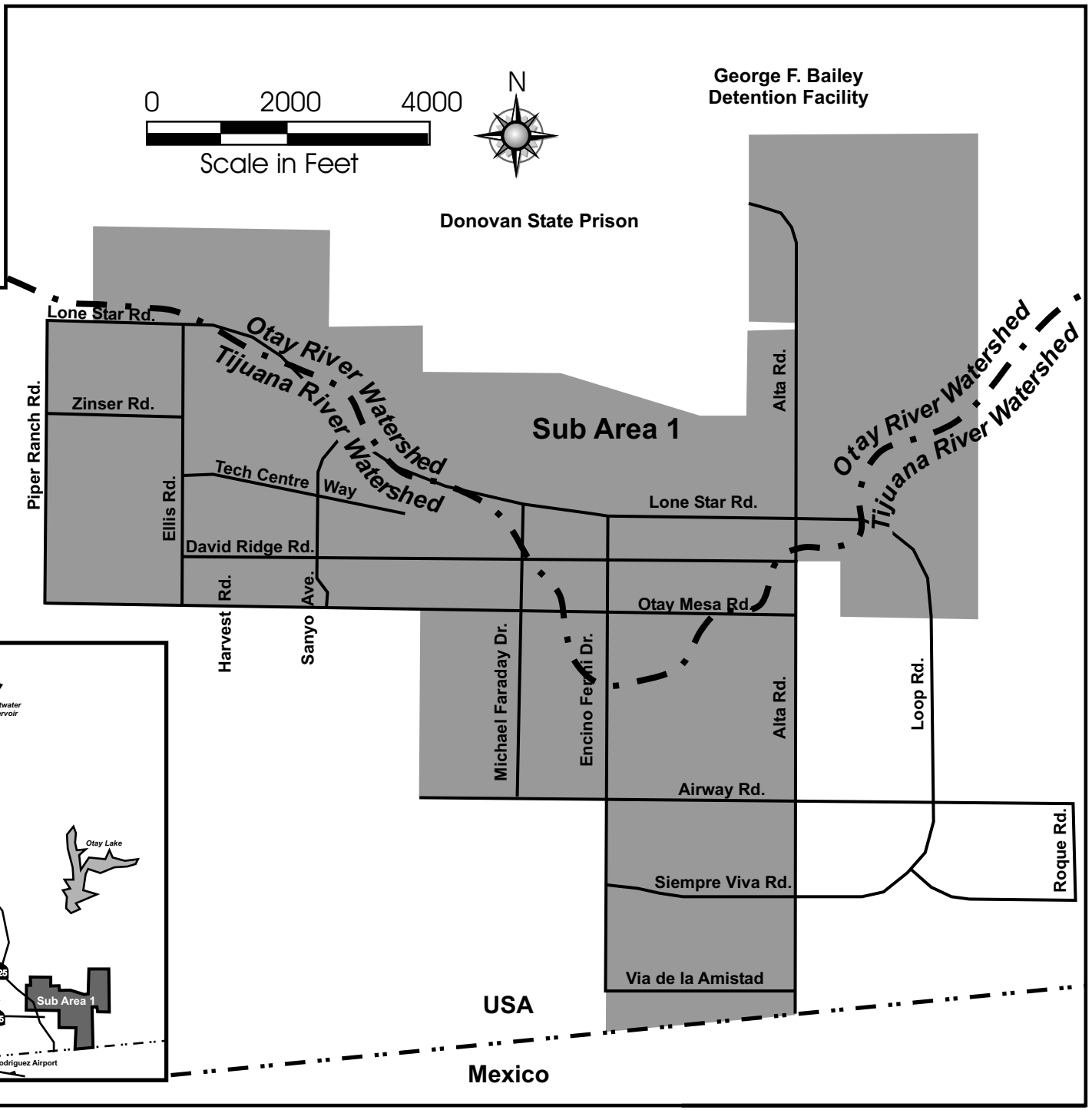
East Otay Mesa Specific Plan Sub Area 1. The northern half of the East Otay Mesa Specific Plan Subarea 1 falls within the Otay River watershed. This specific plan covers approximately 2,007 acres in the southwestern portion of San Diego County, much of which falls within the Otay River watershed, and it is immediately adjacent to the U.S./Mexico border (Figure B.3-4). The site is located to the south of the Otay River Valley, north of the international border with Mexico, west of the East Otay Mesa Sub Area 2 and the San Ysidro Mountains, and east of the City of San Diego's 12,505-acre Otay

Otay River Watershed Management Plan

Figure B.3-4

East Otay Mesa Subarea 1 Project Location

Aspen Environmental Group



Mesa Community Plan Area. The area consists of a relatively flat mesa with steep mountainous area on the eastern edge and a major river valley and tributary canyon to the north. The flatter portions are predominantly native and non-native grasslands, while the steeper areas have not been developed.

East Otay Mesa Specific Plan Subarea 1 is primarily within a minor amendment area of the County's MSCP. Most of the Subarea 1 minor amendment area is covered by non-native grasslands habitat, an MSCP Tier III low sensitivity habitat that requires a 0.5:1 mitigation ratio for impacts. Other amendment areas within Subarea 1 include major amendment areas and minor amendment areas with special considerations. Major amendment areas are mostly located in the hilly eastern portions of the Specific Plan; these are areas where the most sensitive biological resources are known to occur. Minor amendment areas with special considerations are transitional areas between the major and minor amendment areas where there is a higher likelihood of sensitive biological resources. For lands designated major and minor amendment areas with or without special considerations, the County's Take Authorizations do not apply until the amendment process has been completed. All amendments must conform to the MSCP and Subarea Plans.

Minor amendment properties contain habitat that could be partially or completely eliminated (with appropriate mitigation) without significantly affecting the overall goals of the County's Subarea Plan. Minor amendment properties must meet the criteria and achieve the goals for linkages and corridors as described in Sections 4.2.1 and 4.2.2 of the Metro-Lakeside-Jamul Segment of the County's MSCP Subarea Plan and provide mitigation consistent with the Biological Mitigation Ordinance. Minor amendments under County jurisdiction within the Lake Hodges and South County Segments require the approval of the Service's Field Office Supervisor and the California Department of Fish and Game's (CDFG's) NCCP Program Manager.

The East Otay Mesa Specific Plan Sub Area 1 intends to guide the development and use of all lands within the planning area in order to provide a major technological and industrial center for the region by defining standards for the density of population and intensity of development for each designated land use. The current uses of the East Otay Mesa Specific Plan Sub Area 1 include a few scattered single-family residences, a State Truck Inspection facility, a 150-foot-wide Border Enforcement Zone immediately adjacent to and paralleling the border, and an auto storage/auction yard (San Diego County, 2002).

In addition, the East Otay Mesa Specific Plan SubArea 1 Conservation Element aims to protect sensitive environmental resources and establish a system of open space for conservation, recreation, and aesthetic purpose. The Specific Plan Area contains a variety of habitats, some of which are biologically sensitive, including vernal pools, Diegan coastal sage scrub, and riparian areas. Much of these sensitive habitats are located in the hilly eastern portion of the Specific Plan and in the southern portion of along the international border with Mexico.

San Diego Unified Port District - Port Master Plan

The Port Master Plan provides the official planning policies for the physical development of the tidelands and submerged lands conveyed and granted in trust to the SDUPD. The SDUPD owns and exclusively controls approximately 167.4 acres near the outlet of the Otay River watershed (Figure B.3-3).

The Port Master Plan identifies various permitted land uses, including commercial, industrial, public recreation, military, public facilities, and circulation and navigation. In addition, the plan identifies conservation areas, including wetlands, estuaries, salt ponds, and habitat replacement areas to further protect the natural resources of the region. The plan contains conservation planning sub areas, which

include the Wildlife Preserve, the Coronado Salt Pond, the Otay River Inlet, and the South Bay Salt Ponds (i.e., the same salt evaporation pond area referred to under the City of Imperial Beach discussion above). Through the Port Master Plan, these areas are further protected, allowing for further guidance on the development and use of land within and adjacent to the San Diego Unified Port District.

The SDUPD, in conjunction with the U.S. Navy, sponsored the preparation of the San Diego Integrated Natural Resources Management Plan (INRMP) (September 2000), also known as the Bay Ecosystem Plan (Figure B.3-5). The plan's goal is to ensure the long-term health, recovery, and protection of San Diego Bay's ecosystem, in concert with the Bay's economic, Naval, recreational, navigational, and fisheries needs. While it is specific to San Diego Bay, it recommends Watershed Management Strategies for the Otay River watershed, Sweetwater River watershed, and several smaller watershed basins affecting the Bay. The plan was developed with an understanding that the conditions of the watersheds contributing to the San Diego Bay also affect the health of the Bay itself. Through this approach, it establishes baseline conditions for the identification of sound management strategies in the Bay and portions of the contributing watersheds (the portions of the watersheds directly linked to the Bay's resources). It also facilitates a more comprehensive understanding of the cumulative effects resulting from specific actions.

This plan recommends protecting and restoring ecosystem processes and several habitat types, including intertidal flats, salt marsh, salt ponds (the salt ponds at the south end of San Diego Bay), and stream/river mouths for better corridor connectivity. For the Otay River watershed, there is a recommendation to enhance the interconnections between the South Bay salt ponds and the nearby salt marsh and mud flat habitats. The wetlands in the lower Otay River are also recommended enhancement areas. Moreover, there is a recommendation to restore the ecological functioning of the Otay River's 100-year floodplain.

Multijurisdictional Plans

Otay Ranch General Development Plan/Subregional Plan

The Otay Ranch General Development Plan (GDP)/Subregional Plan (SRP), approved by the County of San Diego and the City of Chula Vista on October 28, 2003, serves as a comprehensive plan for overall development of the Otay Ranch area, which covers approximately 22,900 acres (Figure B.3-6). Otay Ranch is divided into three planning areas or parcels, which include the Otay River Parcel, the Proctor Valley Parcel, and the San Ysidro Parcel. Approximately 13,662 acres of Otay Ranch lie within the unincorporated area of San Diego County, 8,856 acres within the City of Chula Vista, and the remaining 386 acres lying within the Otay Mesa portion within the City of San Diego. The 2,900-acre areas surrounding and including the Otay Lakes is owned by the City of San Diego. The GDP/SRP governs land development patterns for the area and sets forth policies in response to requirements of the City of Chula Vista and the County of San Diego. The GDP is contained within the Otay Subregional Plan, which is in turn, a part of the County of San Diego General Plan. The Plan sets forth guidelines for the development of residential, mixed-use, and commercial uses, integrated with transit and open space within the boundaries of Otay Ranch. Additionally, the GDP addresses individual issue areas with respect to Otay Ranch including: Land Use, Mobility, Housing, Air Quality, Safety, and Noise.

The majority of Otay Ranch lies within the Otay River watershed. The Otay River Parcel supports a number of drainages, with the Otay River Valley being the major valley. Telegraph Canyon, which is not in this watershed, and Poggi Canyon flow to the west from the Otay River parcel; however, they do not flow to the Otay Valley within the Otay Ranch property. To the east, the Parcel is bounded by the Salt Creek Canyon. The westerly portion of the Proctor Valley Parcel drains to the Upper Otay

Otay River Watershed Management Plan

Figure B.3-5

San Diego Bay Habitats as Identified in the San Diego Bay Integrated Natural Resources Management Plan

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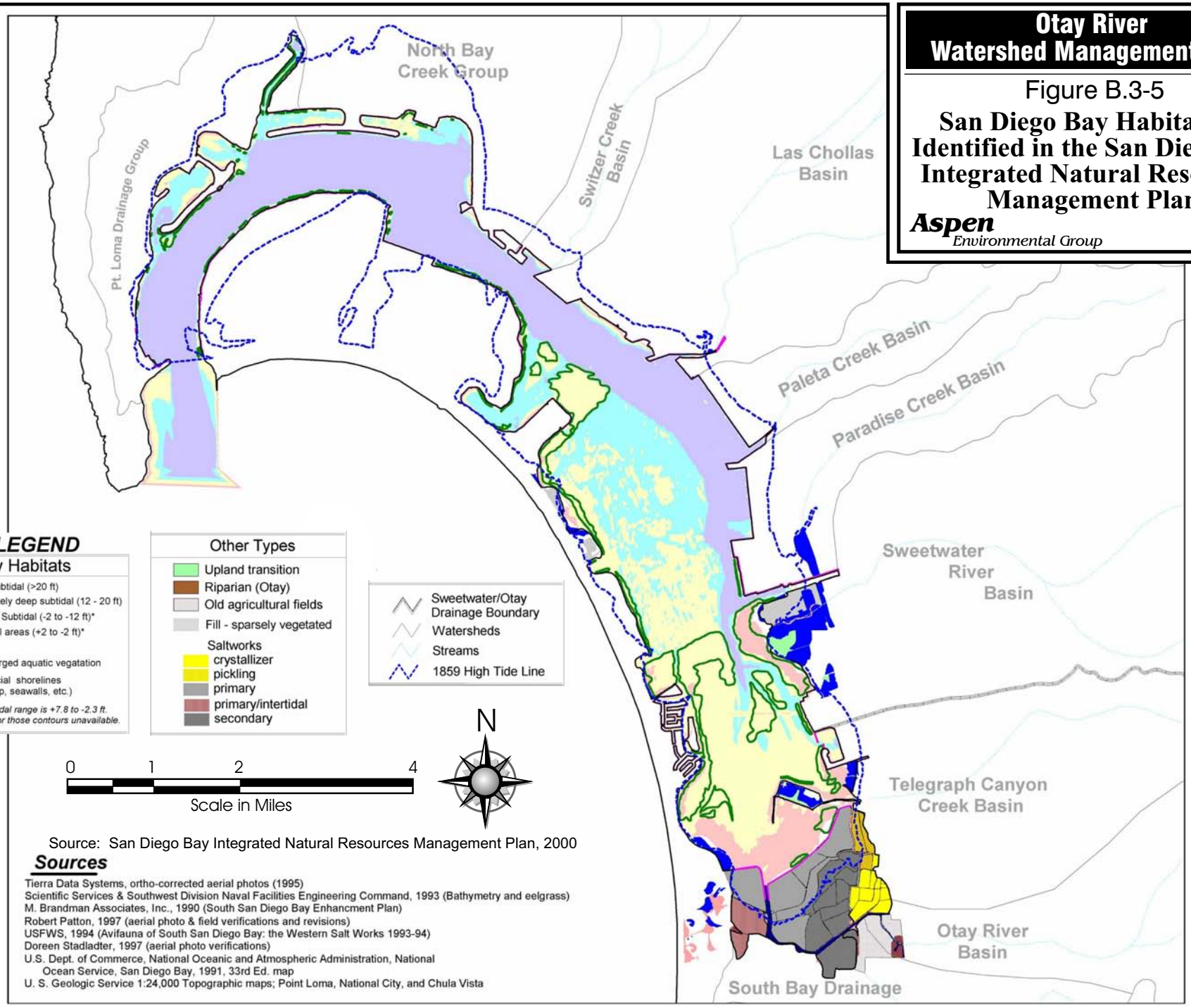
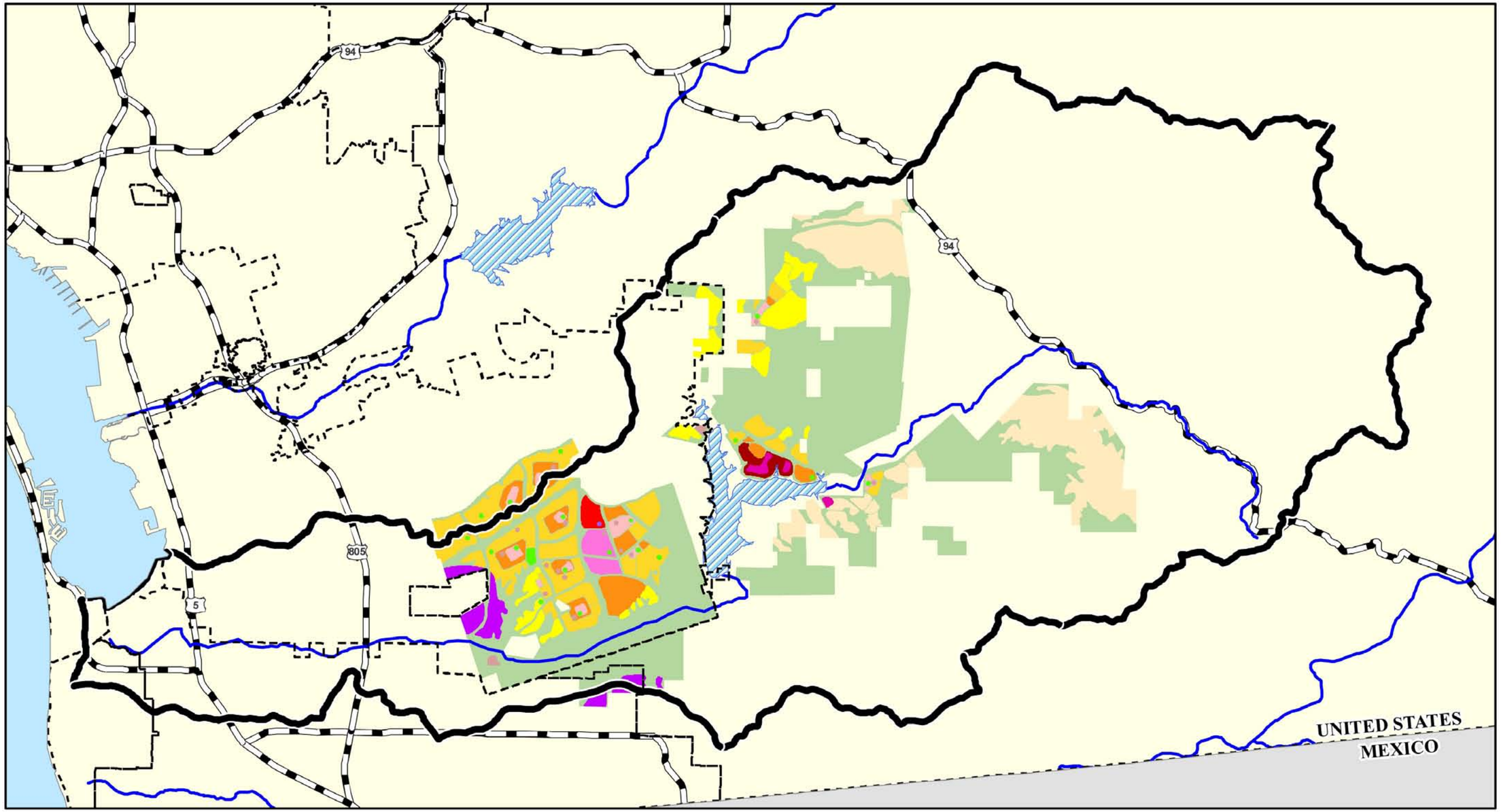


Source: San Diego Bay Integrated Natural Resources Management Plan, 2000

Sources

Tierra Data Systems, ortho-corrected aerial photos (1995)
Scientific Services & Southwest Division Naval Facilities Engineering Command, 1993 (Bathymetry and eelgrass)
M. Brandman Associates, Inc., 1990 (South San Diego Bay Enhancment Plan)
Robert Patton, 1997 (aerial photo & field verifications and revisions)
USFWS, 1994 (Avifauna of South San Diego Bay: the Western Salt Works 1993-94)
Doreen Stadladter, 1997 (aerial photo verifications)
U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, San Diego Bay, 1991, 33rd Ed. map
U. S. Geologic Service 1:24,000 Topographic maps; Point Loma, National City, and Chula Vista



Legend

- VERY LOW RESIDENTIAL
- LOW DENSITY RESIDENTIAL
- LOW-MEDIUM DENSITY RESIDENTIAL
- LOW-MEDIUM VILLAGE DENSITY RESIDENTIAL
- MEDIUM DENSITY RESIDENTIAL
- MEDIUM-HIGH DENSITY RESIDENTIAL
- MIXED USE
- EAST URBAN CENTER
- RESORT
- FREEWAY COMMERCIAL
- INDUSTRIAL
- PARK AND RIDE
- PARK
- PUBLIC/QUASI-PUBLIC
- OPEN SPACE
- SPECIAL RESOURCE STUDY AREA

N

Basemap Legend

- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes

0 1.25 2.5 5
Scale in Miles

Source: TAIC, 2004

Otay River Watershed Management Plan

Figure B.3-6

Otay Ranch General Development Plan Area

Aspen Environmental Group

Reservoir and the easterly portion flows to the Lower Otay Reservoir. The San Ysidro Parcel largely drains to the north to Dulzura Creek, which ultimately drains to the Lower Otay Reservoir. In addition, a portion of this parcel drains directly to the Lower Otay Reservoir.

Otay Ranch Facility Implementation Plan. While the Otay Ranch GDP/SRP guides land development within Otay Ranch, the Otay Ranch Facility Implementation Plan (FIP) provides a framework for development of public facilities and services to support and allow for the continued development of Otay Ranch. The FIP addresses a number of issue areas pertaining to the development of public facilities and services within Otay Ranch, of which the following were found to be potentially applicable to the development in the Otay River watershed: drainage facilities; urban runoff facilities; water reclamation facilities; and parks, recreation, and open space facilities.

The Otay Ranch FIP examines each issue area and establishes thresholds, goals, objectives, policies and standards to guide implementation of needed facilities for the Otay Ranch area.

Otay Ranch Resource Management Plan. As noted, the Otay Ranch consists of three distinct planning areas or parcels (Otay River, Proctor Valley and San Ysidro) mostly within the Otay River watershed, totaling 22,899 acres. The Otay Ranch Resource Management Plan (RMP) is a comprehensive planning document that addresses the preservation, enhancement, and management of sensitive natural and cultural resources within a conservation area (Preserve) to be established on these parcels. The three key elements of the plan are (1) resource protection and management; (2) research; and (3) public education and appreciation. The open space system originally envisioned consisted of 11,375 acres of preserve, in addition to “restricted development” areas and parks. Through negotiations and acquisitions of lands for open space previously slated for development, the total amount of open space to be preserved now exceeds 12,500 acres.

The key objectives of the Otay Ranch RMP include protection, restoration, enhancement, and management of sensitive resources. The RMP establishes a standard of no net loss of wetland quality or quantity, requires that at least 90 percent of identified wetlands be included within the Preserve (with most of the remainder to be protected as non-Preserve open space), and specifies minimum conservation percentages and buffer distances for certain habitat types. Within the 9,618 acre Otay River Parcel, 3,000 acres is designated as Preserve with the exception of 400 acres active recreational use within the OVRP. Furthermore, the RMP calls for restoration of wetland and riparian habitat to be concentrated in the Otay River Valley. To protect the Preserve, the Preserve Owner/Manager (POM) is authorized to prohibit uses within the Preserve that have a negative effect on sensitive resources and to review and comment on proposed uses on Otay Ranch adjacent to the Preserve. Land within Salt Creek and a portion of Otay Ranch has been conveyed to the POM. Pending Irrevocable Offers of Dedication (IODs) will also be dedicated to the POM. A short-term management plan is in place, and a long-term management plan is in preparation.

Otay River Watershed Special Area Management Plan

Recognizing the need for more comprehensive planning in this watershed, a resolution by the United States House of Representative's Committee on Public Works authorized the Corps to initiate a Special Area Management Plan (SAMP) within the Otay River watershed. A SAMP is a management tool intended to achieve a balance between aquatic resource protection and economic development and promote the resolution of conflicts between aquatic resource conservation and those development and infrastructure projects affecting aquatic resources in a coordinated process with federal, State, and local agencies, and local stakeholders.

CDFG also recognizes the need for a management tool that will achieve comprehensive aquatic resource protection in this watershed. In order to achieve this, the CDFG is developing an analogous process known as the Master Streambed Alteration Agreement (MSAA) to address aquatic resource issues from the perspective of the State of California.

The broad goals of the SAMP/MSAA provide for comprehensive management of aquatic resources and increase regulatory predictability for development and infrastructure projects that may impact aquatic resources. The SAMP/MSAA involves an evaluation of the extent and condition of existing aquatic resources and an analysis of the direct, indirect, and cumulative impacts to aquatic resources from a reasonable array of development and management alternatives within the study area. Toward this end, the Corps' Cold Regions Research and Engineering Laboratory (CRREL) and Engineer Research and Development Center (ERDC) and have been conducting studies to delineate at the planning level the locations and integrity of aquatic resources in this watershed (*Planning Level Delineation and Geospatial Characterization of Aquatic Resources for Otay Watershed, San Diego County, California* by ERDC and CRREL; *Assessment of Riparian Ecosystem Integrity: Otay River Watershed, San Diego, California* by ERDC). Substantial data already exist for vernal pools in this region.

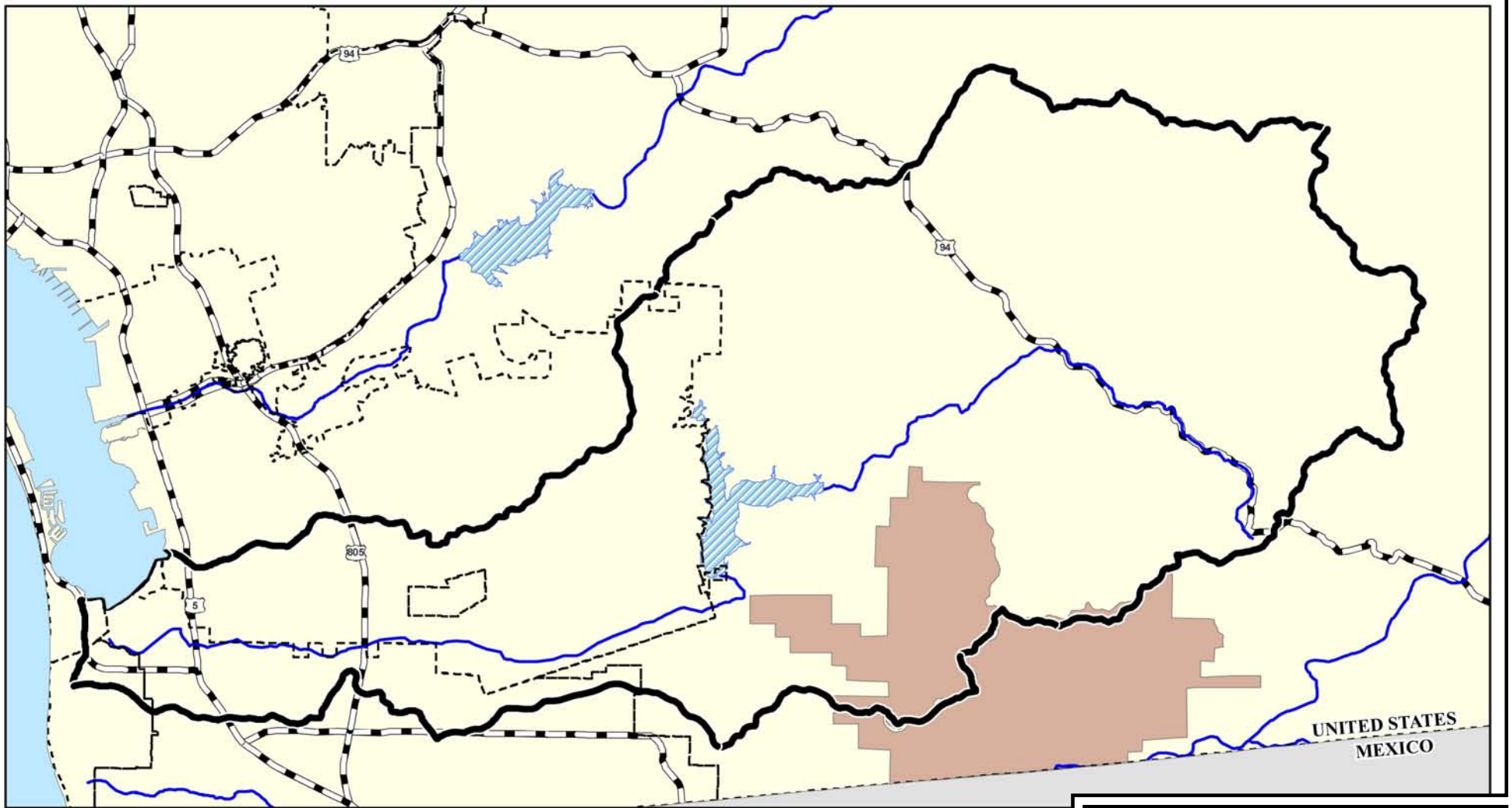
The systematic permitting procedures resulting from the SAMP/MSAA are based on the analysis of opportunities for avoidance, minimization, and compensation for impacts to the aquatic resources at both the watershed scale and project level. The SAMP/MSAA provides for preservation, enhancement, and restoration of aquatic resources, while allowing economic activities and development within the study area through advanced planning. The aquatic resource management program would complement and enhance existing conservation efforts within the watershed, establish compensatory mitigation requirements for proposed projects consistent with the SAMP/MSAA, and implement an adaptive resource management and monitoring program. In coordination with the existing MSCP and the ORWMP being prepared, the goal of this process is a comprehensive natural resource management program that would provide for protection of both aquatic resources and upland natural resources. Finally, the SAMP provides a platform for the tiering of future NEPA compliance on specific actions within the study area, and the MSAA also provides a platform for the tiering of future CEQA compliance on specific actions within the study area.

Federal Agency Plans

Bureau of Land Management South Coast Resource Management Plan

The Bureau of Land Management (BLM) South Coast Resource Management Plan (SCRMP), approved in May 1994, documents where and how the BLM plans to administer approximately 296,000 acres of public lands under its jurisdiction in the five-county South Coast Planning Area. The San Diego County Management Area encompasses approximately 65,000 acres of BLM land and an additional 74,000 acres where the BLM holds mineral rights, including lands in the vicinity of Otay Mountain (Figure B.3-7).

The SCRMP attempts to strike a balance between the protection of sensitive resources and open space values with other potential uses (in the case of the SCRMP, recreation, grazing, and mineral development). In 1991, the BLM and other agencies signed a memorandum of understanding intended to promote interagency cooperation in development of plans to preserve biological resources. On March 21, 2005, the BLM Palm Springs-South Coast Field Office published a Notice of Intent in the Federal Register to prepare an amendment to the SCRMP with an associated environmental assessment (EA) or, if needed, an environmental impact statement (EIS) for BLM-administered public lands in the Border Mountains portion of the San Diego County Management Area. The plan amendment proposes to establish management guidelines for lands acquired since 1994 and designate a route of travel network.



Legend

- BLM Wilderness Study Area
- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes

Source: TAIC, 2004

N

0 1.25 2.5 5

Scale in Miles

Otay River Watershed Management Plan

Figure B.3-7

BLM's South Coast Resource Management Plan Area in the Otay River Watershed

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This planning activity encompasses approximately 60,000 acres of federally managed public land, including the Otay Mountain Wilderness, the Hauser Mountain Wilderness Study Area, the Kuchamaa Area of Critical Environmental Concern (ACEC), and the McAlmond Canyon/Hauser Mountain Wildlife Management Area.

The BLM has been, and is anticipated to continue to be, an active participant in multi-agency planning initiatives for protecting natural diversity while promoting sound economic development. In the "Border Mountains" area, south of Interstate 8, a major objective is to consolidate public land ownership and improve management by using natural corridors, such as canyons, to connect the BLM parcels in the area, and by acquiring privately held in-holdings.

San Diego NWR Complex Comprehensive Conservation Plans

San Diego Bay NWR, South San Diego Bay Unit – Comprehensive Conservation Planning Process. The South San Diego Bay Unit includes the salt evaporation ponds at the south end of the San Diego Bay, portions of the south bay's open water areas, and the portion of the Otay River and associated floodplain west of Interstate 5 (Figure B.3-8). Of the 3,940-acre approved acquisition boundary, the USFWS currently has management authority over approximately 2,300 acres. The Land Protection Plan (LPP), approved in January 1999, established the acquisition boundary and outlined the various habitat protection methods to be used by the USFWS, including leases and cooperative agreements, conservation easements and fee title acquisition from willing sellers (USFWS, 1999). In addition, the USFWS has prepared a Draft Comprehensive Conservation Plan (CCP) and Environmental Impact Statement (July 2005) for the South San Diego Bay Unit. The purpose of the CCP is to describe the desired future conditions of the NWR by setting the long-term vision for the NWR. When approved, the CCP will also provide guidance for how the NWR should be managed for the next 15 years. The wildlife and habitat management goals of the CCP include protecting, managing, enhancing, and restoring open water, coastal wetlands, and native upland habitats; supporting the recovery and protection efforts for listed and sensitive species; and providing high quality foraging, resting, and breeding habitat for colonial nesting seabirds, migratory shorebirds and waterfowl, and salt marsh-dependent species.

The Draft CCP/EIS encompasses both the Sweetwater Marsh Unit and the South San Diego Bay Unit of the San Diego Bay National Wildlife Refuge. Of these, only the South San Diego Bay Unit is within the scope of the ORWMP. The CCP/EIS includes several proposals for habitat enhancement and restoration in the form of management alternatives, including restoration of the western extent of the Otay River floodplain.

San Diego NWR, Otay-Sweetwater Unit - Land Protection Plan. The approved acquisitioin boundary for the Otay-Sweetwater Unit encompasses approximately 52,080 acres of land (Figure B.3-8), of which approximately 8,400 acres have been aquired as of the end of 2005. The acquisition boundary stretches from Loveland Reservoir along the Sweetwater River to the Sweetwater Reservoir; extends northward between the communities of El Cajon and Crest; encompasses the San Miguel, Mother Miguel, and Jamul Mountains; extends along the northern flanks of the San Ysidro Mountains and portions of Otay Mesa and the Otay River Valley; and runs west of State Route 94 between Jamul and Rancho San Diego. The LPP, approved in April 1997, provides a description of the biological values, protection and acquisition methods, and acquisition priority for individual tracts of land within the approved NWR boundary (USFWS, 1997a). The CCP process for the San Diego NWR is scheduled to begin in early 2006.

San Diego Bay NWR, Vernal Pools Stewardship Project - Land Protection Plan. The Vernal Pools Stewardship Project boundary of the San Diego NWR Complex encompasses approximately 8,220 acres of land. It includes several disparate areas of San Diego County, with areas in the Otay River watershed limited to properties near Lower Otay Reservoir (509 acres) and on Otay Mesa (1,460 acres) (Figure B.3-8). The LPP, approved in April 1997, describes the various habitat protection methods for lands within the Vernal Pools Stewardship Project, and includes a priority listing of private lands to be considered for acquisition within the approved boundary (USFWS, 1997b). The upcoming CCP planning process for the Otay-Sweetwater Unit will also address the Vernal Pools Unit.

Other Important Plans

There are other planning efforts and ownership interests in the Otay River watershed that are addressed elsewhere in this document (Sections B.3.3, B.5.7, and B.6.4). As discussed in the individual jurisdictional plans above and further detailed in Section B.6.4, the MSCP Subregional Plan and the resulting MSCP Subarea Plans have established large preserve areas in this watershed to protect species and habitats while allowing for reasonable economic development and other uses. The OVRP is an ongoing effort to balance resource protection and recreational and educational opportunities along the lower Otay River and around the Otay Lakes. The U.S. Forest Service owns and manages two small areas of land at the northeast end of the watershed. In addition, the CDFG owns two preserve areas, Hollenbeck Canyon and Rancho Jamul. Wildlands, Inc. owns a 109-acre Mitigation Bank within the Rancho Jamul Property. Additionally, San Diego Gas and Electric has an NCCP for new construction and operations and maintenance activities that was approved by the USFWS and CDFG in 1995. This NCCP currently covers 110 species.

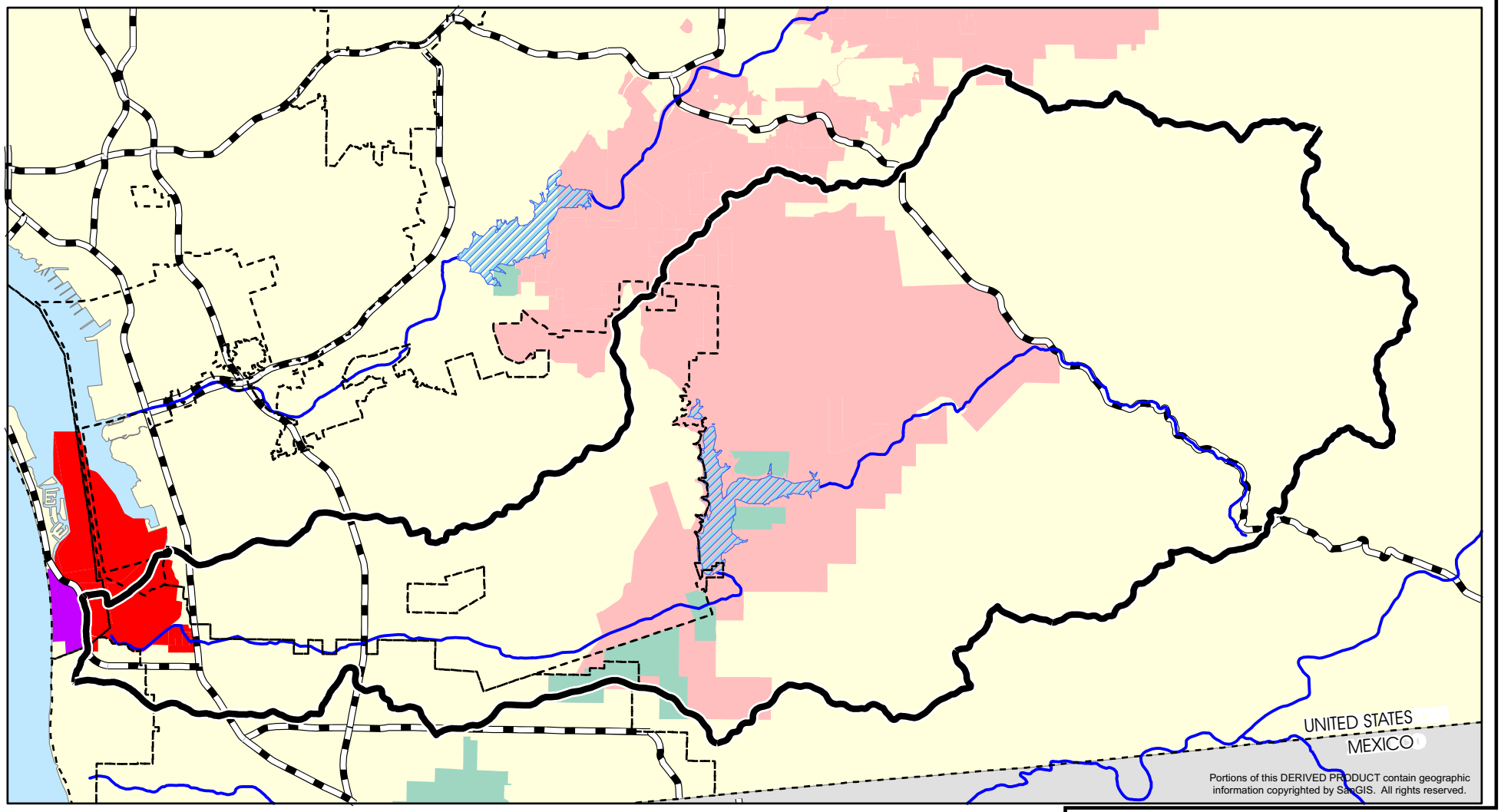
Planned Land Uses

As described above, each applicable land use policy plan and, therefore, each jurisdiction, specifies the type and the density of each land-use category that is intended for development within each jurisdiction. Table B.3.8 identifies the percentage of various land use types planned for each jurisdiction within the Otay River watershed.

Table B.3-8 Planned Land Uses within the Otay River Watershed

Land Use Type	Acres	Percentage of Total Watershed Area	Percentage Change from Existing (Table B.3-3)
Public Utility	291.5	0.3 %	+ 9.9 %
Public Facility	530.6	0.6 %	+ 7.7 %
Temporary Residential	382.9	0.4 %	- 8.0 %
Agriculture	782.2	0.8 %	- 55.1 %
Commercial	995.1	1.1 %	+ 97.6 %
Schools	1,298.8	1.4 %	+ 121.6 %
Light Industrial and Industrial	2,198.9	2.4 %	+ 42.4 %
Transportation	3,596.4	3.9 %	+ 4.6 %
Permanent Residential	37,092.3	39.9%	+ 314.1 %
Recreation	2,007.3	2.2 %	+ 23.3
Open Space/Vacant/Water	43,744.3	47.1 %	- 40.4 %
Total	92,920.3	100 %	0.0%

Source: TAIC, 2005, based on the jurisdictions' current General Plans, which each anticipate build-out conditions occurring 20 or more years following adoption of that General Plan.



Legend
- Vernal Pool Unit (Preserved)
- Otay-Sweetwater Unit (Preserved)
- South San Diego Bay Unit (Planned Acquisition Area)
- Stewardship Project (Preserved)

Basemap Legend
- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes

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0 2.5 5
Scale in Miles

Otay River Watershed Management Plan

Figure B.3-8

U.S. Fish and Wildlife Service National Wildlife Refuge Units

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When compared to the information presented in Table B.3-3, it is apparent that some significant land use changes are planned for the watershed. Most notably is the planned reduction in land area devoted to open space/vacant/water and agriculture, and the significant increase in land area devoted to urban development, including permanent residential, schools, commercial, and industrial designations.

Collectively, the General Plans in the watershed designate approximately 40 percent less land for open space/vacant/water and 55 percent less land for agriculture than exists today.

In general, these lands will be converted to urban uses. In this watershed, the General Plans designate additional lands for development, including increases of: 314 percent for permanent residential uses, 122 percent for schools, 98 percent for commercial uses, 42 percent for industrial uses, and 5 percent for transportation. Please refer to Figure B.3-9 for a graphical representation of the planned land uses in the Otay River watershed. Table B.3-9 summarizes the planned land uses within the Otay River watershed by jurisdiction.

Table B.3-9 Planned Land Use Within the Otay River Watershed by Jurisdiction

Jurisdiction	Permanent Residential	Temporary Residential	Commercial	Light Industrial/ Industrial	Recreation	Open Space/Vacant/ Water	Public Facility	Public Utility	Transportation	Schools	Agriculture	Total
	Percent Land Area											
City of National City	0.0 % (0)	0.0 % (0)	0.0 % (0)	0.0 % (0)	0.0 % (0)	0.1 % (124.3)	0.0 % (0)	0.0 % (0)	0.0 % (0)	0.0 % (0)	0.0 % (0)	0.1 % (124.3)
City of Coronado	0.0 % (0)	0.0 % (0)	0.0 % (0)	0.0 % (0)	0.0 % (0)	0.2 % (199.9)	0.0 % (0)	0.0 % (0)	0.0 % (0.4)	0.0 % (0)	0.0 % (0)	0.2 % (200.3)
City of Imperial Beach	0.3 % (268.8)	0.0 % (2.5)	0.1 % (56.5)	0.0 % (5)	0.0 % (5.5)	0.0 % (23.6)	0.0 % (6.3)	0.0 % (0)	0.2 % (173.5)	0.0 % (15.8)	0.0 % (0)	0.6 % (557.5)
City of San Diego	1.6 % (1,493.3)	0.2 % (152.1)	0.2 % (185.8)	0.4 % (415.9)	0.2 % (205.3)	2.6 % (2,446.3)	0.1 % (66.7)	0.0 % (12.5)	1.0 % (959.5)	0.2 % (202)	0.0 % (39.4)	6.6 % (6,178.9)
City of Chula Vista	6.1 % (5,676.3)	0.2 % (228.4)	0.7 % (651.1)	1.4 % (1,262.7)	1.3 % (1,247.7)	5.5 % (5,141.5)	0.2 % (167.5)	0.2 % (187.4)	2.0 % (1,868.3)	1.1 % (1,001.8)	0.1 % (125.6)	18.9 % (17,558.3)
San Diego County (unincorp-orated)	31.9 % (29,653.7)	0.0 % (0)	0.1 % (101.7)	0.6 % (515.3)	0.6 % (548.9)	38.5 % (35,808.8)	0.3 % (290.1)	0.1 % (91.5)	0.6 % (594.7)	0.1 % (79.2)	0.7 % (617.2)	73.5 % (68,301.0)
Total	39.9 % (37,092.3)	0.4 % (382.9)	1.1% (995.1)	2.4 % (2,198.9)	2.2 % (2,007.3)	47.1 % (43,744.3)	0.6 % (530.6)	0.3 % (291.5)	3.9 % (3,596.4)	1.4 % (1,298.8)	0.8 % (782.2)	100 % (92,920.3)

Source: TAIC, 2005, based on the jurisdictions' current General Plans, which each anticipate build-out conditions occurring 20 or more years following adoption of that General Plan.

As indicated in Table B.3-9, nearly half (47 percent) of the land area in the watershed is planned for open space/vacant/water uses and approximately 40 percent is planned as permanent residential. These lands are primarily within County and City of Chula Vista jurisdiction. Currently, land designated as permanent residential encompasses 9.6 percent of the existing land uses within the Otay River watershed, indicating the substantial plans for expansion of residential development in the watershed.

Existing and Future Impervious Cover and Effects on Watershed Resources

Urbanization of watersheds increases the impervious cover present within these interconnected drainage areas. Roads, houses, and other forms of land compaction and hardscaping can reduce the capacity of

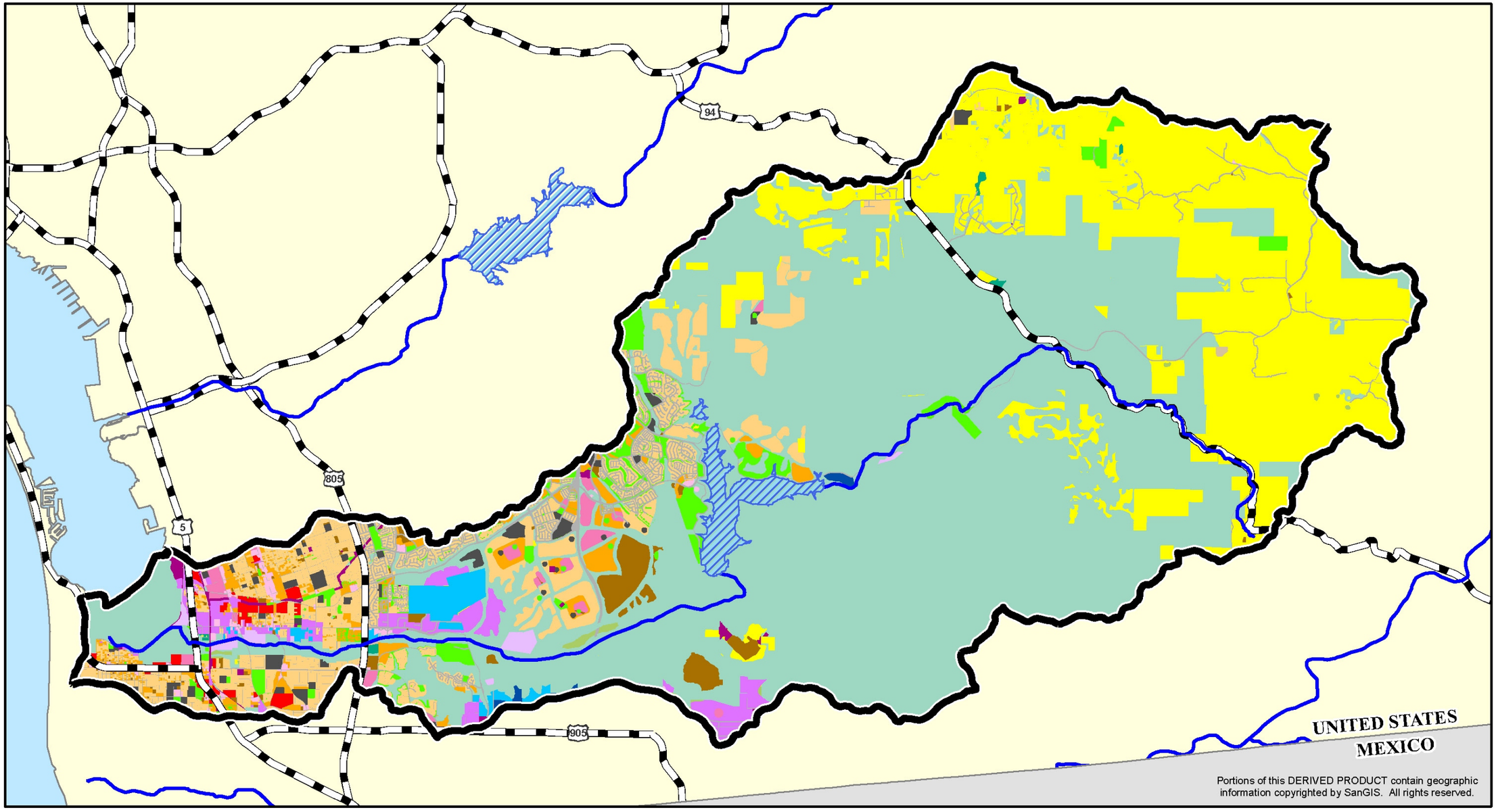
the land to capture and infiltrate storm and irrigation water. Research has demonstrated that increases in impervious cover on the landscape can lead to increases in surface runoff and degradation of water quality for downstream receiving waters, such as creeks, wetlands, and bays (Center for Watershed Protection, 1999). Imperviousness can be evaluated for a drainage area (e.g., watershed, sub-watershed, catchment) based on the land uses within it. Uncompacted, native habitat has the lowest impervious cover (i.e., 0 percent), whereas concrete has the highest imperviousness (i.e., 100 percent). While correlations have not been firmly established for the arid southwest, in many regions of the country, an impervious cover percentage of as little as 10 percent has shown to result in stream degradation, with more severe degradation occurring above 25 percent (Schueler, 1994; Center for Watershed Protection, 1999). While the results might not apply in the Otay River watershed, a technical report by the Southern California Coastal Water Research Project indicates that as little as 2-3 percent impervious cover can have deleterious effects on ephemeral and intermittent streams in smaller (less than 5 square miles) basins in southern California (SCCWRP, 2005). Recent research by the County of San Diego has suggested protecting areas with 15 percent or less cover to limit further degradation (by minimizing increases in percent impervious cover in these areas) (County of San Diego DPLU, 2003). In cases where this is not practicable, disconnecting impervious cover from surface waters (e.g., routing runoff through an infiltration basin) is a means of minimizing the adverse effects. Moreover, they recommend redevelopment in areas already developed (defined as having a percent impervious cover exceeding 40 percent). In areas with impervious cover between these values (i.e., 16 to 40), the County recommends acquiring undeveloped lands and restoring water quality. The County generally favors clustering development over the "urban sprawl" approach, which requires construction of more infrastructure to support and thereby increases imperviousness on larger scales.

To evaluate which parts of the watershed are likely to be experiencing this type of degradation, the existing land use data (2003) for this watershed were converted into impervious surface area and percentages and evaluated by sub-basin. The impervious surface percentages applied for each land use came from the County of San Diego's research (County of San Diego DPLU, 2003). Table B.3-10 shows the percent impervious cover assumed for each land use type.

Table B.3-10 Percent Impervious Cover Assumed by Land Use Type

Land Use Type	Percent Impervious Cover
Single-Family Residential (1 to 10 acres)	15
Single-Family Residential (less than 1 acre)	34
Multi-Family Residential, Group Quarters, Hotels	68
Industrial	91
Transportation	100
Airports	100
Commercial/Office	92
Hospital	80
Military	80
Schools	80
Commercial Recreation	91
Parks	22*
Agriculture	1*
Open Space	1*
Vacant	1**
Water	0
Under Construction	0

Source: County of San Diego DPLU, 2003
* Percentages based on 2005 input from the County of San Diego, City of Chula Vista, City of San Diego, and the City of Imperial Beach.
** Vacant includes land with very low development densities (less than 1 dwelling unit per 10 acres).



Legend

- Airports
- Commercial Recreation
- Commercial and Office
- Education
- Extensive Agriculture
- Extractive Industry
- Freeway-Roads
- Institutions
- Intensive Agriculture
- Junkyard/Dump/Landfill
- Light Industry
- Mobile Homes
- Multiple Family
- Open Space
- Orchards and Vineyards
- Parks
- Shopping Centers
- Single Family
- Spaced Rural
- Transportation and Communication
- Undeveloped
- Water

N

0 2.5 5

Scale in Miles

Basemap Legend

- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes

Source: SANDAG, 2004

Otay River Watershed Management Plan

Figure B.3-9

Planned Land Use Within the Watershed

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Using the County's lower threshold, areas having 15 percent or less impervious cover were identified as having lower expected degradation. Areas having greater than 30 percent impervious cover were identified as having an expected high degree of degradation. As shown in Table B.3-10, areas with impervious cover greater than 30 percent include more dense residential lots (less than 1 acre per unit), industrial, commercial, and transportation land use types. These land use types exceed the 25 percent threshold observed in other parts of the country as severely degradational and are at or above the 40 percent threshold identified by the County as being categorized as a developed area. As shown in Figure B.3-10, the most intense development, and therefore, impervious cover areas (greater than 30 percent), occur along the lower Otay River; particularly west of I-805. These are areas with high-density residential, commercial, industrial, and infrastructure development. The eastern portion of the watershed also has some level of imperviousness, due to the rural residential development, pockets of commercial development, and rural roads.

Using the Table B.3-10 criteria, a Geographic Information System (GIS) was used to spatially analyze impervious surface area in each Hydrologic Area (HA) and Hydrologic Subarea (HSA) within the Otay River watershed. Hydrologic Areas and Hydrologic Subareas are portions or subdivisions of watersheds identified by the Regional Water Quality Control Boards as having similar drainage characteristics (similar to sub-watersheds). For this evaluation, the Otay Valley HA was subdivided into two sections (east and west) in the vicinity of the La Nacion Fault Zone (located just east of I-805), based on differences in geology and land use. As shown in Table B.3-11 and Figure B.3-10, the watershed is approximately 10 percent covered by impervious surfaces (9,623 acres out of 92,920 acres), with the highest percentage (49 percent) occurring in the west Otay Valley West HA.

Table B.3-11 Impervious Cover in the Watershed Based on Existing (2004) Land Use

Hydrologic Sub-Area	Total Acres	Total Impervious Acres	Percent Impervious
Engineer Springs Hydrologic Subarea	1,233	69	6%
Hollenbeck Hydrologic Subarea	31,730	990	3%
Jamul Hydrologic Subarea	7,795	506	6%
Lee Hydrologic Subarea	2,075	220	11%
Lyons Hydrologic Subarea	2,076	117	6%
Otay Valley East Hydrologic Area	19,674	2,279	12%
Otay Valley West Hydrologic Area	9,990	4,911	49%
Proctor Hydrologic Subarea	8,129	223	3%
Savage Hydrologic Subarea	10,220	308	3%
Otay River Watershed	92,920	9,623	10%

As of 2004, six of nine HSAs were below the 10 percent threshold identified as producing measurable degradation in other parts of the country. Lee HSA and Otay Valley East HSA were slightly higher, at 11 percent and 12 percent, respectively. The overall watershed was at 10 percent. All except Otay Valley West, which was more than 3-fold higher, were below the County's suggested 15 percent threshold.

In general, areas with higher percentages of impervious surface cover also received lower riparian ecosystem integrity scores, as evaluated by ERDC (Smith, 2004). ERDC's baseline assessment of riparian ecosystem integrity in the Otay River watershed under current conditions was accomplished by dividing the watershed's riparian ecosystem into assessment units or "riparian reaches" and assessing each riparian reach (212 in number) using a suite of indicators of riparian ecosystem integrity. The riparian reach in this assessment was defined as a segment of a mainstem bankfull channel and adjacent riparian ecosystem relatively homogeneous in terms of its geological, geomorphological, edaphic,

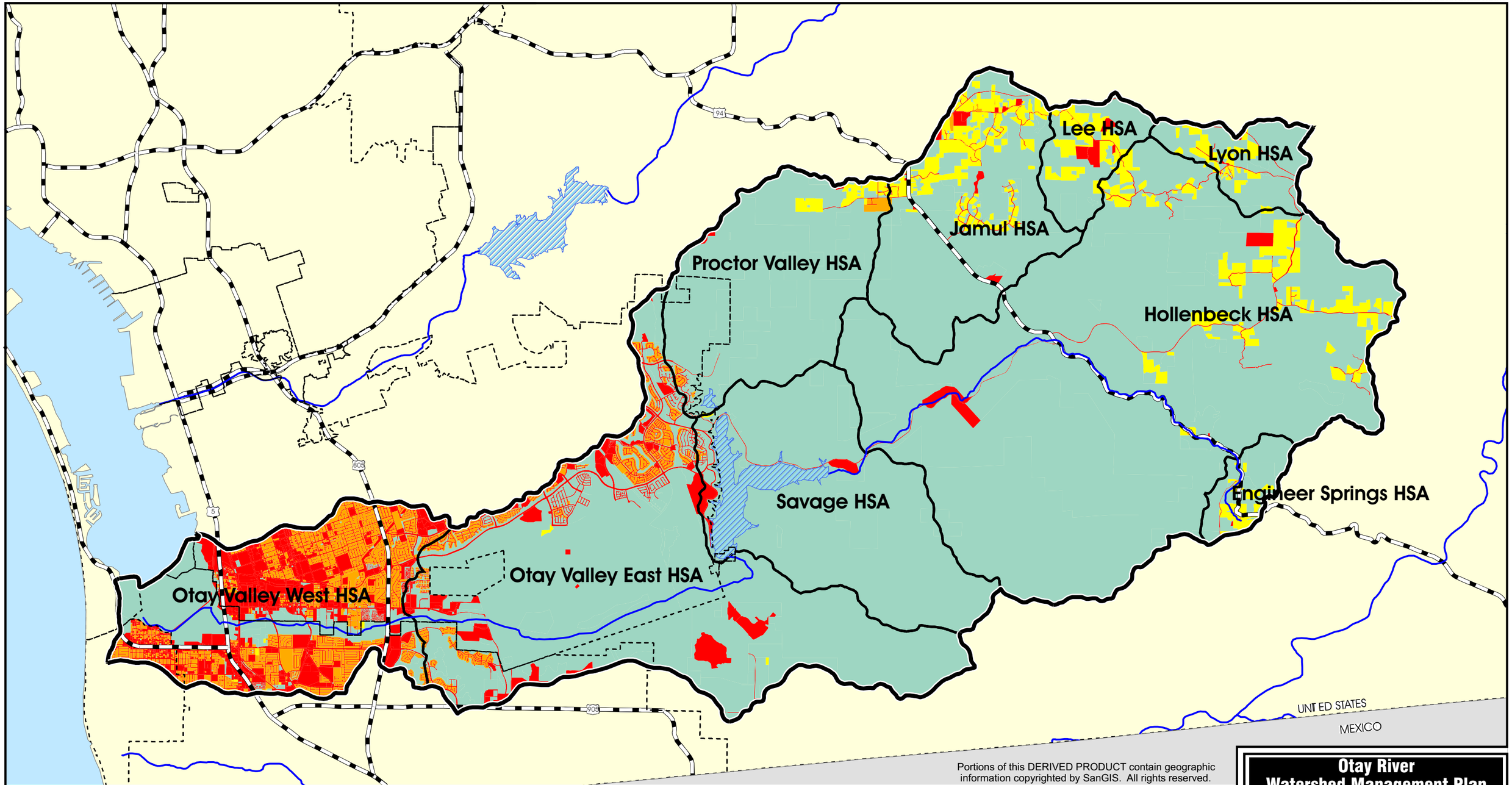
hydrological, channel morphological, vegetation, and cultural alteration characteristics. Because watersheds are hydrologically connected, local drainage and drainage basin characteristics were considered in the scoring of particular indicators. Data used to score these indicators included remotely sensed data and field data. Ultimately, each riparian reach was scored in terms of its Hydrologic, Water Quality, and Habitat Integrity (i.e., three separate Indices) relative to a culturally unmodified condition; with 1 being culturally unmodified or best, and 0 representing no riparian ecosystem integrity for that Index. As shown, in Figures B.3-11 to B.3-13, the lowest scores for all three Indices are concentrated west of the Otay Reservoirs; particularly west of I-805. The highest scoring riparian reaches predominantly occur north, south, and east of the Otay Reservoirs, in open space areas; although scattered developments, grazing, and other cultural modifications have depressed the Indices for particular riparian reaches in these upper watershed areas as well.

As shown in Table B.3-12 and Figure B.3-14, future development pursuant to the existing General Plans is expected to increase the level of imperviousness in this watershed to 17 percent. Otay Valley West is expected to increase slightly to 50 percent, whereas Otay Valley East is expected to more than double to 27 percent. The Otay Ranch and East Otay Mesa Business Park developments are expected to be the primary contributors to these increases. All of the HSAs are expected to increase substantially in their impervious cover. Lee (19 percent) and Lyons (17 percent) HSAs are expected to exceed the County's suggested 15 percent threshold. Overall, according to the existing General Plans, there will be substantial moderate- and high-density development constructed west of and around the Otay Reservoirs, with mostly low-density or rural residential developments constructed along portions of the eastern edge of the watershed.

Table B.3-12 Future Impervious Cover in the Watershed Based on Planned Land Use

Hydrologic Subarea	Impervious Acres	Percent Impervious	Existing Impervious Acres	Percent Change
Engineer Springs Hydrologic Subarea	150	12%	69	118%
Hollenbeck Hydrologic Subarea	2,416	8%	990	144%
Jamul Hydrologic Subarea	830	11%	506	64%
Lee Hydrologic Subarea	393	19%	220	78%
Lyons Hydrologic Subarea	345	17%	117	195%
Otay Valley West Hydrologic Area	5,011	50%	4,911	2%
Otay Valley East Hydrologic Area	5,2335	27%	2,279	130%
Proctor Valley Hydrologic Subarea	693	9%	223	210%
Savage Hydrologic Subarea	545	5%	308	77%
Otay River Watershed	15,616	17%	9,622	62%

It is important to note that care must be taken in interpreting and applying impervious surface area percentages to a watershed, because physical and biological conditions vary across the landscape and can affect how streams, subbasins, and the larger watershed respond in terms of infiltration, surface water runoff, and stream erodibility. As discussed in Section B.7, key factors to consider are the area's geomorphic setting, geology, soils, and vegetation. For example, higher percentages of impervious surface area might have less effect on a given area and downstream receiving waters if the area has little slope, lower infiltrating soils (e.g., Group C or D), and plenty of vegetation. In contrast, lower percentages could have more effect on a given area and downstream receiving waters if the area is steeply sloped, has higher infiltrating soils (e.g., Group A or B), and has little vegetation. Therefore, the specific physical and biological conditions in different subbasins are essential to consider when predicting watershed response or in developing and applying impervious cover limitations.



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Legend

- Greater than 40 Percent Impervious Cover (Multi-Family Residential, Commercial, Industrial, Institutions, Roads)
- 16 to 40 Percent Impervious Cover (Single Family Residential, Active Parks)
- Less than 16 Percent Impervious Cover (Spaced Rural Residential)
- Negligible Impervious Cover (Vacant, Open Space Preserve, Agricultural Field/Orchard, Golf Course, Extractive)

Basemap Legend

- Otay River Watershed Boundary
- Hydrologic Subbasin
- City Boundary
- Major Rivers
- Lakes

0 1.25 2.5 5
Scale in Miles

N

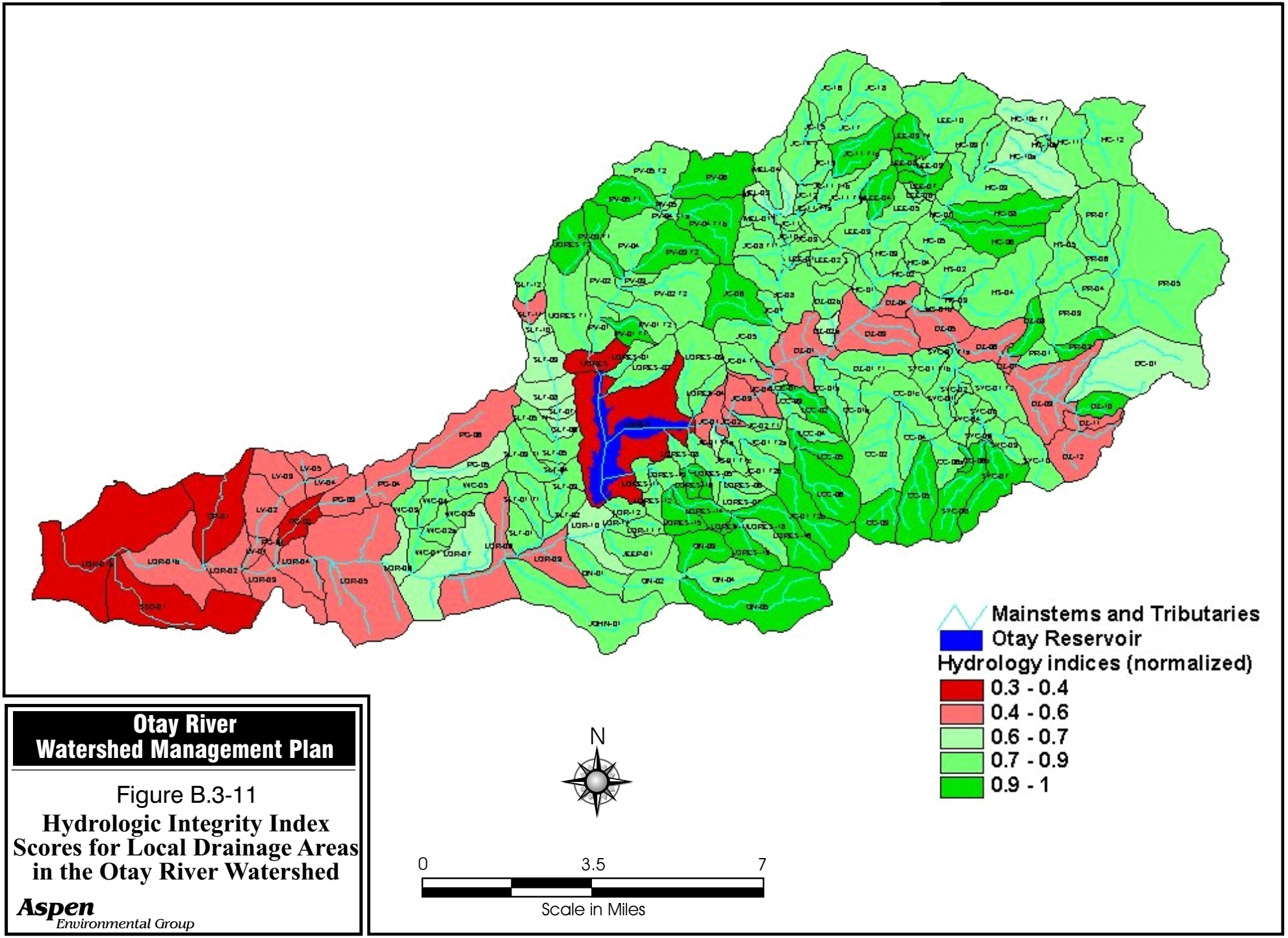
Source: TAIC, 2005

Otay River Watershed Management Plan

Figure B.3-10

Watershed Impervious Cover Distribution Based on Existing Planned Land Use

Aspen Environmental Group

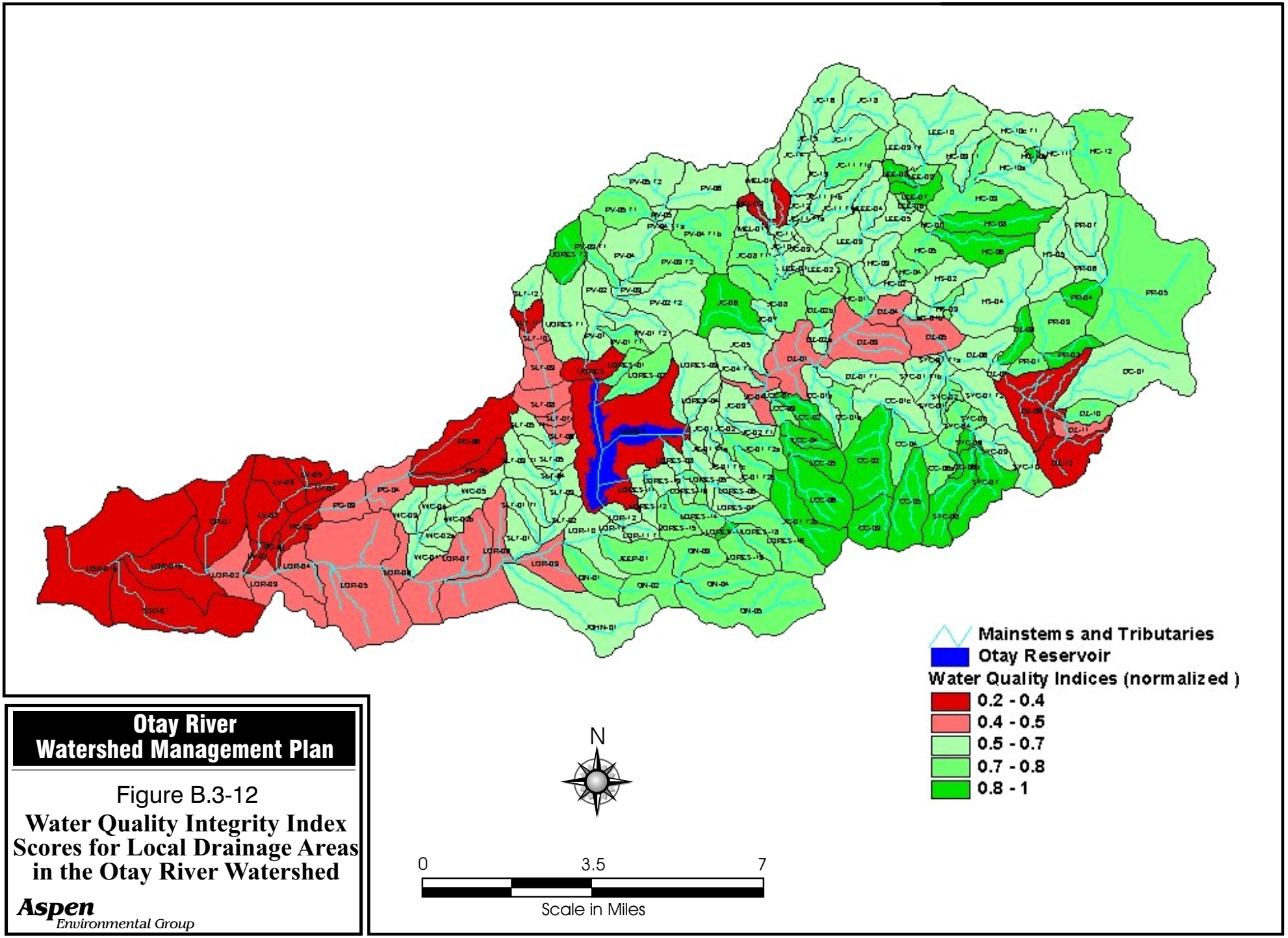


Otay River Watershed Management Plan

Figure B.3-11

Hydrologic Integrity Index Scores for Local Drainage Areas in the Otay River Watershed

Aspen Environmental Group

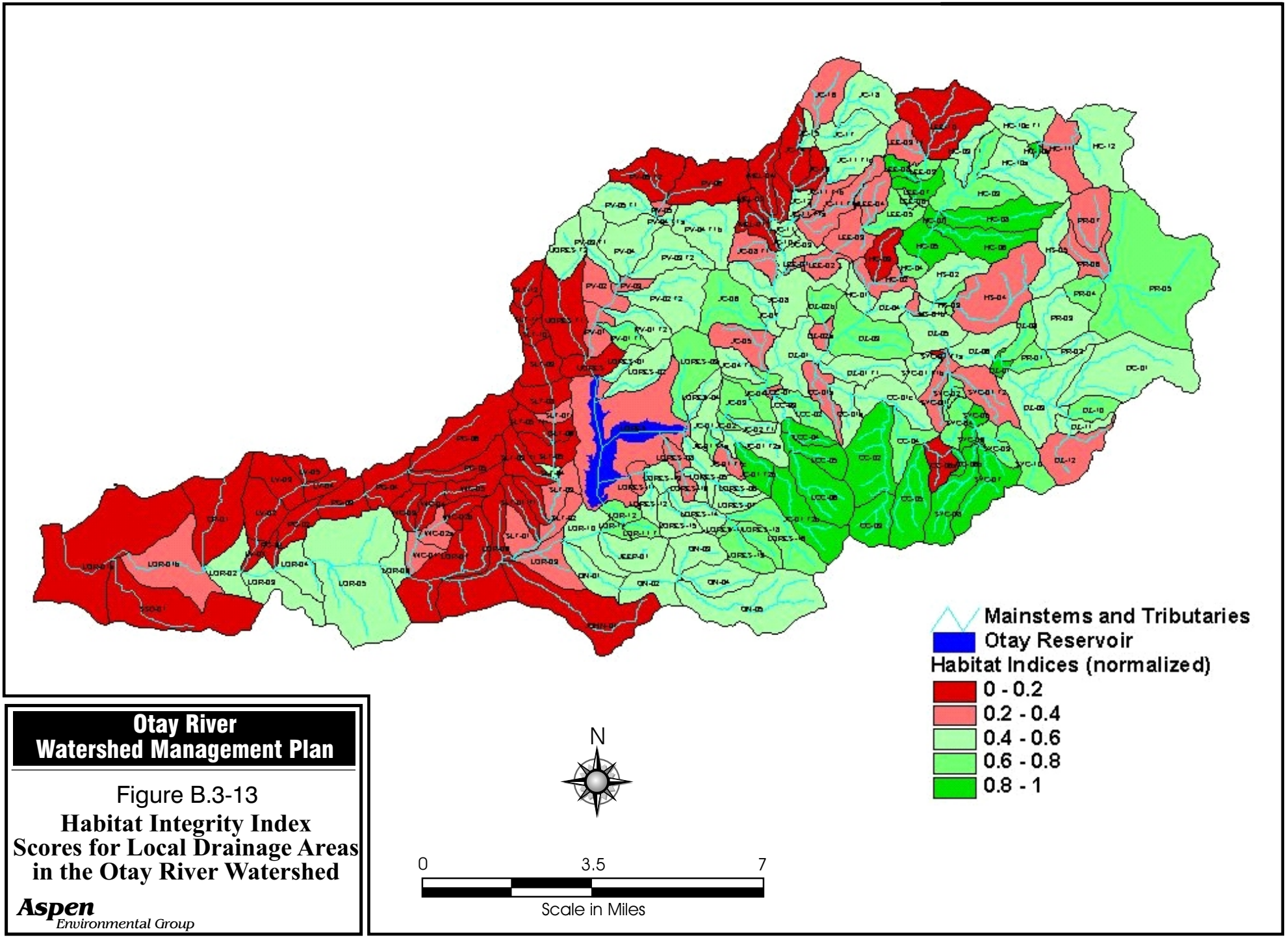


Otay River Watershed Management Plan

Figure B.3-12

Water Quality Integrity Index Scores for Local Drainage Areas in the Otay River Watershed

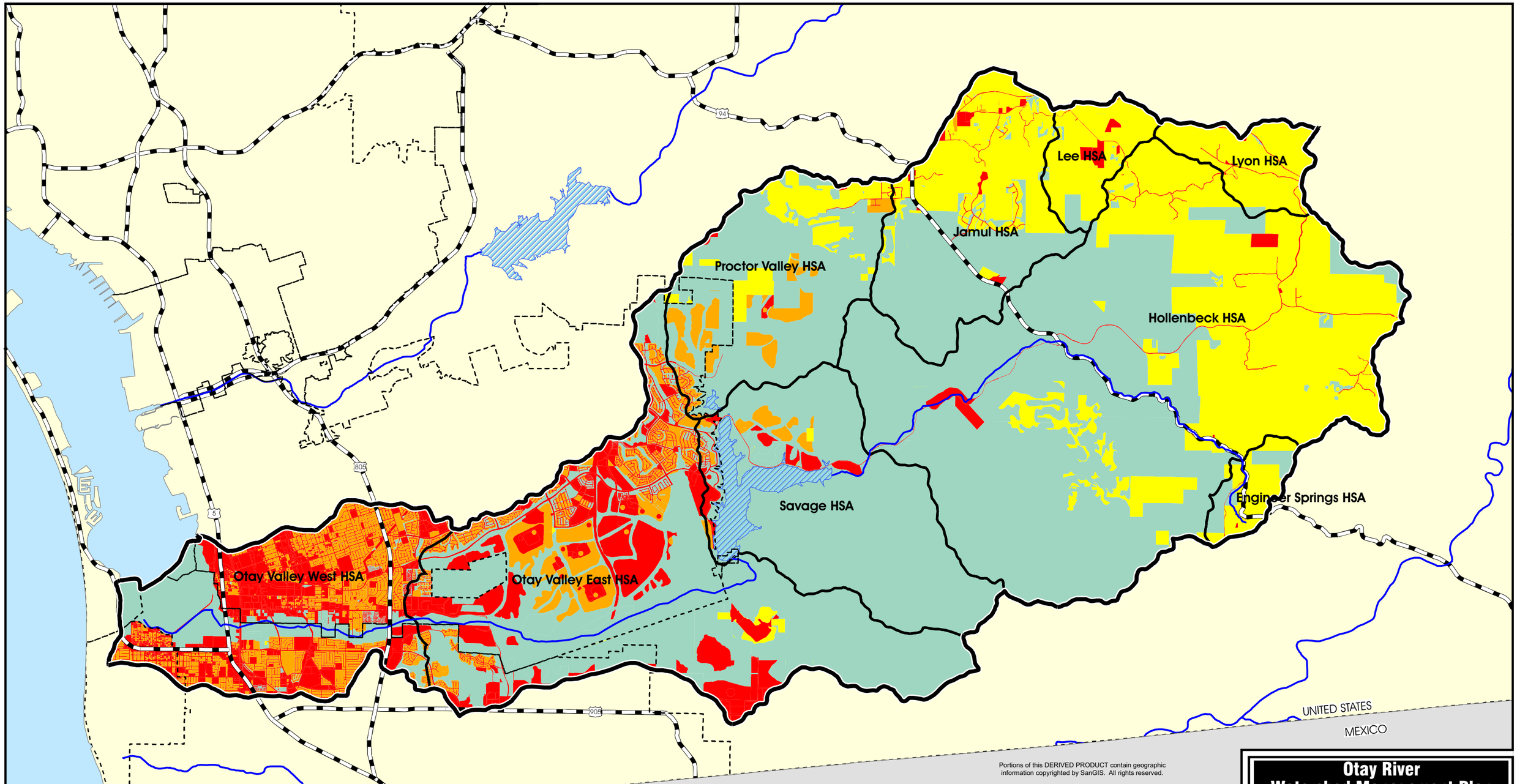
Aspen Environmental Group



Otay River Watershed Management Plan

Figure B.3-13
Habitat Integrity Index Scores for Local Drainage Areas in the Otay River Watershed

Aspen Environmental Group



Legend

- Greater than 40 Percent Impervious Cover (Multi-Family Residential, Commercial, Industrial, Institutions, Roads)
- 16 to 40 Percent Impervious Cover (Single Family Residential, Active Parks)
- Less than 16 Percent Impervious Cover (Spaced Rural Residential)
- Negligible Impervious Cover (Vacant, Open Space Preserve, Agricultural Field/Orchard, Golf Course, Extractive)

Basemap Legend

- Otay River Watershed Boundary
- Hydrologic Subbasin
- City Boundary
- Major Rivers
- Lakes

N

0 1.25 2.5 5

Scale in Miles

Source: TAIC, 2005

Otay River Watershed Management Plan

Figure B.3-14

Watershed Impervious Cover Distribution Based on Future Planned Land Use

Aspen Environmental Group

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As planned, the land use changes will substantially increase the overall imperviousness of the watershed, which could reduce its riparian ecosystem integrity; although, as noted above and as discussed further in Section B.7 and Appendix 4, the actual effects will depend on the specific physical and biological conditions. These changes would directly affect natural land, various habitats and species, infiltration capacity, and have indirect effects on aquatic resources, such as water quality degradation, changes in stream hydrographs, and channel incision. These effects are expected to be tempered in most of the eastern watershed (i.e., where most of the open space occurs), due to the extensive network of existing and planned preserves areas. Implementation of particular watershed protection practices or BMPs, such as disconnecting impervious cover (e.g., routing runoff through infiltration basins) from the drainage system and set backs or buffers around aquatic resources, would further minimize these urbanization effects (Appendix 4). Implementation of effective BMPs would be particularly important in the eastern watershed to protect the preserve areas against the large increases in impervious cover (on a percentage basis) expected.

Sewer Service and Septic Systems

Developments within the Otay River watershed portions of the Cities of Chula Vista, San Diego, and Imperial Beach are connected to the sewer system (Figure B.3-15). This contrasts with the unincorporated areas north, south, and east of the Otay Reservoir; in these areas, most of the limited developments are on septic. While sewer service may extend into previously unserviced areas over time, most of the unincorporated areas north, south, and east of the Lower Otay Reservoir are expected to remain on septic. As discussed in Section B.5, these areas are also primarily dependent on groundwater. This dependence on septic systems and groundwater and the steep topographic relief greatly restrict development density in these areas.

B.3.2 Socioeconomics

This section discusses recent socioeconomic conditions within the region and the Otay River watershed. Specifically, it describes basic demographic information such as population, housing, employment, and income for the region and watershed, and for each jurisdiction that occurs within the Otay River watershed.

As indicated in Table B.3-13, the City of Chula experienced the largest overall growth between 1990 and 2004 (55 percent increase in total population, 41 percent increase in total housing units, and 22 percent increase in total employment), whereas the City of Imperial Beach experienced the least amount of growth. Within the region, there was an overall increasing trend in population between 2000 and 2004, except for the City of Imperial Beach, where the population experienced a 5 percent decrease.

Approximately 148,000 people live in the Otay River watershed, with a diverse racial composition (Table B.3-14). Slightly more than half of the watershed population is Hispanic, while the remainder of the population identifies themselves as one of the following: White, African American, American Indian/Alaskan Native, Asian, Native Hawaiian (or other Pacific Islander), another unlisted race, or multi-racial.

Table B.3-15 summarizes the existing housing units and vacancy rates within the Otay River watershed by jurisdiction. The vacancy rate is the percentage of unoccupied housing units in each jurisdiction as estimated by the San Diego Association of Governments in 2004. Vacancy rate is often used as an indicator of available housing capacity. As indicated in Table B.3-15, the vacancy rates show a relatively low number of available housing units, indicating a potential need for additional housing units in all of the jurisdictions.

Table B.3-13 Region-Wide Historical Population, Housing, and Employment Data

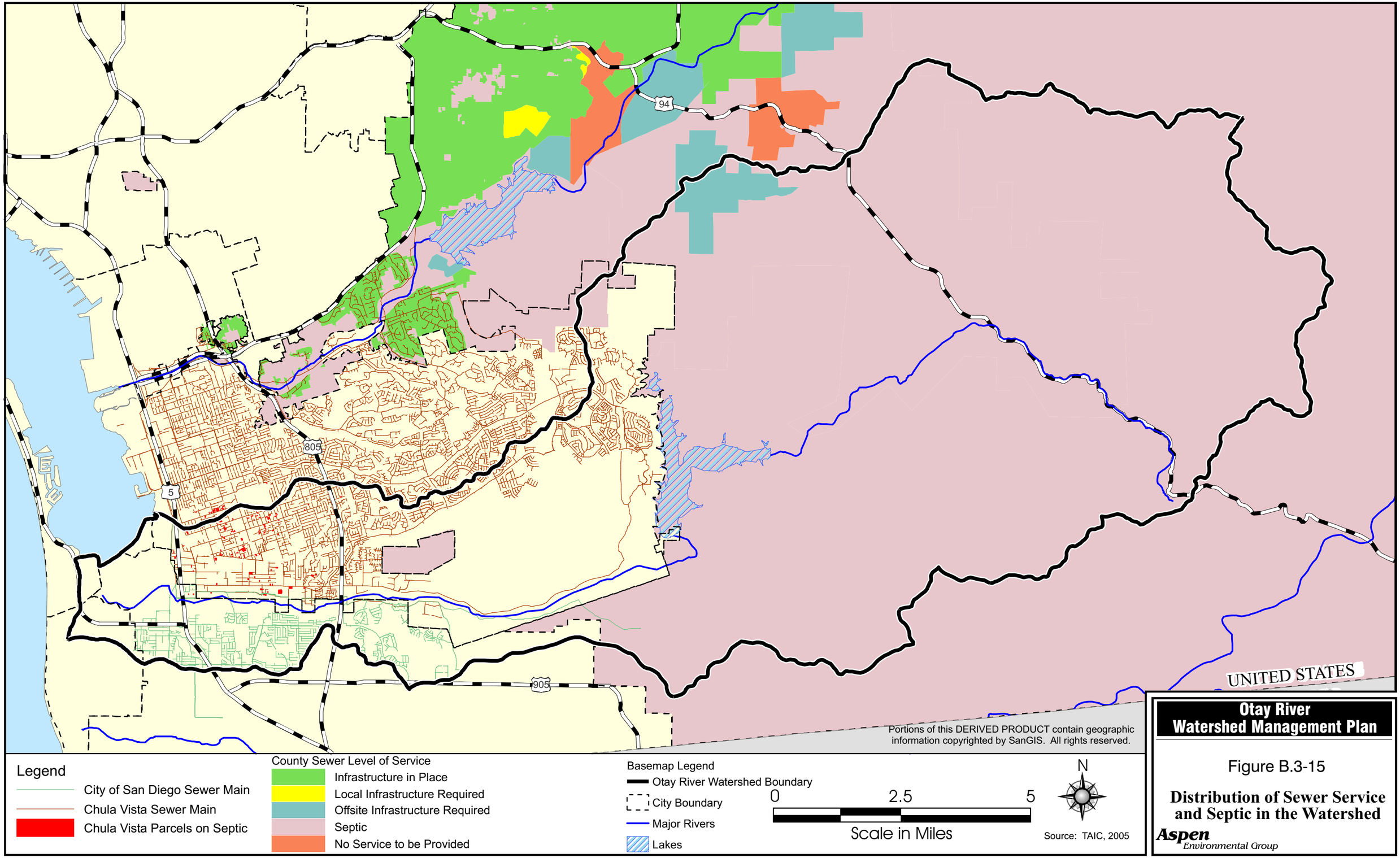
Jurisdiction	1990	2000	2004	% Change 1990-2000	% Change 2000-2004
City of Chula Vista					
Total Population	135,160**	174,319**	209,133*	29%	17%
Total Housing Units	49,846**	59,333**	70,067*	19%	15%
Total Employment***	60,740	70,540	74,180	16%	5%
City of Coronado					
Total Population	25,540**	24,673**	26,459*	(3%)	7%
Total Housing Units	9,145**	9,559**	9,558*	5%	0%
Total Employment***	7,360	8,550	8,990	16%	5%
City of Imperial Beach					
Total Population	26,512**	29,180**	27,779*	10%	(5%)
Total Housing Units	9,525**	9,892**	9,814*	4%	(1%)
Total Employment***	10,200	11,850	12,460	16%	5%
City of National City					
Total Population	54,249**	55,447**	57,047*	2%	3%
Total Housing Units	15,243**	15,482**	15,465*	2%	0%
Total Employment***	18,100	21,010	22,110	16%	5%
City of San Diego					
Total Population	1,110,623**	1,227,168**	1,294,032*	10%	5%
Total Housing Units	431,726**	471,162**	487,252*	9%	3%
Total Employment***	532,550	618,410	650,330	16%	5%
San Diego County (unincorporated)					
Total Population	397,763	442,919	469,493	11%	6%
Total Housing Units	137,237	152,947	159,743	11%	4%
Total Employment***		140,269		6%	

Source: * DOF, 2004; **DOF, 2000;
***EDD, 2004 (Total Employment Data for 1990 and 2000 was extracted from annual averages from each corresponding year. Employment Data for 2004 was extracted from 2003 annual average).

Table B.3-14 Population Data for the Watershed

	Hispanic	White alone	African American	American Indian/Alaskan Native	Asian alone	Native Hawaiian / Other Pacific Islander	Other race	Population of two or more races	Total Population
City of Chula Vista	47,129	19,639	3,596	260	9,978	429	123	2,070	83,224
City of Coronado	0	0	0	0	0	0	0	0	0
City of Imperial Beach	5,312	3,973	491	61	740	57	14	517	11,165
City of National City	0	0	0	0	0	0	0	0	0
City of San Diego	25,134	7,672	2,671	106	7,051	246	101	1,260	44,241
San Diego County (unincorporated)	3,058	4,360	1,487	46	483	4	12	111	9,561
Otay River Watershed	80,633	35,644	8,245	473	18,252	736	250	3,958	148,191
Percentage of Watershed	54%	24%	6%	<1%	12%	<1%	<1%	3%	100%

Source: SANDAG, 2004. People do not reside in the City of Coronado or the City of National City portions of this watershed.



Otay River Watershed Management Plan

Figure B.3-15

Distribution of Sewer Service and Septic in the Watershed

Aspen Environmental Group

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Table B.3-15 Total Housing and Vacancy Rates

Jurisdiction	Total Housing Units	Vacancy Rate (%)
City of Chula Vista	27,319	2 %
City of Coronado	0	NA
City of Imperial Beach	3,788	4 %
City of National City	0	NA
City of San Diego	12,494	3 %
San Diego County (unincorporated)	1,420	4 %

Source: SANDAG, 2004. The portions of the City of Coronado and the City of National City in this watershed do not have housing units.

As indicated by Table B.3-16, the City of Chula Vista includes the largest labor force, with a 3 percent unemployment rate. The City of San Diego includes the second largest labor force in the watershed; however, it also has the highest unemployment rate (8 percent).

Table B.3-16 Labor Force and Unemployment Rate

Jurisdiction	Labor Force	Unemployment Rate (%)
City of Chula Vista	32,175	3 %
City of Coronado	0	NA
City of Imperial Beach	14,146	6 %
City of National City	0	NA
City of San Diego	30,666	8 %
San Diego County (unincorporated)	4,212	2 %

Source: U.S. Census, 2000. The portions of the City of Coronado and the City of National City in this watershed do not contribute to the labor force. The values in this table are estimated from the U.S. Census tracts. U.S. Census tracts overlap jurisdictions and watershed boundaries, which only allows for approximating values.

The City of Imperial Beach has the highest percentage of people living in poverty (18 percent), as indicated by the data in Table B.3-17. The unincorporated area of San Diego County has the lowest percentage of people living in poverty (6 percent).

Table B.3-17 Poverty Rate

Jurisdiction	People Living in Poverty	Percent in Poverty
City of Chula Vista	10,576	11%
City of Coronado	0	NA
City of Imperial Beach	4,211	18%
City of National City	0	NA
City of San Diego	8,832	13%
San Diego County (unincorporated)	677	6%

Source: U.S. Census, 2000.

Notes: People do not reside in the portions of the City of Coronado and the City of National City in this watershed. The values in this table are estimated from the U.S. Census tracts. U.S. Census tracts overlap jurisdictions and watershed boundaries, which only allows for approximating values. The Census Bureau uses a set of money income thresholds that vary by family size and composition to determine who is in poverty. The thresholds vary according to the size of the family and the ages of the family members. If a family's total income is less than the family's threshold, then that family and every individual in it is considered in poverty. The official poverty thresholds do not vary geographically, but they are updated for inflation using Consumer Price Index (CPI-U). The official poverty definition uses money income before taxes and does not include capital gains or noncash benefits (such as public housing, Medicaid, and food stamps). The Census Bureau's definition of poverty is based on the Office of Management and Budget's (OMB) Statistical Policy Directive 14. The poverty thresholds for recent years can be viewed at http://www.census.gov/hhes/www/poverty/threshld.html.

Population, Housing, and Employment Forecasts for the Otay River Watershed

This section summarizes forecast data for the Otay River watershed by HSA as well as the jurisdictions within each. Forecast information in Table B.3-18 was provided by the San Diego Association of Governments (SANDAG). However, the source of the County data is the GP 2020 map update.

The population and number of housing units in this watershed are projected to nearly double by 2030. Employment will increase by 60 percent in this watershed. Table B.3-18 provides details of the socioeconomic forecast for this watershed.

As indicated in Table B.3-18, Engineer Springs HSA is the only watershed area not expected to experience a greater than 100 percent increase in population and housing units. In contrast, employment is not expected to increase in Lee HSA, Lyons HSA, Hollenbeck HSA, or Engineer Springs HSA. Most of the increases are expected to occur on City of Chula Vista or unincorporated County lands. It is expected that there will be considerable infrastructure demands to meet the needs of the growing population.

Table B.3-18 Watershed Population, Housing, and Employment Forecasts

Hydrologic Area or Subarea	2000*	2004	2010	2020	2030	% Change 2000-2030
Otay Valley Hydrologic Area						
Total Population	119,502	144,093	190,566	217,167	227,518	90
Total Housing Units	34,646	43,573	55,224	61,477	63,023	82
Total Employment	28,430	29,905	32,118	41,478	53,869	89
Unincorporated County Population	6,801	5,493	10,529	11,885	13,766	102
Unincoporated County Housing Units	1	1	807	946	1,046	104500
Unincorporated County Employment	2,618	2,753	2,955	4,497	10,141	287
City of Chula Vista Population	63,800	83,194	116,430	132,847	137,760	116
City of Chula Vista Housing Units	20,002	27,290	36,028	40,037	40,749	104
City of Chula Vista Employment	17,808	18,536	19,629	24,947	30,740	73
City of San Diego Population	38,059	44,241	52,396	60,118	62,191	63
City of San Diego Housing Units	10,870	12,494	14,579	16,420	16,771	54
City of San Diego Employment	6,331	6,803	7,511	9,720	10,594	67
City of Imperial Beach Population	10,842	11,165	11,211	12,317	13,801	27
City of Imperial Beach Housing Units	3,773	3,788	3,810	4,074	4,457	18
City of Imperial Beach Employment	1,673	1,813	2,023	2,314	2,394	43
Savage Hydrologic Subarea						
Total Population	5	33	839	871	899	17880
Total Housing Units	3	31	269	271	276	9100
Total Employment	0	3	7	549	1,070	NA
Unincorporated County Population	3	3	8	2	16	433
Unincorporated County Housing Units	2	2	3	5	10	400
Unincorporated County Employment	0	3	7	294	694	NA
City of Chula Vista Population	2	30	831	869	883	44050
City of Chula Vista Housing Units	1	29	266	266	266	26500
City of Chula Vista Employment	0	0	0	255	376	NA
Proctor Valley Hydrologic Subarea						
Total Population	595	633	2,606	3,316	3,689	520
Total Housing Units	187	195	828	1,021	1,139	509
Total Employment	86	86	88	111	156	81

Hydrologic Area or Subarea	2000*	2004	2010	2020	2030	% Change 2000-2030
Unincorporated County Population	595	633	628	1,228	1,574	165
Unincorporated County Housing Units	187	195	199	392	510	173
Unincorporated Employment	86	86	88	111	156	81
City of Chula Vista Population	0	0	1,978	2,088	2,115	NA
City of Chula Vista Housing Units	0	0	629	629	629	NA
City of Chula Vista Employment	0	0	0	0	0	NA
Jamul Hydrologic Subarea						
Total Population	1,242	1,405	1,634	2,164	2,728	120
Total Housing Units	377	425	500	657	848	125
Total Employment	359	387	428	609	609	70
Lee Hydrologic Subarea						
Total Population	211	225	226	226	501	137
Total Housing Units	71	75	73	77	167	135
Total Employment	24	24	24	24	24	0
Lyons Hydrologic Subarea						
Total Population	429	462	928	923	968	126
Total Housing Units	184	193	360	360	387	110
Total Employment	3	3	3	3	3	0
Hollenbeck Hydrologic Subarea						
Total Population	1,198	1,263	1,249	2,321	3,706	209
Total Housing Units	476	496	479	883	1,359	186
Total Employment	173	173	173	173	173	0
Engineer Springs Hydrologic Subarea						
Total Population	77	77	81	80	83	8
Total Housing Units	33	33	33	33	35	6
Total Employment	4	4	4	4	4	0
Watershed Population	123,259	148,191	198,129	227,068	240,092	95
Watershed Housing Units	35,977	45,021	57,766	64,779	67,234	87
Watershed Employment	2,236	2,404	2,655	3,382	3,583	60

Sources: *U.S. Census, 2000
SANDAG, 2004, with County data provided by the GP 2020 map update

B.3.3 Recreational and Scenic Resources

The Otay River watershed contains many recreational and scenic resources of both regional and local significance. The following section discusses these resources, as well as selected planning documents that guide development of parks and recreational facilities in the watershed.

Recreational Resources

Figure B.3-16 and Table B.3-19 identify selected public recreational resources within the Otay River watershed. As discussed below (Scenic Resources), there are several State or federally owned preserves throughout the watershed, some of which allow for passive recreational activities.

Table B.3-19 Recreational Resources within the Otay River Watershed

Resource	Location	Description
Auld Golf Course	Chula Vista	280-acre championship golf course
Bayshore Bikeway	San Diego Bay	This 26-mile route circles the San Diego Bay and passes through the Cities of San Diego, National City, Chula Vista, Imperial Beach, and Coronado
Bureau of Land Management (BLM)	Eastern Watershed	BLM controls much of the southeastern portion of the Otay River watershed
CDFG	Eastern Watershed	CDFG controls a portion of land in the northeastern watershed along State Route 94 (Hollenbeck Canyon, Rancho Jamul Property)
Eastlake Country Club	Chula Vista	Public 18-hole golf course
Greg Rogers Park	Chula Vista	Community park with barbeque facilities, ball fields, open space, picnic areas, and softball fields
Loma Verde Park	Chula Vista	Neighborhood park containing barbeque facilities, open space, play equipment, ball fields, recreation center, and swimming pool
Los Ninos Park	Chula Vista	Neighborhood park containing barbeque facilities, basketball, open space, picnic areas, and play equipment
Lower Otay County Park	East of Chula Vista	Functioning reservoir and recreation center containing barbecue facilities, picnic facilities, fishing, concessions, trails, and United States Olympic Training center for rowing sports
Montgomery Waller Community Park	San Diego	Community park with basketball courts and multi-purpose athletic fields, picnic areas, gymnasium, meeting rooms
Otay Lakes Community Park	San Diego County	Community park containing trails, picnicking, play areas, and a pavilion
Otay Valley Regional Park	The greater OVRP extends from approximately 0.5 mile west of I-5 at the southern end of San Diego Bay eastward along the Otay River to and including both the Lower and Upper Otay Reservoirs	The OVRP is a diverse ecosystem containing at least 16 habitats of rare and endangered plant and animal species. Vegetation communities include Maritime succulent scrub, Diegan coastal sage scrub, Southern Riparian Cypress Forest, and Tamarisk scrub. Amenities include: • Golf practice range • Go-cart track • Coors Amphitheater • Knott's Soak City Water Slide Park • Otay Lakes Park • Savage Dam • Picnic areas • Fishing pier • United States Olympic Training Center's Canoe, Kayak and Rowing facility, and • San Diego Air Sports Field The OVRP serves as a part of a greenbelt corridor between the Cities of San Diego (Otay Mesa / Nestor) and Chula Vista. This corridor constitutes a portion of the Chula Vista Greenbelt, a 28-mile continuous open space and park system
Palm Ridge Park	San Diego	Neighborhood park including softball fields, tot lot, basketball court, and picnic facilities
Palomar Park	Chula Vista	Neighborhood park containing barbeque facilities, open space, picnic areas, and play equipment
Robert Egger, Sr. – South Bay Recreation Center	San Diego	Recreation center with gymnasium, meeting rooms, picnic shelters, ball fields, kitchen, youth programs
Rose Teeple Park	Imperial Beach	Neighborhood park containing picnic and barbeque facilities, tot lot, and open space
Silverwing Park	San Diego	Neighborhood park containing softball fields, tot lot, basketball court, picnic tables.

Resource	Location	Description
Thousand Trails Pio Pico Campground	Eastern Watershed	180-acre campground along Cedar Creek and Dulzura Creek with RV hookups, swimming pool, barbeque facilities, picnic areas, and open space
U.S. Fish and Wildlife Service	Western and Central Watershed	The USFWS is planning the acquisition and management of three NWR Units within or overlapping the Otay River watershed (South San Diego Bay Unit, Otay-Sweetwater Unit, Vernal Pools Unit). The focus is on resource protection, enhancement, and restoration, with potential for passive recreation and educational opportunities.
U.S. Forest Service	Eastern Watershed	The USFS controls a few small parcels within the eastern portion of the Otay River watershed
Valle Lindo Park	Chula Vista	Neighborhood park containing barbeque facilities, open space, picnic areas, and play equipment

Sources: City of Chula Vista, 2004; City of Imperial Beach, 2004b; City of San Diego, 2004a; City of San Diego, 2004b; TAIC, 2004; SDUPD, 2004; Yahoo! Maps, 2004.

As shown in the above table, the Otay River watershed contains many neighborhood and several regional recreational resources. On an acreage basis, most of the recreational facilities in the Otay River watershed exist as large tracts of open space or publicly-owned preserves. The western, urbanized portion of the Otay River watershed contains many small neighborhood parks with community amenities such as picnic areas, gathering spaces, and swimming pools.

Recreational Plans

As shown on Figure B.3-16, there are several areas identified as the sites of future recreational facilities. Development of new public parks and recreational facilities in the Otay River watershed is guided by various plans adopted by local agencies. Summarized below are the more significant plans and policies for recreational resources within the Otay River watershed.

OVRP Concept Plan

The OVRPCP forms the basis for creation of the OVRP (Figure B.3-17). It was developed as a result of a Joint Exercise of Powers Agreement for coordinated planning, acquisition, and design entered into by the County of San Diego and the cities of San Diego and Chula Vista in 1990, and was approved by those three entities and the 30-member Citizens Advisory Committee in 1997. The OVRP is planned to extend eastward approximately 11 miles from the southeastern edge of the salt ponds at the edge of San Diego Bay (i.e., approximately 0.5 mile west of I-5) through the Otay River Valley to land surrounding the Lower and Upper Otay Lakes. It is intended to provide a mix of active and passive recreational opportunities; protect environmentally sensitive areas; protect cultural and scenic resources; and encourage compatible agricultural uses within the Park.

Much of the land within the identified boundaries of the OVRP currently is under private ownership. The Concept Plan, therefore, provides policy direction to the jurisdictions for coordinated land acquisition and development for the Regional Park within the framework of private property rights. In addition, the plan contains a number of open space/core preserve area policies, which aim to maintain the natural floodplain, prohibit channelization of the floodplain, and restore and enhance disturbed areas in the Open Space/Core Preserve Area consistent with the MSCP.

Western OVRP Natural Resource Management Plan

The purpose of the Western OVRP (WOVRP) Natural Resource Management Plan (NRMP), anticipated to be adopted by the Cities of San Diego and Chula Vista in 2006, is to provide guidance for the present and future development and maintenance of the portion of the OVRP west of Heritage Road

(Heritage Road is indicated as a red line in Figure B.3-17). The WOVRP comprises approximately 2,030 acres of land along the Otay River. The guidelines of the NRMP are applicable to areas within the OVRP west of Heritage Road that are in public ownership at any given time. They include guidelines related to maintenance, usage, and development; impact mitigation, restoration and enhancement; and interpretive and research opportunities. Overall, the purpose of the plan is to enhance and restore native habitats in the park, control erosion throughout the park, and protect the watershed and enhance and maintain the quality of water resources in the park.

OVRP Trail Guidelines

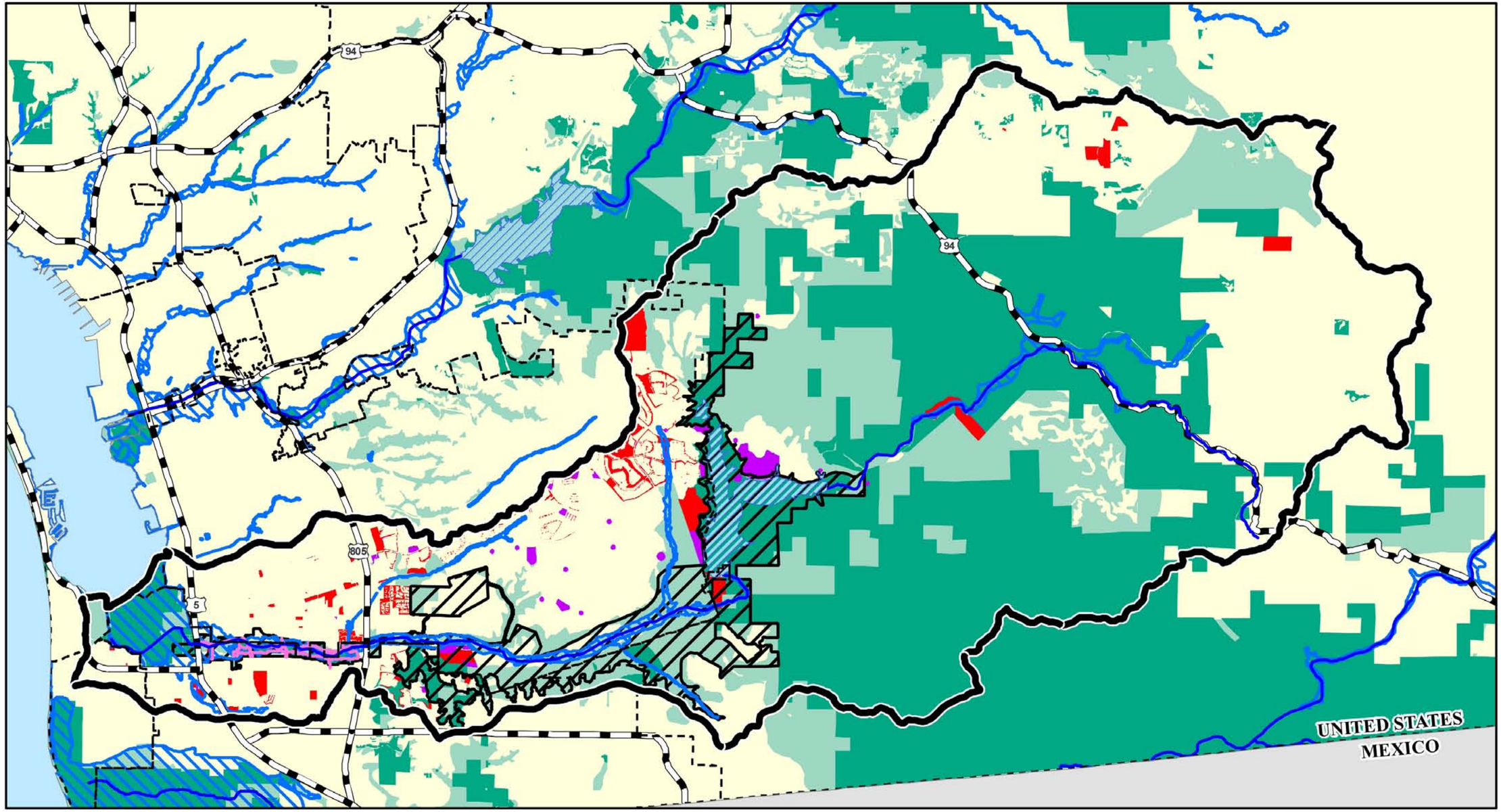
The OVRP Trail Guidelines, finalized in 2003 by staff from the County of San Diego, City of Chula Vista, City of San Diego, and the OVRP Citizens Advisory Committee, establishes guidelines for development of a multi-use trail system from the San Diego Bay, along the Otay River (both sides), and around the perimeter of Otay Lakes Reservoirs. This trail system is intended to be an integral part of a larger regional trail network for connection with the City of Chula Vista Greenbelt, Sweetwater River Park, Jamul/Dulzura Trail system, Eastlake community Trails, and Otay Ranch Neighborhood Trails. This document provides guidelines for development, management, and maintenance of the OVRP trail system, as applied to the five segments of the OVRP: (1) South San Diego Bay to I-5; (2) I-5 to I-805; (3) I-805 to Heritage Road; (4) Heritage Road to Lower Otay Lakes Reservoir; and (5) Otay Lake Reservoirs Vicinity. This document attempts to balance watershed uses (i.e., recreation and interpretation/education) with resource protection (e.g., large setbacks of equestrian staging areas from riparian and coastal sage scrub habitats). The plan has developed a series of guidelines that aim at the balance of watershed uses with resource protection. These include: balance recreation and education/interpretation with protection of natural and cultural resources, avoid impacts and minimize repeated stress (equestrian trials and staging areas), align trails and related facilities to avoid direct and indirect impacts to aquatic resources, and acknowledge that habitat restoration might be necessary for trail construction impacts.

Draft Habitat Restoration and Exotic/Non-Native Plant Removal Plan for the OVRP

This July 2005 draft plan provides an approach for restoring habitat in the OVRP through the eradication of several exotic plant species and selected revegetation with native wetland and upland species. It is anticipated that this plan will be incorporated as an appendix to the WOVRP NRMP. It is designed to guide habitat management activities initially within the western OVRP (i.e., extends from approximately 0.5 mile west of I-5 upstream to Heritage Road) for future extension into the remainder of the OVRP as funding, access, and other logistical considerations are addressed. Removal of exotic plants and revegetation with native species would enhance recreational enjoyment and scenic resources (below) within the OVRP.

City of Chula Vista Greenbelt Master Plan

The City of Chula Vista has prepared the Chula Vista Greenbelt Master Plan, to guide development of a 28-mile open space and park system around the city. Developed parks are located along the Greenbelt, and the majority of the acreage is designated as undeveloped open space (City of Chula Vista, 2003). Commercial recreation uses within the Greenbelt, such as golf courses and the Olympic Training Facility, are compatible with the Greenbelt's policies and guidelines (City of Chula Vista, 1995; City of Chula Vista, 2003). Approximately seventy-five percent of the Chula Vista Greenbelt is located within the Otay River watershed.



Legend

- Existing Recreational Facilities
- Future Recreational Facilities
- Acquired Preserves
- MSCP Planned Preserve
- Otay River Valley Regional Park
- Otay River Valley Regional Park Trails

Basemap Legend

- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes
- 100 Year Flood Plain

0 2.5 5
Scale in Miles

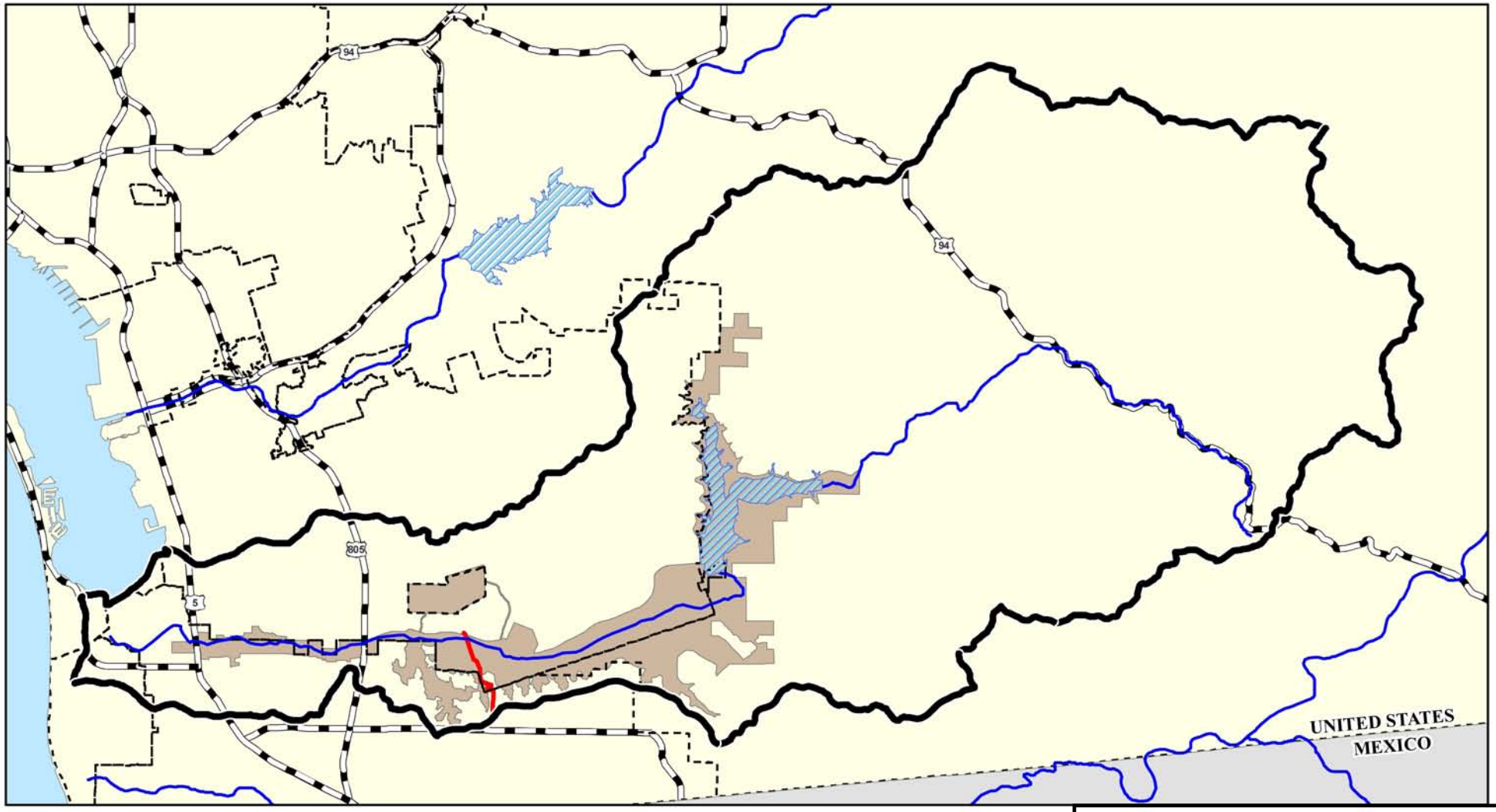
N

Source: TAIC, 2004

Otay River Watershed Management Plan

Figure B.3-16
Recreational Facilities

Aspen Environmental Group



Legend

- Otay Valley Regional Park
- Otay River Watershed Boundary
- Rivers
- Lakes
- City Boundary
- Heritage Road

Source: TAIC, 2004

N

0 1.25 2.5 5

Scale in Miles

Otay River Watershed Management Plan

Figure B.3-17

Otay Valley Regional Park

Aspen Environmental Group

Scenic Resources

The Otay River watershed contains a variety of scenic resources, which reflect its combination of urbanized (western watershed) and natural (eastern watershed) areas. The western portion of the watershed contains mainly incorporated urban areas. As such, scenic resources in this area tend to be more man-made and less natural than the eastern region. However, the western watershed area also contains the southern portion of the San Diego Bay as well as views to the Pacific Ocean. The USFWS controls some of the lands just south of the San Diego Bay as part of the San Diego Bay NWR, designed to protect the existing salt ponds and associated habitat (see Figure B.3-8). The USFWS also owns some of the lands within the planned Otay-Sweetwater and Vernal Pool Units near the Otay Reservoirs.

Mountainous terrain and large tracts of relatively undisturbed land dominate the eastern portion of the watershed. This portion is exclusively unincorporated San Diego County lands, and much is within the MSCP preserve area, ensuring it will likely remain undisturbed for the foreseeable future. The CDFG, the U.S. Forest Service, and the BLM also control large tracts of the eastern watershed (Figure B.3-2).

The central portion of the watershed is dominated by the Upper and Lower Otay Reservoirs and accompanying parks, open space, and trails. Much of the central southern portion of the watershed is owned by the BLM (Figure B.3-7).

Table B.3-20 lists several notable scenic resources within the Otay River watershed.

As represented in the Table B.3-20, the Otay River watershed contains many distinct and varied scenic resources important to an overall characterization of the many uses contained within the watershed. Each of these contributes to the region's identity.

Table B.3-20 Scenic Resources within the Otay River Watershed[4]

Resource	Location	Description
Deerhorn Valley caves and surrounding area	Deerhorn Valley	The Deerhorn Valley caves and surrounding area are notable for their view, natural vegetation, and unique geological formations
McGinty Mountain, Sequan Peak, and Lawson Peak	El Cajon/Harbison Canyon/Dehasa Regions	These mountains are prominent visual features of the area and harbor many threatened and endangered native species. The California Natural Area Coordinating Council designated this area as a Significant Natural Area, ensuring its protection for the time-being.
Mother Grundy	Dulzura area	The rock formation namesake for this mountain is a prominent landscape feature for the Dulzura area.
Mountains	Eastern Otay River watershed	Scenic mountains ring the eastern half of the Otay River watershed, including: • Southeast foothills of the Mother Miguel Mountain • Jamul Mountains • Northern San Ysidro Mountains • San Miguel Mountains
Otay Mountain – Lower Otay Lake	Central Otay River watershed	This scenic resource is designated as an area of Statewide significance. Otay Mountain is predominantly owned by the Bureau of Land Management and is partially designated as a Wilderness Area. The area is also listed by the California Natural Area Coordinating Council as a significant Natural Area. Vernal pools occur on the mesas surrounding the Lower Otay Reservoir.
Otay Valley Regional Park	See Table B.3-19	See Table B.3-19

[4] This list is intended to be representative of scenic resources within the watershed rather than an exhaustive survey.

Resource	Location	Description
Preferred Scenic Highway Corridors	Jamul/Dulzura Subregion of San Diego County	The Jamul/Dulzura Subregional Plan designates several highway corridors for potential designation as scenic highways, including: • First Priority: *State Highway 94* • Second Priority: *Lyons Valley Road* *Skyline Truck Trail* *Proctor Valley Road* • Third Priority: *Honey Springs Road* *Otay Lakes Road*
Regional Historical Sites	Throughout watershed	Many historical sites exist within the Otay River watershed. Collectively, these sites help define the overall character of the region. Examples include: • Barrett House, circa 1890, central Jamul • La Follet House, circa 1895, off Jefferson • Rock House, circa 1895, on Hillside Drive • Jamul School House • Lawson Valley School in Lee Valley • Schnell house, west of intersection of Lawson Valley Road and Skyline Truck Trail • Bratton House, circa 1900, Deerhorn Valley Road • Wats House, Mother Grundy Truck Trail • Jamul Rancho building site east of Pio Pico Park • Plumers House, circa 1915, north of Dulzura Café • Dulzura Café, circa 1900 • Clark Ranch, rebuilt 1900, on Dulzura Creek • Hagenback House, near Forestry Station, • Schekler House, east of Highway 94 at Marron Valley Road • Winnetka Ranch House
State Route 5 (Eligible State Scenic Highway – Not Officially Designated)	Traverses the western Otay River watershed from north to south	As an Eligible State Scenic Highway, Caltrans has documented the scenic qualities of the route, but no local or regional agency has adopted the protection plan necessary to officially designate the route as a State Scenic Highway. In order to designate scenic highways, Caltrans considers the amount of natural landscape seen by travelers, the scenic quality of the landscape, and the extent to which development obscures travelers' view.
State Route 75 (Officially Designated State Scenic Highway)	From Imperial Beach city limit to Avenida Del Sol in the City of Coronado, and Coronado Bridge.	This State Route runs along the world famous Silver Strand, a sand bar that protects San Diego harbor. To the west are occasional glimpses of the Pacific Ocean and to the east, across the bay is the skyline of the city of San Diego. At the north end of the route is the famous old Hotel Del Coronado, once a famous resort for the wealthy.
State Route 94 (Eligible State Scenic Highway – Not Officially Designated)	Traverses the northeastern Otay River watershed from northwest to southeast	As an Eligible State Scenic Highway, Caltrans has documented the scenic qualities of the route, but no local or regional agency has adopted the protection plan necessary to officially designate the route as a State Scenic Highway. In order to designate scenic highways, Caltrans considers the amount of natural landscape seen by travelers, the scenic quality of the landscape, and the extent to which development obscures travelers' view.
Tecate Peak – Cottonwood Creek	Near International Border	Tecate Peak is an international landmark, and Cottonwood Creek and its waterfalls provide scenic value as well as habitat for several threatened and endangered species.
Upper and Lower Otay Reservoir	Central Otay River watershed	Large reservoir system with recreational amenities (See Table B.3-19).

Resource	Location	Description
San Diego Bay National Wildlife Refuge – South San Diego Bay Unit	South end of San Diego Bay at the western terminus of the Otay River Watershed	The South San Diego Bay Unit of the San Diego Bay NWR currently consists of 2,300 acres of shallow subtidal, eel grass, intertidal, and salt pond habitat. The NWR provides important foraging, resting, and breeding areas for several threatened and endangered species, including the California least tern (*Sterna antillarum browni*), light-footed clapper rail (*Rallus longirostris levipes*), western snowy plover (Charadrius alexandrinus nivosis), and tens of thousands of migratory birds. Opportunities for observing the abundance and diversity of birds supported on the NWR are available from the Bayshore Bikeway and South Bay Biological Study Area.

Sources: Caltrans, 2004; Caltrans 2003; Otay Valley Regional Park, 2004; San Diego County, 1979, 1995.

B.4 GEOLOGIC RESOURCES

B.4.1 Regional Geology

The Otay River watershed is located in the Peninsular Range geomorphic province of southern California. The Peninsular Range province is a northwest-southeast oriented complex of igneous and metamorphic rocks, which includes the southern California batholith (a granitic bedrock complex that forms the mountains and hills in the eastern portion of the watershed; Norris and Webb, 1990). During the Mesozoic, sea floor sediments were subducted off the coast of California, forming magma at depth, which resulted in the emplacement of the batholith and associated volcanic and metavolcanic complexes.

The tectonic processes of the Peninsular Range province changed during the Cenozoic (present to 65 million years before present), when subduction ceased, and transform faulting (i.e. lateral shear) began on the San Andreas Fault system (Norris and Webb, 1990). As a result, horizontal motion began in this region between 25 and 20 million years before present and created the strike-slip faults that characterize the present landscape (Atwater, 1970), including the San Andreas and Elsinore fault zones (Figure B.4-1).

From the late Pliocene through the end of the Pleistocene, large-scale climatic episodes (i.e. glacial events) coupled with episodes of tectonic uplift formed the present landscape of the Pacific Coastal Plain of southern California (Ellis and Lee, 1919; Norris and Webb, 1990). The series of wave-cut terraces along the coastal margin were formed by fluctuating sea levels during glacial events, and during events of rapid vertical movements along the coastline (Norris and Webb, 1990).

The rocks of the Peninsular Range province have weathered into westward sloping hills, and form the basement complex onto which the sedimentary formations of the Pacific Coastal Plain were deposited (Izbicki, 1985). Such formations include the San Diego Formation of mid to late Pliocene marine sandstone and conglomerate, and the Otay Formation of Miocene-Pliocene sandstone and claystone (California Division of Mines and Geology [CDMG], 1977).

The San Diego County region can be divided into three major physiographic sections, which are aligned roughly parallel to the coast. From west to east, they are the coastal plain, the central mountain-valley and the eastern mountain-valley regions (California Department of Water Resources [DWR], 1967). The coastal plain extends about 10 miles inland from the Pacific Ocean, and is characterized by marine-cut terraces dissected by drainage channels. In the Otay River watershed, the coastal plain consists of Pleistocene marine sediments capping the San Diego Formation. The central mountain-valley region, which is bounded on the east by the Elsinore Fault Zone and the regional drainage divide, is dominated by intrusive and metavolcanic rocks associated with the Southern California Batholith. In the Otay River watershed, the bedrock in the mountain-valley section is primarily metamorphic rock, with

outcrops of intrusive igneous rocks in the eastern portions of the drainage (DWR, 1967; USGS, 1994; Earth Tech, 1999). The eastern mountain-valley region is distinguished by prominent structural features of parallel and block faulting; the Otay River watershed does not extend into this region.

B.4.2 Local Geology

Surficial geology of the Otay River watershed is shown on Figure B.4-2. The major geologic units identified in the watershed, listed from oldest to youngest, are as follows:

- Santiago Peak volcanics (M2)
- Woodson Mountain granodiorite (Kgr1)
- Otay Formation
- San Diego Formation (Tk7)
- Linda Vista Formation (Qp1)
- Bay Point Formation (Qp1)
- Residuum (Qr)
- Alluvium (Qal).

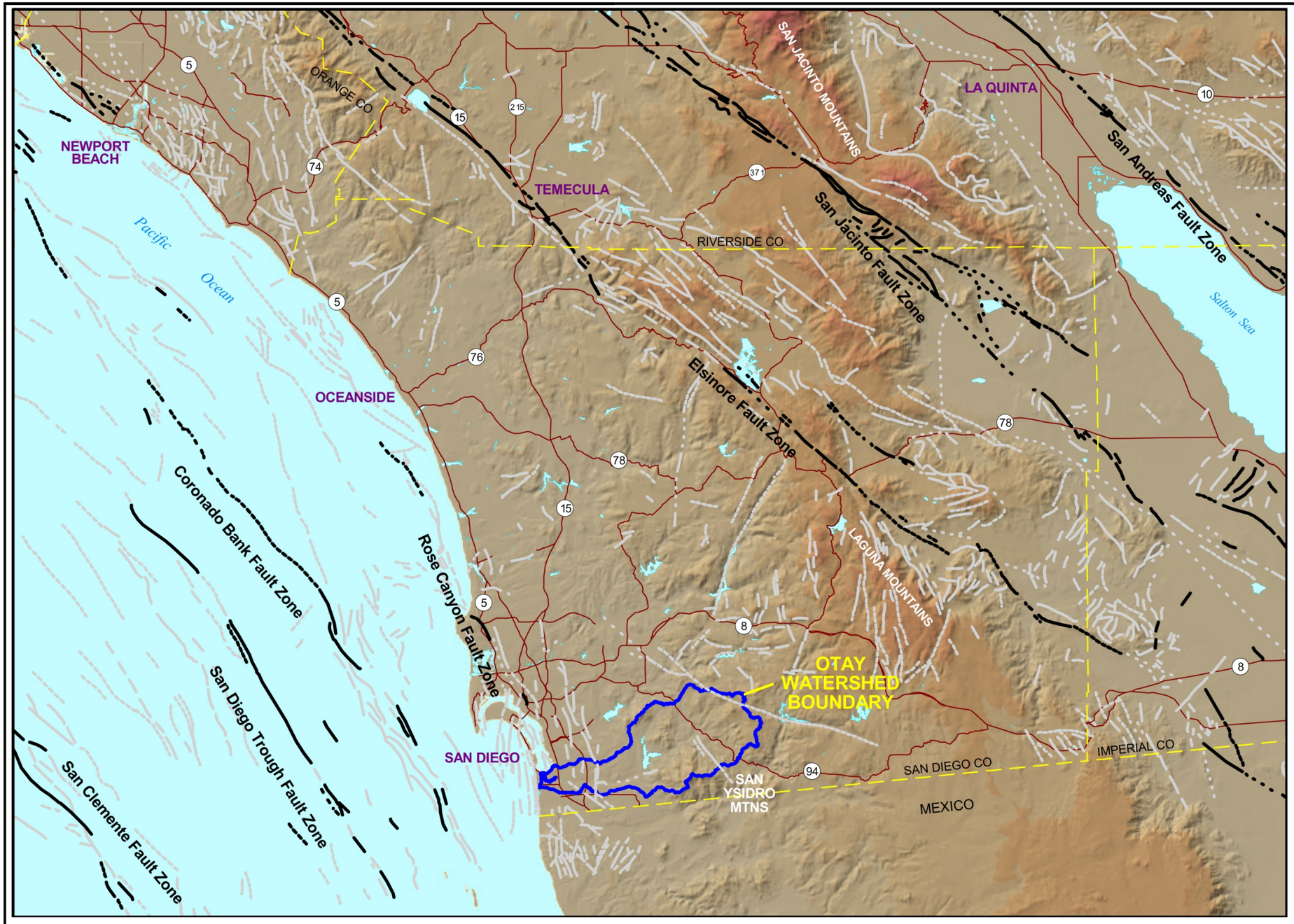
The Santiago Peak volcanics crop out extensively in the central and eastern portions of the Otay River watershed, east of the Lower Otay Reservoir. They consist of Jurassic to Cretaceous-era volcanic flows, predominantly dacite and andesite, and a wide variety of breccia, agglomerate, tuff, and other volcanic conglomerates, and were emplaced contemporaneously with some of the oldest rocks in the Peninsular Range Batholith (CDMG, 1977; USGS, 2003). Generally, they are mildly metamorphosed (California Geological Survey [CGS], 2002a and 2002b). The Santiago Peak volcanics are grouped on Figure B.4-2 with the Black Mountain volcanics and the sedimentary Bedford Canyon Formation; together, the rocks in this map unit are the oldest exposed features in the Otay River watershed.

Intrusive rocks of the Peninsular Range Batholith present in the Otay River watershed include the Woodson Mountain granodiorite (Kgr1), the Bonsall and Green Valley tonalites (Kto3 and Kto1, respectively), the San Marcos gabbro (Kbi), and other differentiated and undifferentiated gabbros and diorites. These formations are of Late Cretaceous age and exhibit complex intrusive relationships, suggesting possible contemporaneous emplacement of some gabbros and granodiorites (DWR, 1967; USGS, 1994).

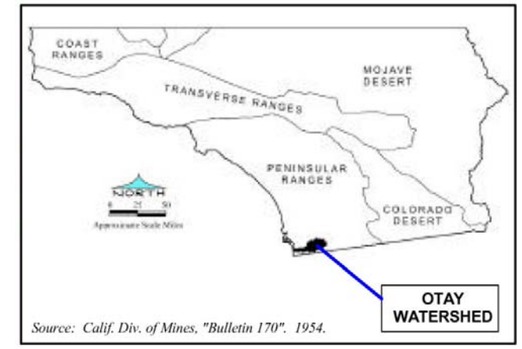
The Otay Formation of early Pliocene age consists of marine-deposited sandstone and claystone. In the Otay Valley, the Otay Formation underlies the San Diego Formation (Huntley et al., 1996a). The San Diego Formation (Tk7) consists of slightly consolidated sandstones, claystones and conglomerates that were deposited during the late Pliocene (CDMG, 1977). CDMG (1977) shows the Otay Formation to comprise the majority of late Tertiary sediments east of the La Nacion Fault Zone – identified as San Diego Formation on Figure B.4-2 (DWR, 1967).

The Linda Vista Formation (Qp1) represents a marine and/or non-marine terrace deposit that was formed in the Pleistocene during a period of dropping sea levels. The formation is a distinctive rust-brown color and forms local mesa surfaces, including Otay Mesa. The Pleistocene Bay Point Formation (also Qp1) is a near-shore marine deposit that is exposed along the San Diego waterfront.

Residuum (Qr) in the eastern watershed consists of residual soils and decomposed granitic rocks that were weathered in situ from igneous and metamorphic rocks during Quaternary time. Residuum is frequently covered by thin alluvial deposits, and is a locally significant water bearing material. Alluvium (Qal) consists of river, stream, and lake deposits of gravel, sand, silt, and clay eroded from the surrounding highlands. Thickness of alluvium in the western watershed may reach 200 feet (DWR, 1967).



Regional Geologic Provinces Inset



Source: Calif. Div. of Mines, "Bulletin 170". 1954.

EXPLANATION

Active Faults During Holocene
(10,000 Years to Present)

- Dashed Where Approximately Located or Inferred
- Dotted Where Concealed
- Solid Where Known

Inactive Faults
(No Holocene Displacement)

- Dashed Where Approximately Located or Inferred
- Dotted Where Concealed
- Solid Where Known

- Otay Watershed Boundary
- County Boundary
- Highway
- Surface Water

0 10 20
Scale in Miles

N

Map Projection:
UTM Zone 11 (1927)
Central Meridian: -117 degrees

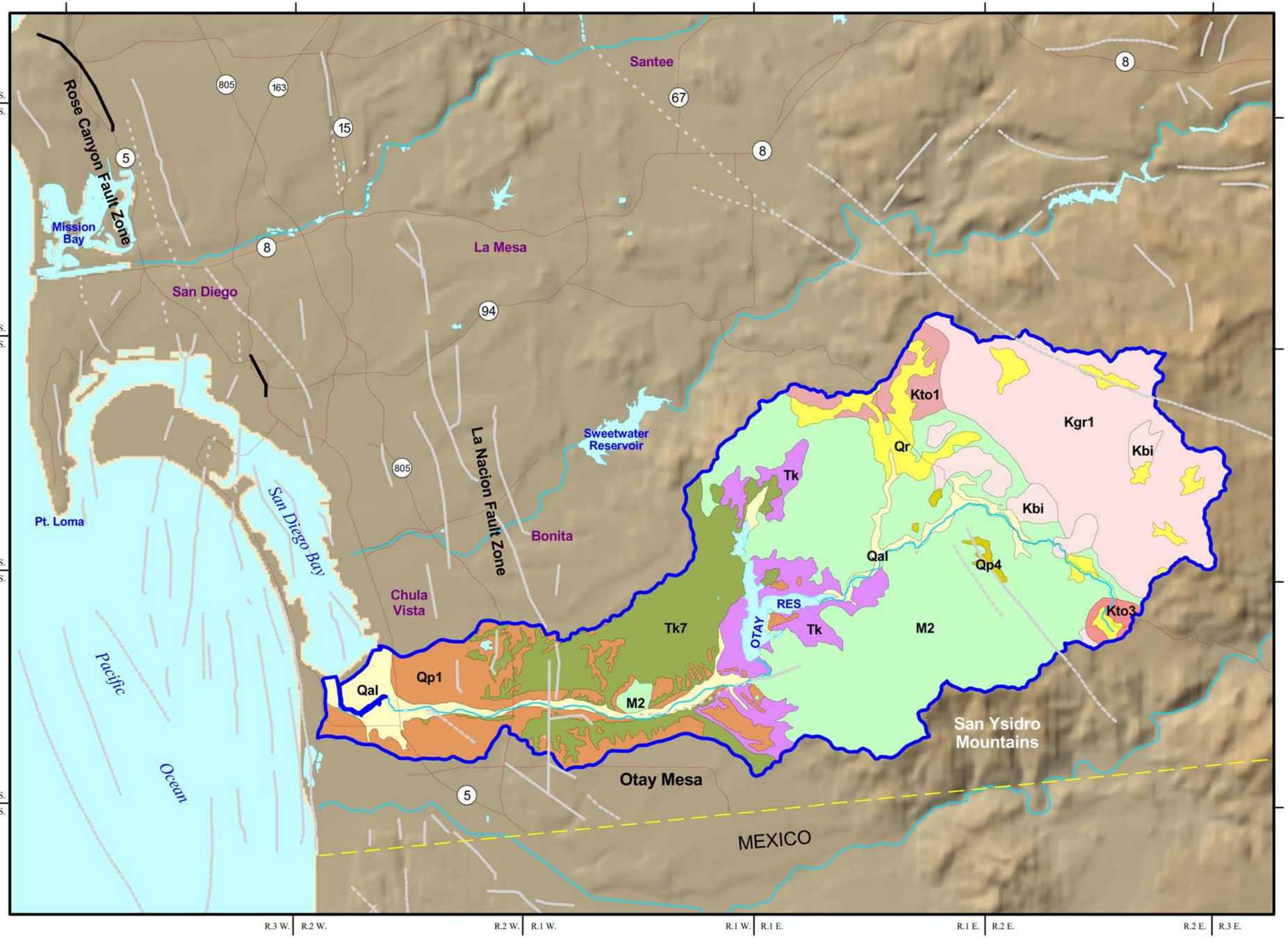
Source of Fault Data:
CDMG. "Digital Database of Faults from the Fault Activity Map of California and Adjacent Areas." 2000.

Source: GSSI, 2004

Otay River Watershed Management Plan

Figure B.4-1
Regional Geologic Features

Aspen Environmental Group



EXPLANATION

Geologic Classification

- **Qal** River, Lake, Beach and Dune Sand Deposits
- **Qr** Residuum
- **Qp4** Older Alluvium, River Terrace Deposits and Unnamed Continental Deposits
- **Qp1** Linda Vista, Bay Point and Sweitzer Formations and Unnamed Marine Deposits
- **Tk7** San Diego Formation
- **Tk** Undifferentiated Sediments and Volcanic Rocks
- **Kgr1** Woodson Mountain Granodiorite
- **Kto3** Bonsall Tonalite
- **Kto1** Green Valley Tonalite
- **Kbi** San Marcos Gabbro, Cuyamaca Gabbro, Viejas Diorite and Undifferientiated Gabbros and Diorites
- **M2** Santiago Peak Volcanics, Black Mountain Volcanics, Bedford Canyon Formation and Undifferentiated Metasediments

Active Faults During Holocene (10,000 Years to Present)

- Dashed Where Approximately Located or Inferred
- Dotted Where Concealed
- Solid Where Known

Inactive Faults - (No Holocene Displacement)

- Dashed Where Approximately Located or Inferred
- Dotted Where Concealed
- Solid Where Known

- Otay Watershed Boundary
- County Boundary
- Highway
- Surface Water
- River, Stream or Drainage Channel

0 10 20
Scale in Miles

N

Prepared by: DWB

Map Projection:
UTM Zone 11 (1927)
Central Meridian: -117 degrees

Source of Fault Data:
CDMG. "Digital Database of Faults from the Fault Activity Map of California and Adjacent Areas." 2000.
Source of Geologic Data:
Digitized from Department of Water Resources Map. 1967.

Source: GSSI, 2004

Otay River Watershed Management Plan

Figure B.4-2
Local Geologic Features

Aspen Environmental Group

The north-south trending La Nacion Fault Zone, which traverses the western portion of the Otay River watershed, has not experienced movement within the last 20,000 years, and is therefore considered inactive (City of San Diego, 2002b; see Figure B.4-2). The City of Chula Vista, however, classifies the La Nacion Fault as potentially active due to evidence of possible Quaternary movement (City of Chula Vista, 1995). The San Diego Formation thickens west of the La Nacion Fault Zone (Huntley, et al., 1996a).

B.4.3 Geologic Hazards

B.4.3.1 Seismic Hazards

The western portions of San Diego County have historically experienced less seismic activity than the rest of southern California. However, several active faults along the coast and offshore are thought to be capable of generating earthquakes as large as magnitude 7.7 and causing considerable damage in the San Diego and Tijuana metropolitan regions (County of San Diego, 2002). These faults include the Rose Canyon Fault, which extends from the sea floor off La Jolla, through Rose Canyon and into San Diego Bay, and the Coronado Bank and San Diego Trough Fault Zones located farther offshore (Figure B.4-1).

Estimated peak horizontal ground acceleration for a uniform firm rock site condition in the Otay River watershed ranges between 20-30 percent of gravitational acceleration (i.e., gravitational acceleration equals 32 ft/sec^2), with a 10 percent probability of exceedance in 50 years (CGS, 2003). Ground motion experienced during an earthquake depends on individual site soil conditions, and sites with soft rock or alluvium would be expected to have higher peak ground acceleration than sites with firm rock.

In addition to damage from ground shaking during an earthquake, there is a risk of damage from liquefaction of wet, unconsolidated soils. This risk is greatest where the water table is high, and soils are comprised of fine-grained silts and sands; these conditions occur around the mouth of the Otay River in the City of Imperial Beach, as well as in areas of artificial fill by the San Diego Bay (City of Imperial Beach, 1994).

B.4.3.2 Landslides

Landslide hazards for the western portion of the Otay River watershed have been mapped by the CDMG (1995) and are shown on Figure B.4-3. Landslide hazards are greatest on the north slopes of Otay Mesa; these slopes show signs of numerous previous landslides, and slope instability is evident even where no demonstrable historical landslides exist.

In general, landslides occur where there are naturally steep slopes in material weakened by weathering and intersecting fractures; the material composition of a slope is critical in determining what angle is considered hazardously steep. Bentonite clay layers in the San Diego Formation have been known to fail at slopes of 1.5:1 (horizontal to vertical) (City of Chula Vista, 1995). Gabbro exposures are also considered vulnerable to landslides, because gabbro weathers more completely than granite or granodiorite (County of San Diego, 2002). Fine-grained gabbro weathers faster than coarse-grained gabbro, so fine-grained gabbro exposures are the most vulnerable of the intrusive igneous outcrops in the Otay River watershed (USGS, 1994).

B.4.4 Mineral and Geologic Resources

B.4.4.1 Mineral Resources

The economically valuable mineral resources in the Otay River watershed are principally comprised of bulk rock products such as sand, gravel, and dimension stone. Sand and crushed rock from the area are used as aggregate in concrete, asphalt, and plaster, and as bulk fill for road beds and other construction activities. Dimension stone, typically granite, is quarried for monuments and decorative rock. Because of the bulk nature of these resources, haulage costs make up a large part of their final price, so it is desirable to locate mines as closely as possible to the point of use (CDMG, 1996).

The scarcest and most valuable aggregate resources are those deposits suitable for using in Portland cement concrete (PCC), as the mineral specifications are more stringent for PCC than for other aggregate types (CDMG, 1996). Significant deposits of PCC-quality alluvial materials are located in the Lower Otay River valley; PCC-quality aggregate resource zones are shown on Figure B.4-4. Two mines are currently producing aggregate from the region: the Nelson and Sloan Company manufactures crushed rock aggregate from metavolcanic material at its Rock Mountain site, and the California Commercial Asphalt Company is reported to operate a quarry near Dulzura Creek (CDMG, 1996).

Total PCC-quality aggregate reserves in the Western San Diego production-consumption region amounted to approximately 352 million tons in 1996, enough to supply projected demands for 20 years (CDMG, 1996). However, mining activities are commonly considered incompatible land uses in residential and recreation areas, and the spread of residential areas onto mining sites is a common problem affecting bulk rock product resources near cities (County of San Diego, 2002). Due to conflicts with residential and habitat conservation zones, it is unlikely that all of the identified aggregate resources will be exploited (CDMG, 1996).

Other commercially exploitable mineral resources within the Otay River watershed include salt and limestone. Limestone is currently being mined at a site next to Cedar Canyon near Dulzura Creek (City of San Diego, 2003). Salt ponds at the mouth of the Otay River produce from 50,000 to 100,000 tons of salt annually, and provide open space and habitat for shore birds (County of San Diego, 2002).

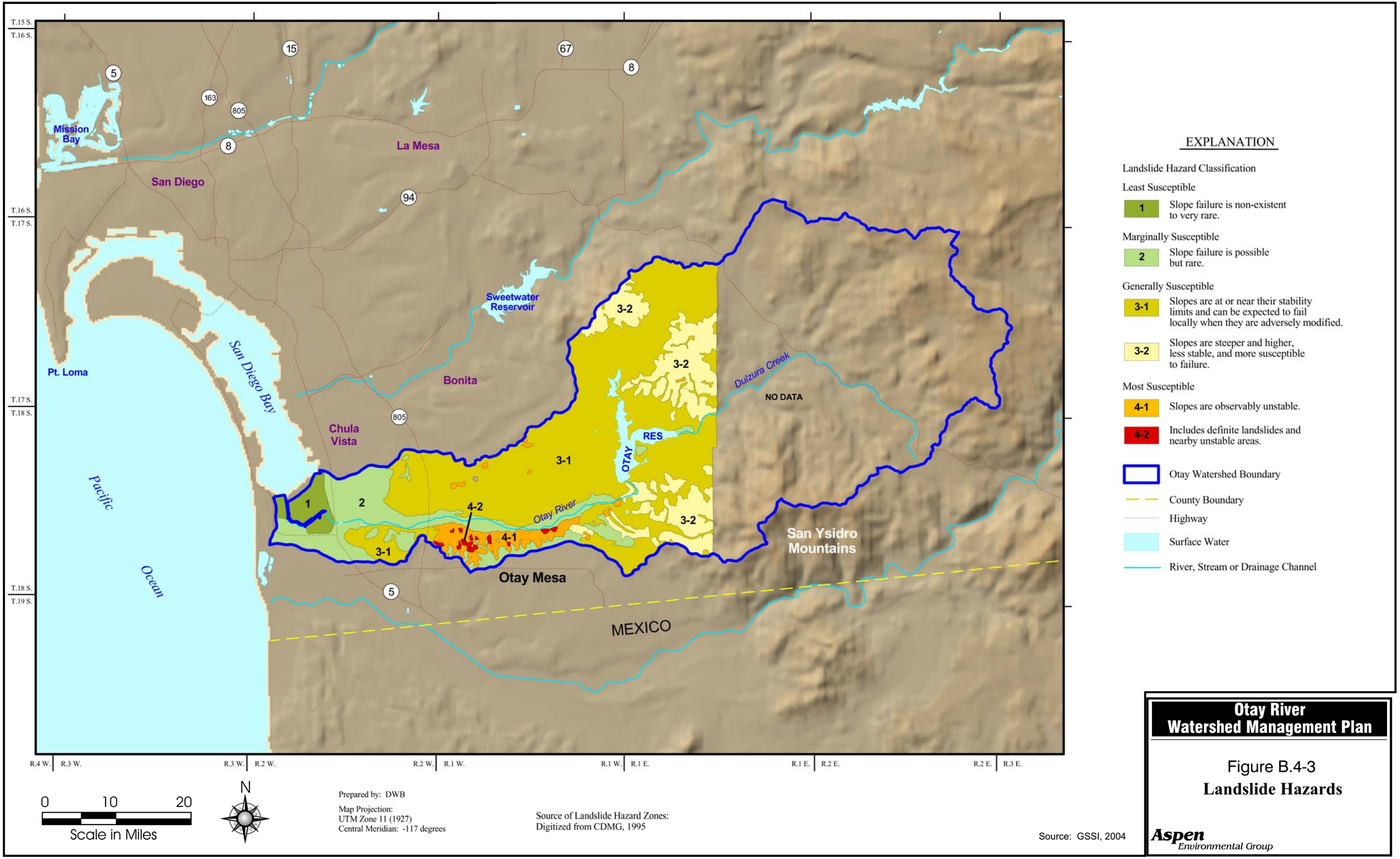
B.4.4.2 Paleontological Resources

The fossilized remains and traces of prehistoric plants and animals are a non-renewable and limited scientific resource. Correlations between fossil occurrence and geology allow rock formations to be evaluated for their paleontological resource potential. The City of San Diego has assigned a high resource sensitivity to the San Diego Formation, the upper third of the Otay Formation, and the Mission Valley Formation, all of which outcrop in the Otay River watershed (City of San Diego, 2002b; CDMG, 1977).

B.4.5 Soils

Major soil groups in the Otay River watershed are shown on Figure B.4-5. The most widespread soil units are loams, including the San Miguel, Friant, and Huerhuero soil associations. The Diablo clays, consisting of dark-gray to black adobe clays and clay loams, are also extensive to the west of the Lower Otay Reservoir (USDA, 1918).

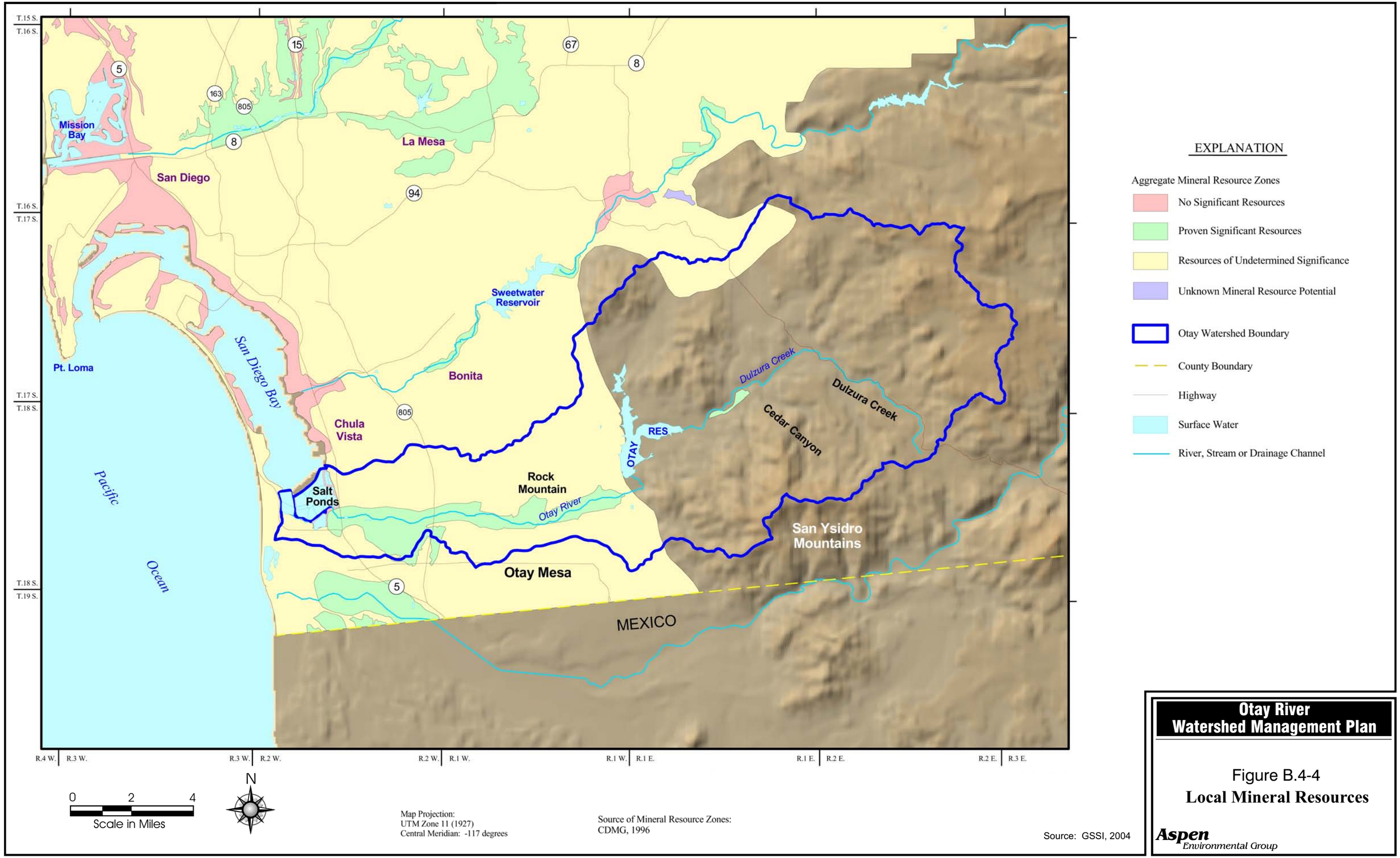
Soils in the riparian areas and active floodplains of the Otay River are generally well drained and poorly developed, without distinct layers. Floodplain soils are of recent age and mainly consist of silt loams and silty clay loams of alluvial origin (Lichvar and Ericsson, 2003).



Otay River Watershed Management Plan

Figure B.4-3
Landslide Hazards

Aspen Environmental Group



Otay River Watershed Management Plan

Figure B.4-4
Local Mineral Resources

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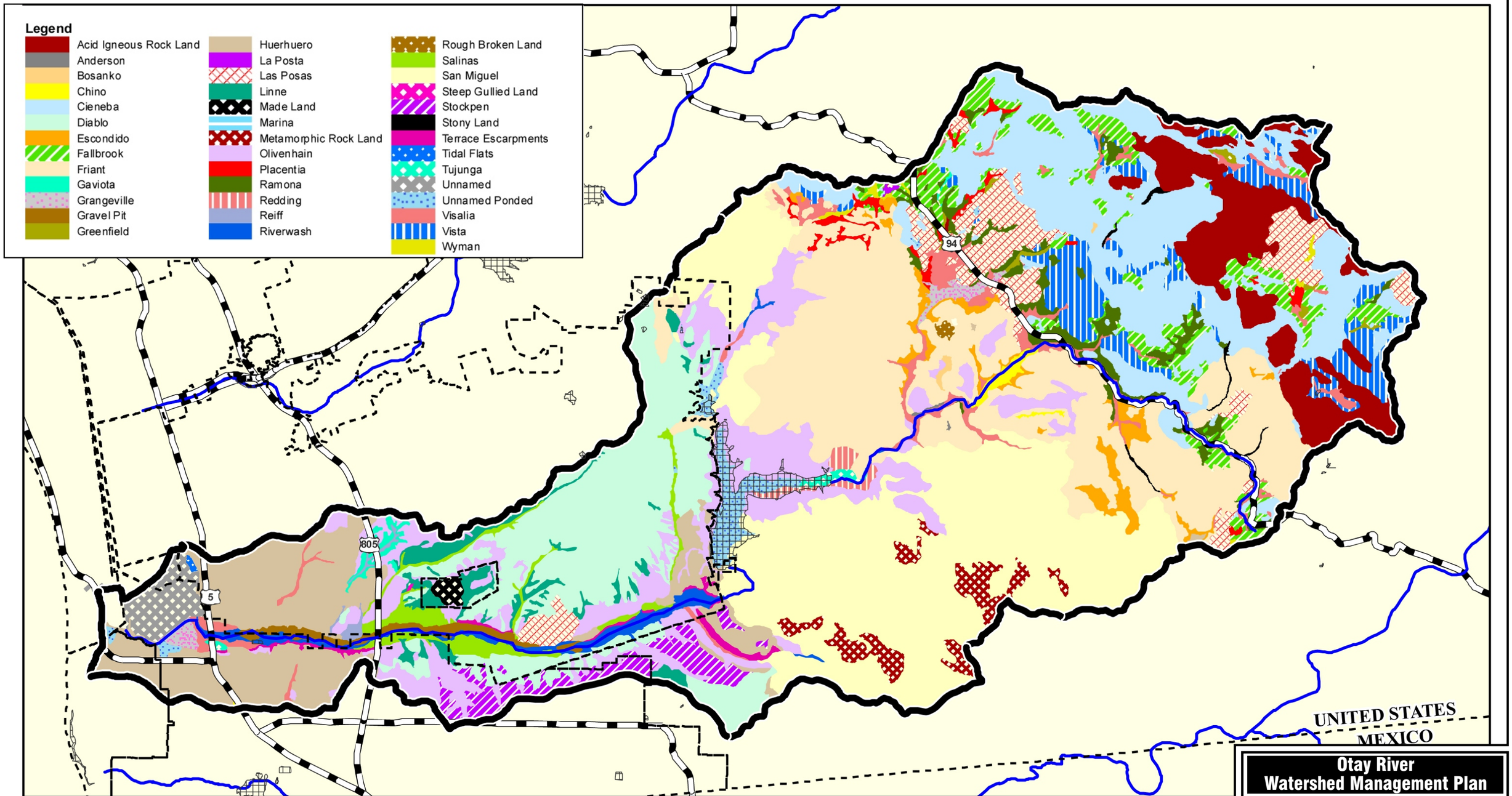

Otay River Watershed Boundary
City Boundary
Rivers
Lakes

0 1.25 2.5 5
Scale in Miles

N

Source: TAIC, 2004

Otay River Watershed Management Plan

Figure B.4-5
Soil Series

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B.5 WATER RESOURCES

B.5.1 Hydrology

The Otay River watershed is located in southern San Diego County, stretching from its San Diego Bay outlet approximately 22.5 miles inland to its headwaters near the mountains of Cleveland National Forest. The Pacific Ocean influences the climate of the region significantly, and climate factors such as precipitation and temperature are highly correlated with distance from the coast and elevation. This section discusses the hydrologic climate of the San Diego Region with an emphasis on the hydrologic data that are available for the Otay River watershed.

Temperature

The Pacific Ocean tempers the prevailing winds and weather of coastal San Diego County. This moderating effect results in cool summers and warm winters in comparison with other locations in the same general latitude (NOAA, 2004). The climate of the San Diego region is so temperate that United States Weather Bureau has described coastal San Diego's weather as the closest thing to perfect in America (City of San Diego, 2004c). Figure B.5-1 illustrates the average monthly temperatures typical of coastal areas in the San Diego region.

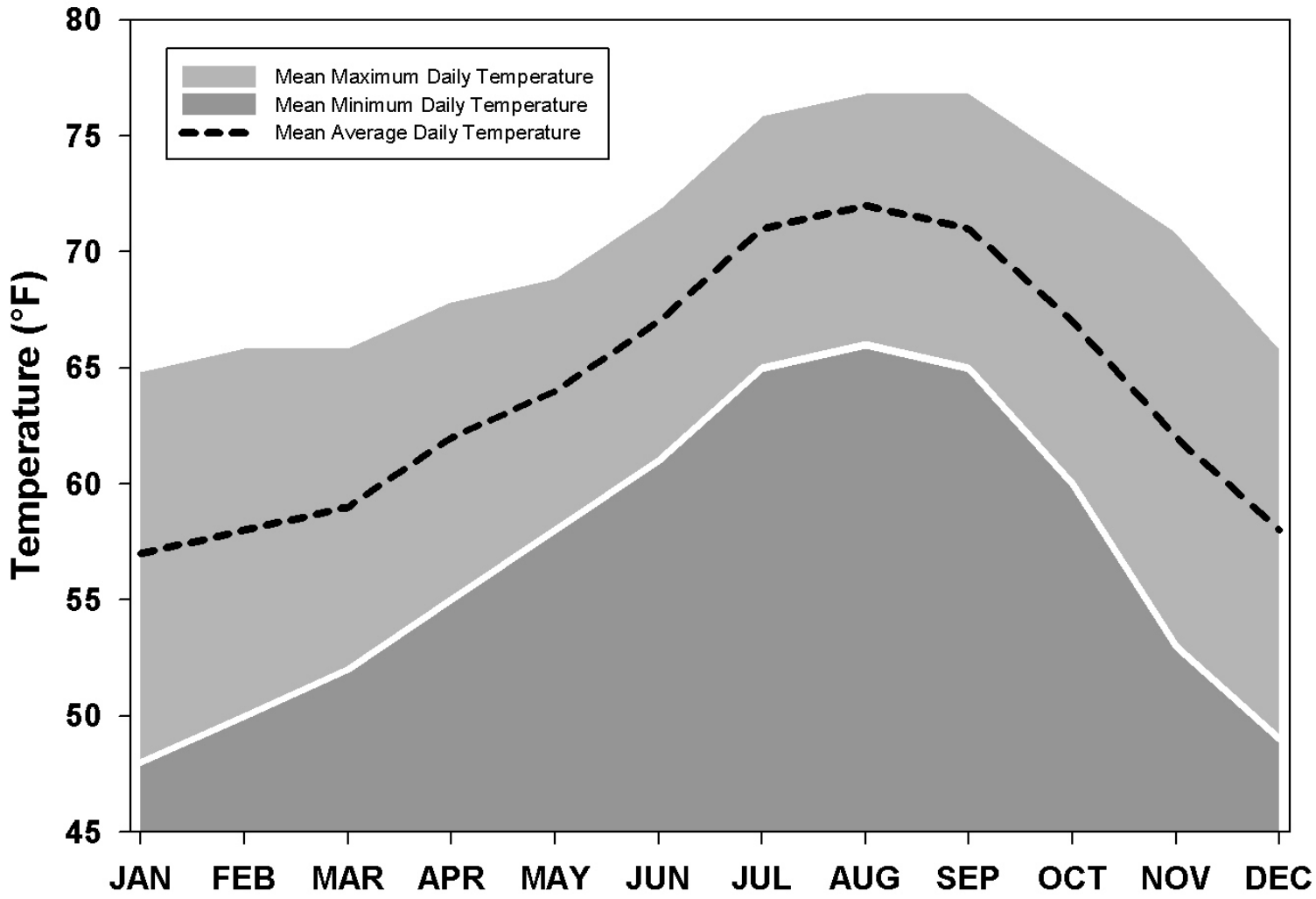
Freezing temperatures are extremely rare in coastal San Diego County; hot weather (90 degrees or above) is more frequent. Dry easterly winds sometimes blow in the vicinity for several days at a time during the fall, bringing temperatures in the 90s and at times even in the 100s in inland areas. The highest temperatures occur in the months of September and October. Records show that over 60 percent of the days with 90 degrees or higher have occurred in these two months. High temperatures are almost invariably accompanied by very low relative humidity, which often drop below 20 percent and occasionally below 10 percent.

A major feature of the San Diego climate is the wide variation in temperature within short distances. In contrast to the coastal region, daytimes are much warmer in summer and winter nights are noticeably cooler in inland valleys. Freezing also occurs much more frequently than in coastal regions. Records show small daily temperature ranges (only about 15 degrees between the highest and lowest readings) at coastal weather stations, while a few miles inland these ranges increase to 30 degrees or more.

Precipitation

Annual precipitation increases with elevation and distance from the coast. Coastal San Diego receives approximately 10 inches of precipitation annually. The average precipitation on the eastern side of the Otay River Watershed is approximately 15 inches, and may be higher in some locations depending on slope and elevation. Figure B.1-3 illustrates the average annual rainfall isopluvials for the San Diego region.

The National Weather Service has monitored precipitation at the Lower Otay Reservoir since 1906. This station is the only precipitation gauge within the Otay River watershed. Figure B.5-2 summarizes the precipitation data at this station, which has a mean annual precipitation of approximately 11.3 inches. While technically not within the Otay River Watershed, the precipitation station at San Diego Lindbergh Field can be used as a surrogate for precipitation at the mouth of the Otay River Watershed. The National Weather Service has historical precipitation records for this station from 1850. Figure B.5-3 summarizes the precipitation data at this station, which has a mean annual precipitation of approximately 9.9 inches. Similarly, the precipitation station at Dulzura Summit can serve as a



Source: RBF, 2004

Otay River Watershed Management Plan

Figure B.5-1

Mean Daily Temperature at San Diego Lindbergh Field

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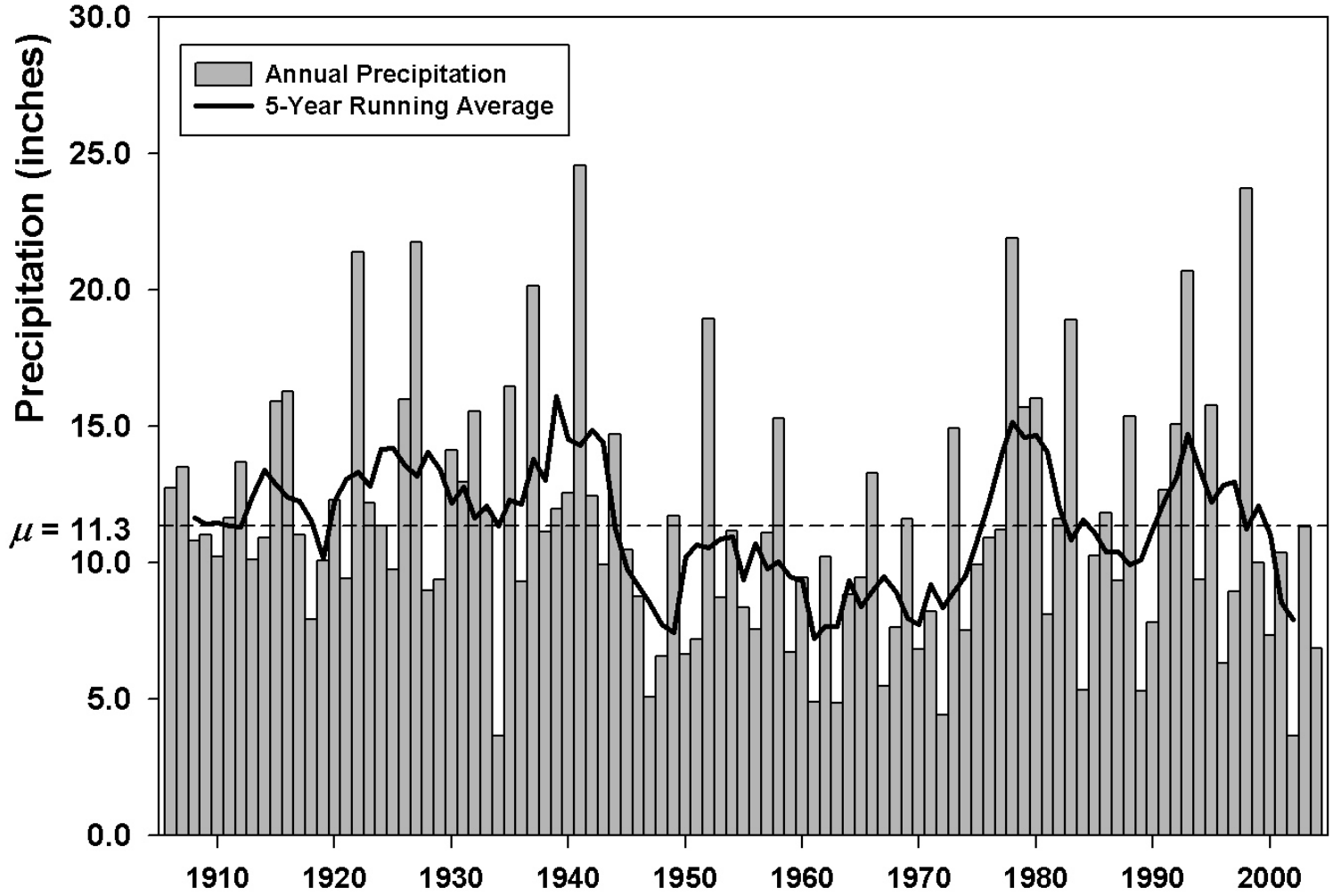

Source: RBF, 2004;
FY 1906-2004

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Figure B.5-2

Annual Precipitation at Lower Otay Reservoir

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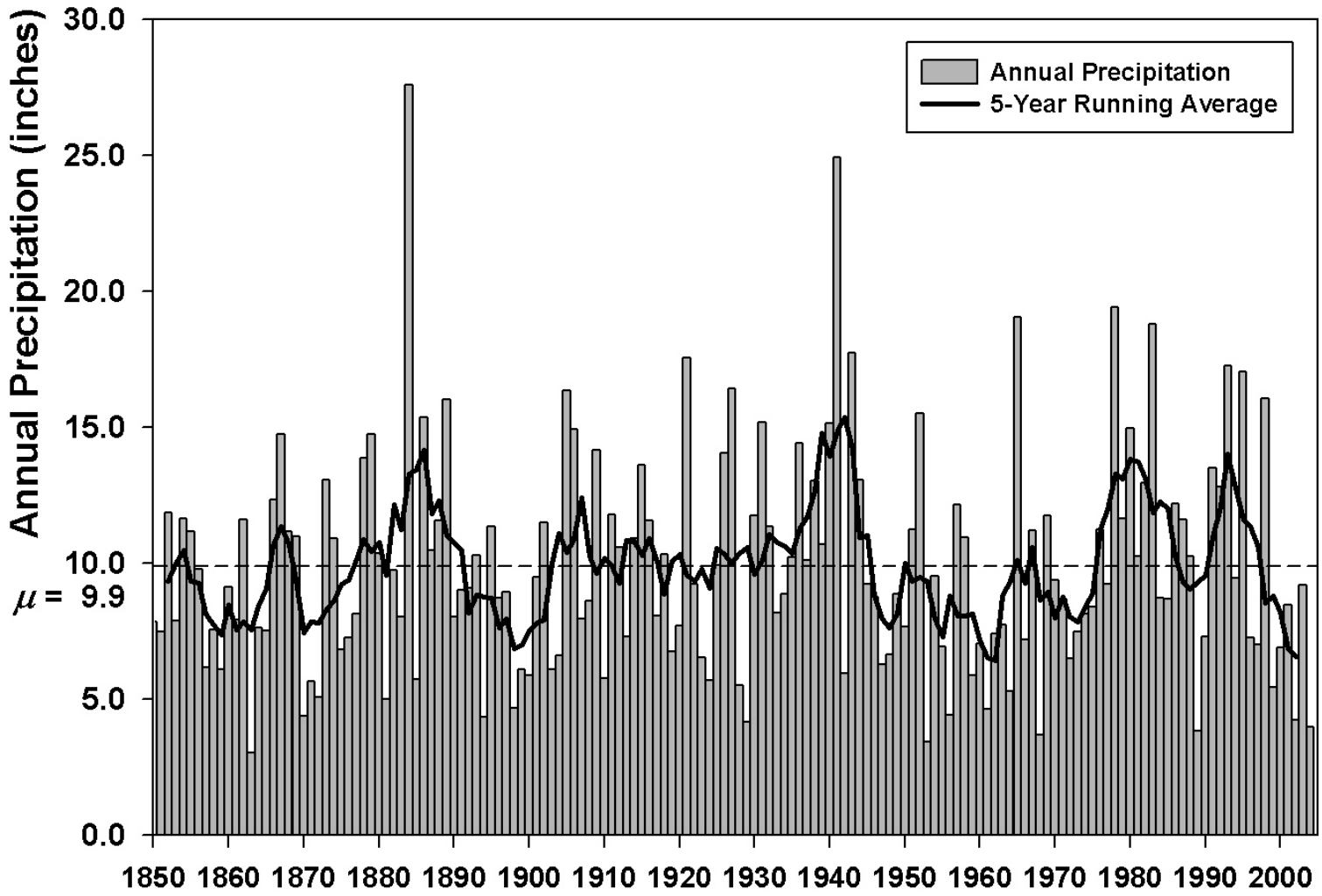

Source: RBF, 2004;
CY 1850-2003

Otay River Watershed Management Plan

Figure B.5-3

Annual Precipitation at San Diego Lindbergh Field

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surrogate for precipitation at the headwaters of the watershed. The National Weather Service has historical precipitation records for this station from 1970. Figure B.5-4 summarizes the total annual precipitation at the Dulzura Summit, which has a mean annual precipitation of approximately 14.2 inches.

Most of the precipitation falls in winter. Eighty-five percent of rainfall occurs from November through March, but wide variation takes place in monthly and seasonal totals. Figure B.5-5 illustrates the monthly variation in precipitation in the San Diego region. Thunderstorms in coastal San Diego are rare, but may occur occasionally in the more mountainous eastern portion of the Otay River Watershed.

Other Weather Patterns

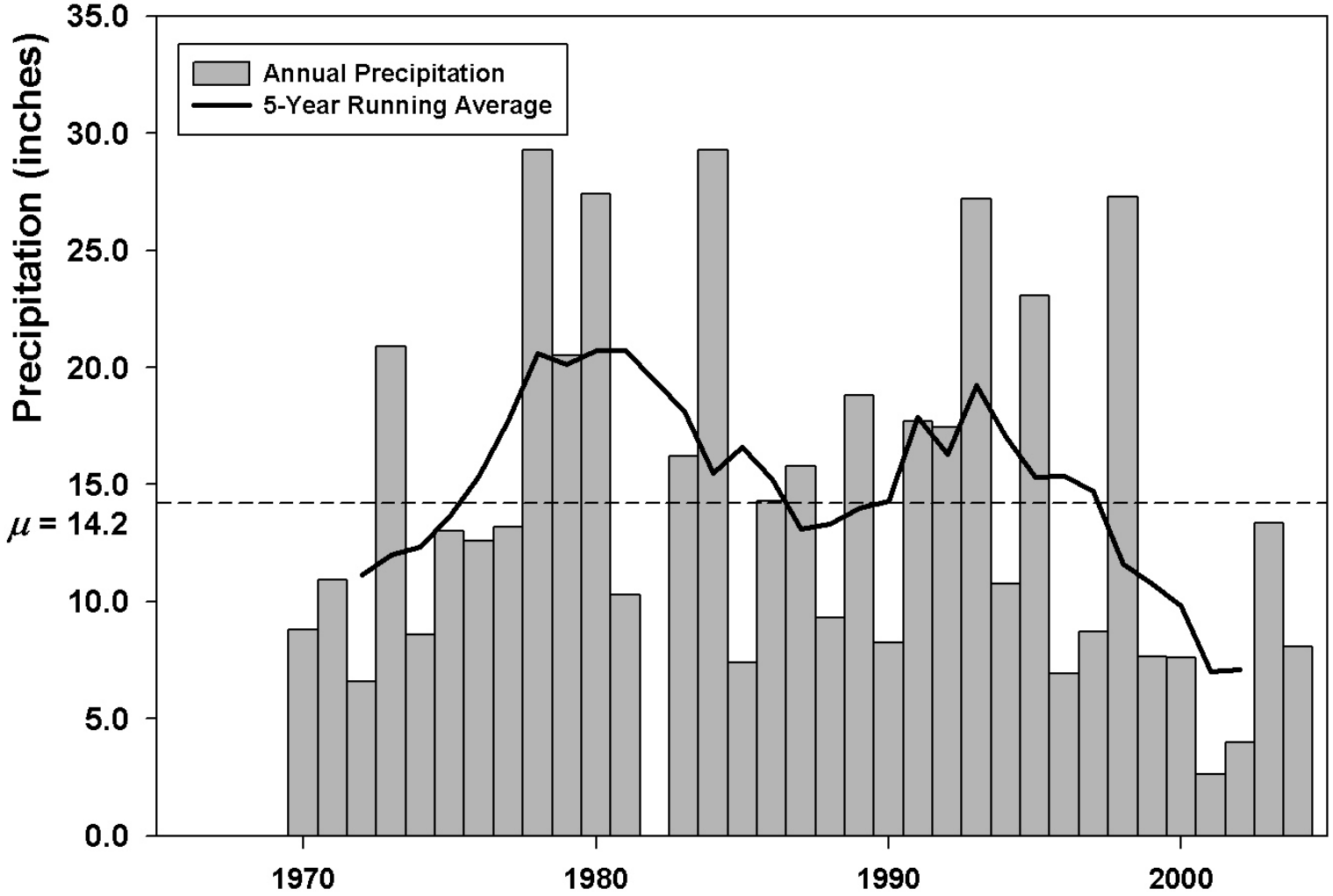
Nighttime and early morning cloudiness is the dominant weather pattern in spring and summer, which is typical of the Pacific Coast. A "marine layer" of low clouds forms regularly during these months, and frequently extends inland over the coastal valleys and foothills. These clouds usually dissipate during the morning, and the afternoons are generally clear. Similar to regional precipitation patterns, there is a marked increase in sunshine in inland San Diego, where the cloudiness of the coastal areas give way to clearer skies and high visibility. The coast can be very foggy during the fall and winter months, but the amount of fog decreases with distance inland.

Strong winds and gales associated with Pacific tropical storms are infrequent due to San Diego's latitude. Measurable amounts of hail occur in San Diego on rare occasions, but snow is practically unknown in the coastal zone. Snow that has arrived in coastal San Diego historically has been less than 0.5 inch deep and very ephemeral, remaining on the ground for only about an hour. Snow occurs more frequently in the higher altitudes of the eastern portion of the watershed, but not in amounts significant enough to provide permanent winter snow cover or significant spring snowmelt.

Cyclic Climate Oscillations

The El Niño-Southern Oscillation (ENSO) is climatic pattern with a cycle of six to eighteen months that is correlated to Pacific Ocean temperature. Recent work by Andrews et al. (2004) examined the hydrologic record for 38 coastal streams in California, including Jamul Creek on the Otay River watershed, and found that the ENSO had significant influence on the annual peak flood record of streams in southern California between 1950-2000. Specifically, flood peaks in Southern California are significantly larger during El Niño phases than non-El Niño phases. Figure B.5-6 illustrates the results of Andrews et al.'s El Niño analysis for Jamul Creek, compared to the results of the flood frequency analysis for the period of record (WY 1940-2002).

Other researchers are examining the effect of the Pacific Decadal Oscillation (PDO) on the hydrology of the western United States (Mantua, 2004). The PDO is a long-term pattern of climate variability that is generally correlated to ocean temperatures in the Pacific Ocean. On a cycle of approximately 25 to 30 years, the PDO influences climate patterns in the Western Hemisphere. During the "cool cycle" of the PDO, the southern U.S. and Northern Mexico tend to experience above average precipitation; the converse is true for PDO warm cycles. Therefore, the PDO enhances the El Niño effect when it is in phase with ENSO, and damps the El Niño effect when it is not in phase with ENSO.



Source: RBF, 2004
FY 1970-2004

Otay River Watershed Management Plan

Figure B.5-4

Annual Precipitation at Dulzura Summit

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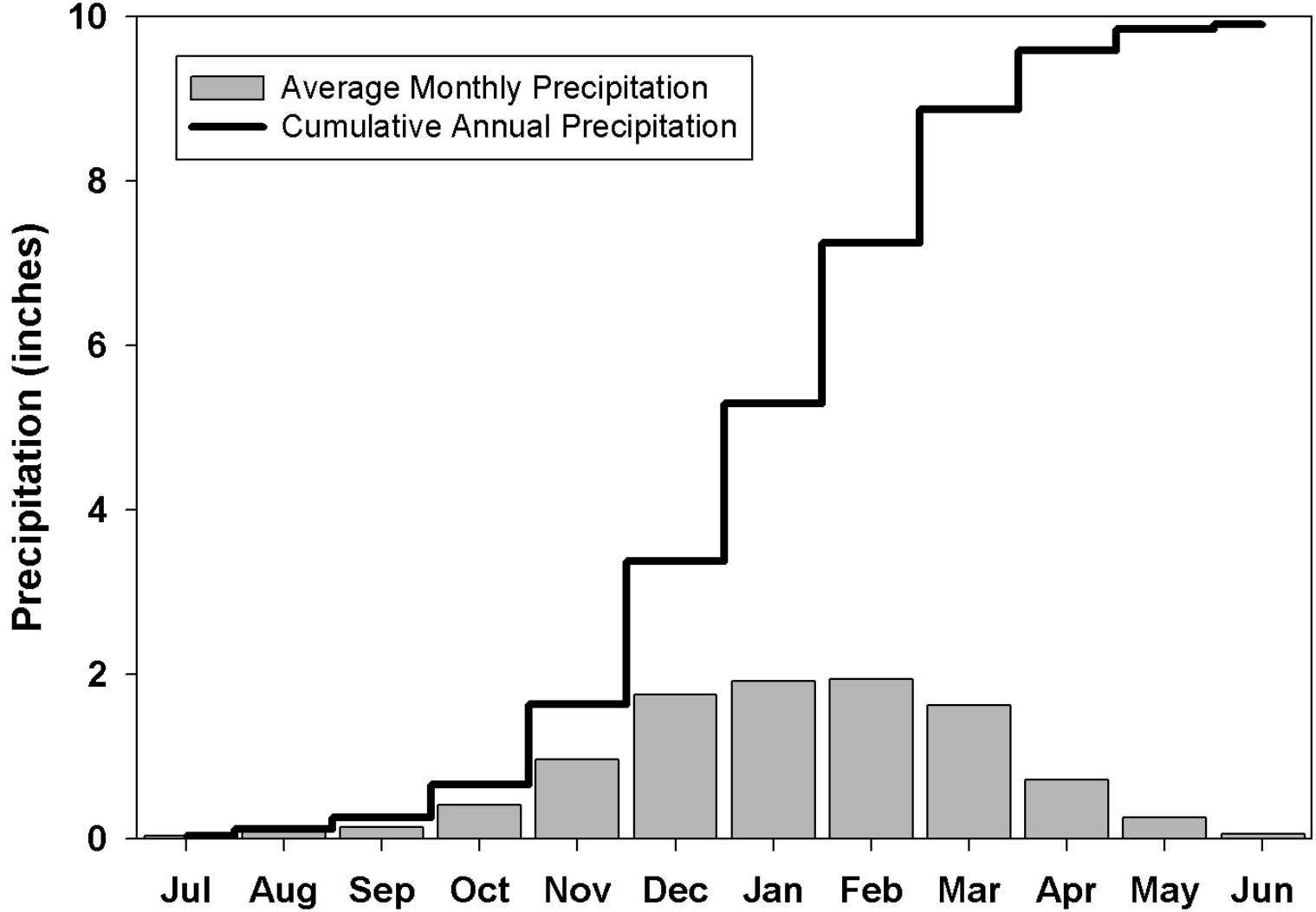

Source: RBF, 2004

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Figure B.5-5

Monthly Distribution of Average Rainfall at San Diego Lindbergh Field

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Figure B.5-6
Effect of El Niño-Southern Oscillation on Flood Peaks on Jamul Creek

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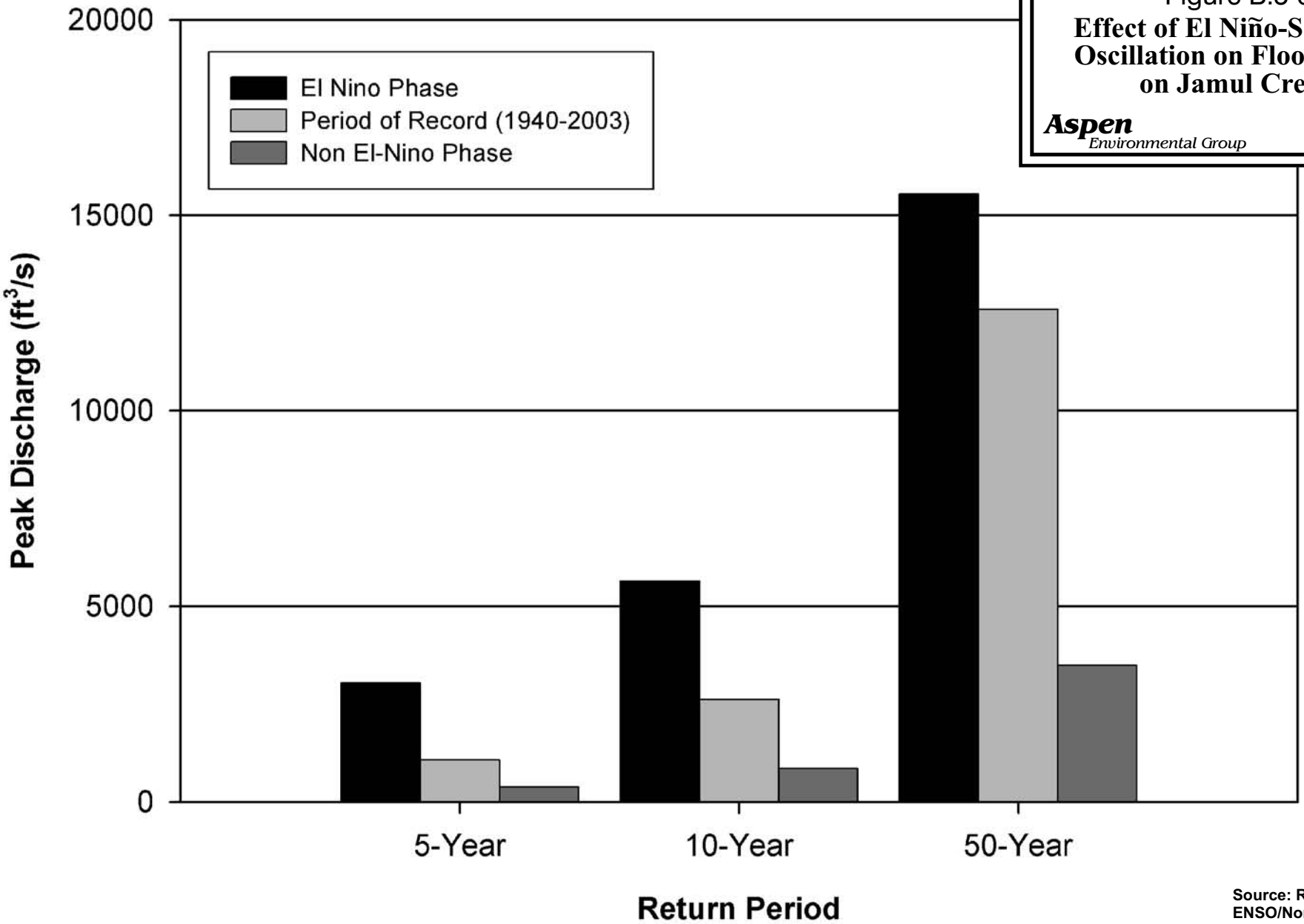


Source: RBF, 2004; ENSO/Non-ENSO Data from Andrews et al., 2004

Stream Gauging

The U.S. Geological Survey (USGS) has maintained two streamflow gauges on the Otay River watershed; only one is currently in use. Table B.5-1 summarizes the stream gauges located on the Otay River Watershed. The stream gauge on Jamul Creek is a real-time stream gauge located near where Jamul Creek enters the Otay Reservoir, and serves 70.2 square miles of watershed.

Table B.5-1 Stream Gauges on the Otay River Watershed

Stream Gauge No.	Description/Location	Period of Record	Tributary Area	Type of Data
11014000	Jamul Creek near Jamul, CA	1940 – 2002	70.2 mi^2	Real Time Peak Streamflow Daily Streamflow
11013600	Jamul Creek at Lee Valley	1983-1988	2.27 mi^2	Peak Streamflow Daily Streamflow

Source: USGS 2004a, 2004b.

Regional Regression Equations

Regional regression equations are an indirect source of hydrology data for the Otay River watershed. The USGS developed regional regression equations for ungauged streams in California (Waananen and Crippen, 1977) to provide a convenient and useful method for estimating flows for ungauged sites in the absence of more definitive data. The equations are based on factors such as watershed area, mean annual precipitation, and altitude. Tables B.5-2 and B.5-3 summarize the regional regression equations for the South Coast region of California and the calculated peak flows for streams within the Otay River watershed, respectively.

Table B.5-2 Regional Flood-Frequency Regression Equations for South Coast Region of California

Return Period	K	α	β
2 yr	0.14	0.72	1.62
5 yr	0.40	0.77	1.69
10 yr	0.63	0.79	1.75
25 yr	1.10	0.81	1.81
50 yr	1.50	0.82	1.85
100 yr	1.95	0.83	1.87

Source: USGS, 1977. $Q = KA^{\alpha}P^{\beta}$; Q = peak flow rate in cubic feet per second; K, α, β = regression equation coefficients; A = watershed area in square miles; P = mean annual precipitation in inches.

Table B.5-3 Regional Regression Equation Estimate of Peak Flood Flows

	2-year (cfs)	5-year (cfs)	10-year (cfs)	25-year (cfs)	50-year (cfs)	100-year (cfs)
Otay River (Watershed Below Reservoir Only)	133	548	1,084	2,378	3,728	5,297
Proctor Valley Creek	52	202	390	834	1,290	1,809
Jamul Creek at Jamul Valley	68	266	519	1,121	1,746	2,457
Jamul Creek at Lee Valley	26	96	182	384	590	819
Hollenbeck Canyon Creek at Lyons Valley	34	125	239	507	785	1,093
Jamul Creek at Otay Reservoir	187	785	1,573	3,494	5,521	7,878
Dulzura Creek at Engineer Springs	18	64	121	252	385	532

Peak flows are not adjusted for urbanization or other factors.

The regression analysis used to develop the regional regression equations did not include any data from the Otay River watershed. Because there are now 25 years of additional peak flow data available (WY 1940-2002), a flood frequency analysis was conducted to verify the applicability of the regional regression equations for the Otay River watershed. Figure B.5-7 provides average daily stream flow data for Jamul Creek. Figure B.5-8 illustrates the results of the flood frequency analysis for Jamul Creek and compares them to the results of the regional regression equations. Because the results of the USGS regional regression equations show good agreement with the flood frequency analysis for the gauge at Jamul Creek, the equations can be used to calculate the flood frequency of the unregulated streams within the Otay River watershed with reasonable confidence.

Flood Insurance Studies and Drainage Master Plans

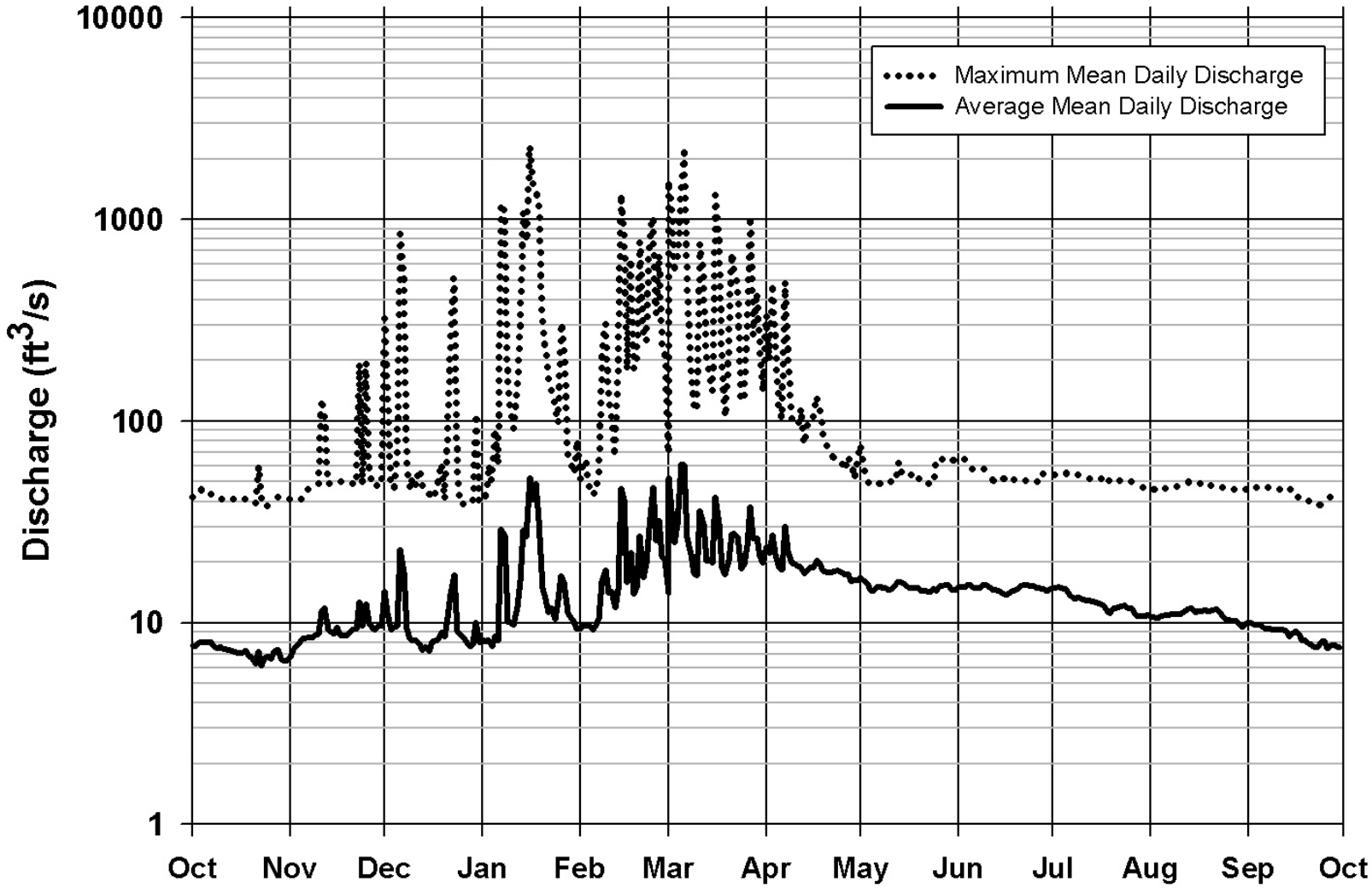
A secondary source of hydrology data for the Otay River watershed is the Flood Insurance Study (FIS) for San Diego County. Most of these flood insurance studies were completed in the late 1970s and early 1980s. The FIS maps several creeks in the Otay River watershed as Special Flood Hazard Areas (SFHAs), including: the Otay River below the Otay Reservoir; Poggi Canyon Creek; and portions of Dulzura Creek. Table B.5-4 summarizes the FIS for creeks within the Otay River watershed. The FIS for San Diego County is based on predictive hydrologic models, which generally were not calibrated to real streamflow or flood stage data. Therefore, these data should not be construed as real data, but used only as an order of magnitude estimate of the amount of flow at particular locations on the watershed.

Table B.5-4 Summary of Flood Insurance Studies on the Otay River Watershed

	Tributary Area	Peak Discharge (cfs)			
		10-year	50-year	100-year	500-year
Otay River					
at Otay Valley Road	122.7 mi^2	1200	12,000	22,000	50,000
Nestor Creek					
at Palm Avenue	2.75 mi^2	--[1]	--[1]	1,093	--[1]
at 19th Street	--[1]	--[1]	--[1]	864 [2]	--[1]
at Elm Avenue	2.45 mi^2	--[1]	--[1]	796 [2]	--[1]
at Coronado Avenue	2.33 mi^2	--[1]	--[1]	698 [2]	--[1]
at Hollister Street	1.99 mi^2	--[1]	--[1]	496 [2]	--[1]
at 25th Street/Interstate 5	1.71 mi^2	--[1]	--[1]	456 [2]	--[1]
at San Diego and Eastern RR	1.40 mi^2	--[1]	--[1]	945	--[1]
Johnson Canyon Creek	--[1]	--[1]	--[1]	--[1]	--[1]
Poggi Canyon Creek					
at Chula Vista Corporate Limits	3.74 mi^2	180	830	1280	2470
at confluence with Otay River	4.63 mi^2	220	930	1400	2630
Salt Creek	--[3]	--[3]	--[3]	--[3]	--[3]
Dulzura Creek	--[3]	--[3]	--[3]	--[3]	--[3]

[1] Data Not Available; [2] Flow Decreases due to Detention Basin Upstream of Railroad; [3] Dulzura Creek and Salt Creek mapped Zone A, with no Base Flood Elevations; data are not available. Source: FEMA, 2002.

The Otay River watershed is located within the San Diego County Flood Control District Zone IV. The County of San Diego commissioned Comprehensive Plans for Flood Control and Drainage for all drainage zones in the mid 1970s (San Diego County, 1975). These Comprehensive Plans serve as master plans of drainage that estimate peak flow rates based on predicted 1990 land uses and identify the correlating drainage facility deficiencies. The County prepared a similar drainage master plan for the East Otay Mesa Specific Plan in 1993, which includes hydrologic analyses and predicted flow rates



Source: RBF, 2004;
WY 1940-2002

Otay River Watershed Management Plan

Figure B.5-7
Average Daily Stream Flow at Jamul Creek near Jamul, CA

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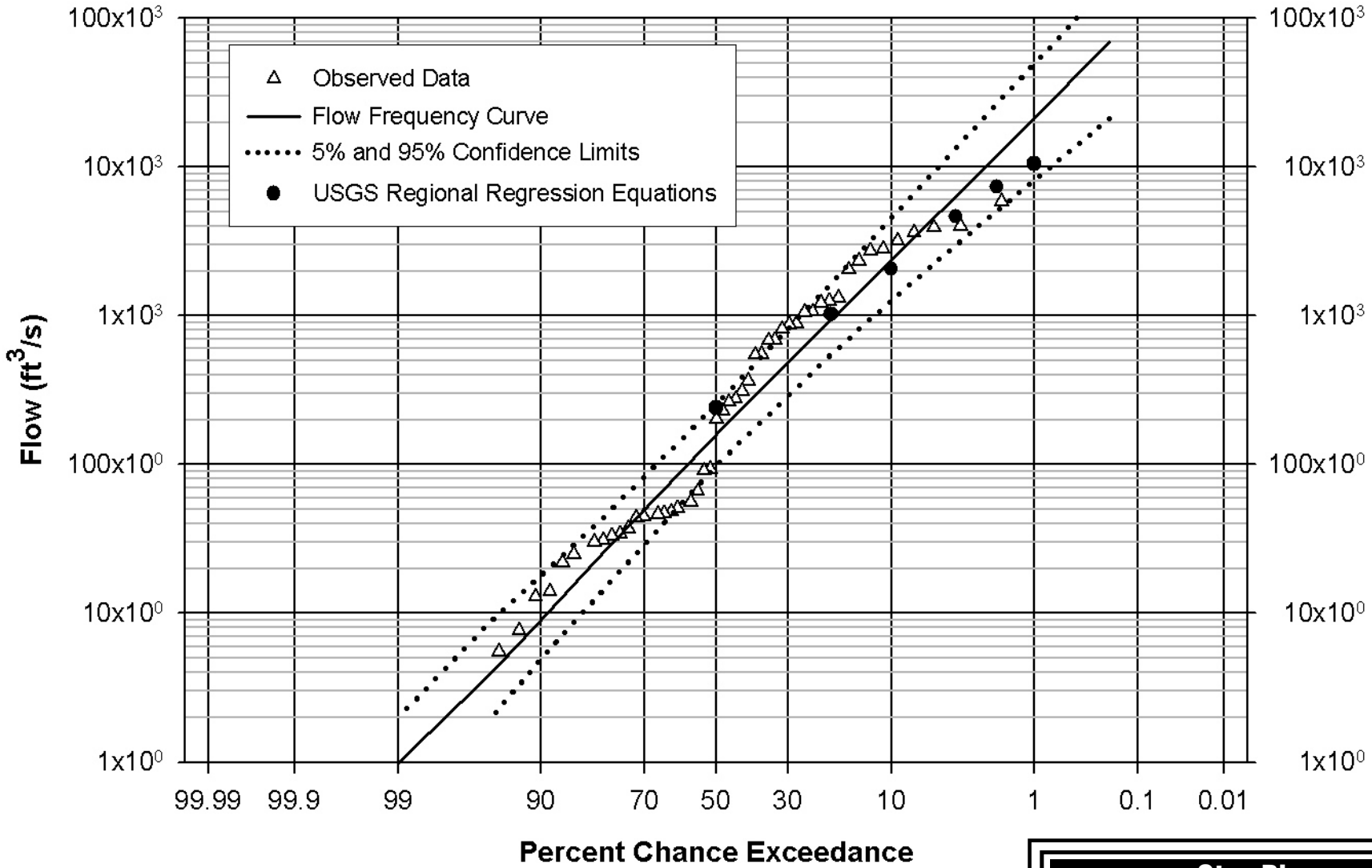

Source: RBF, 2004; WY 1940-2002

Otay River Watershed Management Plan

Figure B.5-8
Flood Frequency Analysis for Jamul Creek

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for both Johnson Canyon and O'Neal Canyon. The City of Chula Vista's Master Plan of Drainage also covers portions of the Otay River watershed, and dates from the 1980s. Both the County Department of Public Works and the City of Chula Vista are currently updating their drainage master plans.

B.5.2 Hydraulics

This section presents an inventory of major hydraulic structures on the Otay River watershed. Development in the watershed is largely concentrated downstream of the Lower Otay Reservoir within the Cities of San Diego and Chula Vista. Upstream of the reservoir, development in the County of San Diego is considerably less dense, with large areas remaining completely undeveloped. Vehicular access to tributaries becomes more limited as one gets farther upstream from the reservoir. This inventory is based upon field reconnaissance conducted in May 2004, and limited to the following stream reaches: Otay River, Salt Creek, Poggi Canyon Creek, O'Neal Canyon Creek, Dulzura Creek, Proctor Valley Creek, Hollenbeck Canyon Creek, and Jamul Creek.

Floodplains/Flood Risk

Flood risk, or at least perceived flood risk, is inherently related to human development on the watershed. Natural systems experience, and ecosystems often depend on, periodic inundation of low-lying areas. Human activity changes the perspective on the natural flooding cycle. In fact, flood inundations areas are often not even mapped unless there is perceived risk to human life, safety, and/or property. Therefore, any discussion of flooding on watershed is necessarily tied to this anthropogenic perception of flood risk.

The primary flood risks on the Otay River watershed are in older urbanized areas located on the lower part of the watershed, in particular drainageways such as Nestor Creek. These flooding issues are partly due to the inherent difficulty of draining low-lying coastal areas, and the fact that older drainage facilities are often under-sized when compared to modern design standards. Modern facilities are usually designed to safely convey the runoff from a 100-year event (i.e., one with a one percent annual probability of occurring). This is why more recent development, such as in the majority of the City of Chula Vista, has drainage infrastructure that is adequate to eliminate most flood hazards. In accordance with the National Flood Insurance Program (NFIP) eligibility rules, municipal floodplain ordinances generally require that new structures be kept out of the 100-year floodplain. At a minimum, development must not cause (or must at least limit) any increases in 100-year flooding depth. Localized flooding may still occur due to unanticipated obstructions or maintenance issues in storm drains or channels, but these occurrences are usually minor in the context of the over-all drainage of the watershed.

The Otay Reservoirs, by impounding flow from the majority of the watershed, have for the most part eliminated flooding on the Otay River mainstem. Spills over dam are infrequent and insignificant in magnitude when compared to a pre-dam flooding regime. There is still a possibility, however low in probability, of a catastrophic flood that would cause a catastrophic collapse of the Otay Dam such as occurred in 1916.

Flood risks are less upstream of the Otay Reservoirs, primarily because there is less development in this part of the watershed. Fewer streams are mapped for flood hazards for the same reason. Consistent with NFIP eligibility rules, County of San Diego floodplain management ordinances and design standards require that development project proponents identify flood inundation areas and keep new structures outside of the 100-year floodplain, and limit project effects on floodplain depth. Thus, flood risk is very low in the upper watershed.

Upstream of the Otay Reservoirs

Dulzura Creek

Dulzura creek extends upstream from the Lower Otay Reservoir, generally paralleling Otay Lakes Road until reaching State Route 94 (SR-94). The creek then bends southeast to follow SR-94, passing through the communities of Engineer Springs and Dulzura. This creek has few flood control facilities and little adjacent development.

Immediately upstream of the reservoir, the creek passes under Otay Lakes Road in a triple-box culvert. Based on field observations, it appears that this culvert may overtop and flood the road during storm events. However, because the crossing occurs at a dip section of the road, flooding appears localized. Upstream of this crossing, the creek parallels the road on the north side with hilly terrain on both sides.

Approximately two miles upstream of the reservoir, the creek passes through an RV Park. The RV Park has constructed a culvert road crossing of the creek to facilitate access to the north side of the creek. An abandoned crossing was observed approximately 50 yards downstream of the existing crossing. The existing culvert consisted of four reinforced concrete pipes laid in the creek. Upstream of the RV Park, the hilly terrain on the north side of the creek flattens out, and the creek passes through large areas of open, flat land before reaching State Route 94.

State Route 94 passes over the creek on an older 3-pier bridge. The creek then parallels SR-94 through the communities of Dulzura and Engineer Springs. Along this reach, the creek crosses under the highway once. A single-pier bridge carries traffic from the south to north bank of the creek near the Dulzura Post Office. While this section of the creek was more heavily developed than the downstream reaches, development was sparse with limited impervious improvements. While some small culvert crossings may exist in this area to facilitate access for private property owners, no additional significant flood management facilities were observed.

Hollenbeck Canyon Creek

The Hollenbeck Canyon Creek headwaters exist near the intersection of Honey Springs Road and Lyons Valley Road. Flows proceed downstream in a southwesterly direction towards a junction with Dulzura Creek. The upstream creek reach runs alongside Lyons Valley Road with only one visible flood management facility: a culvert crossing under Lyons Valley Road. Development in the area consists of single-family homes on large lots interspaced with natural open space. After a steep drop in elevation and another culvert crossing, the creek leaves the rural residential area behind. There are no other flood control facilities until the creek reaches SR-94.

The creek crosses under SR-94 in a culvert. After the crossing, flows return to a natural creek channel and continue downstream until reaching a junction with Dulzura Creek. Other then the three road crossings, no flood management facilities were visible.

Jamul Creek

Jamul Creek is a natural stream that is only interrupted by the SR-94 crossing. Similar to the Hollenbeck Canyon Creek, the Jamul Creek main stem has its headwaters northeast of SR-94, originating in the area of Lee Valley. Flows proceed downstream in the natural creek until reaching SR-94. After passing through a culvert crossing, flows continue downstream and confluence with a significant tributary that originates upstream of the unincorporated community of Jamul. Jamul Creek eventually confluences with Dulzura Creek just upstream of the Lower Otay Reservoir. With the

exception of the community of Jamul, the area adjoining this creek is largely undeveloped without improvements of any kind.

Proctor Valley Creek

Proctor Valley Creek represents the last tributary upstream of the reservoir examined as part of this evaluation. The creek has its headwaters in the Indian Springs area of San Diego County and ultimately discharges into Upper Otay Reservoir. While some residences dot the area surrounding the headwaters, the creek quickly draws away from the homes. A dirt road paralleling the creek nearly all the way to reservoir allows access to the remaining creek reach length. No facilities were visible.

An old spillway connects the Upper and Lower Otay Reservoirs. In the event the upper reservoir overtops, flows will pass through the spillway and into the Lower Otay Reservoir. The Lower Otay Reservoir has a concrete man-made dam at its southern end and supplies potable water to the San Diego area. The western and southern shores of the lower reservoir encompass the ARCO Olympic Training Center, two local parks, an open space preserve, and a water treatment plant.

Downstream of the Otay Reservoirs

O'Neal Canyon Creek

O'Neal Canyon Creek confluences with the Otay River immediately downstream of the Lower Otay Reservoir dam. The headwaters of O'Neal Canyon Creek are located in the Otay Mountain Wilderness near Otay Mountain. A short distance upstream of this confluence, O'Neal Canyon Creek passes between the East and West Mesa Detention Facility (R.J. Donovan Correctional Facility). The creek flows through a culvert to pass through a significant embankment supporting the access road connecting the East and West Detention Facilities. Given the steep bank slopes adjoining the creek and the greater than 20-foot-high road embankment, this culvert acts as a significant flood management facility for this creek. Upstream of this culvert and the detention facility, the creek flows through undeveloped land. No further flood management facilities were observed along this reach.

Poggi Canyon Creek

Poggi Canyon Creek's headwaters occur just south of Olympic Parkway and east of the proposed State Route-125; the creek confluences with the Otay River immediately downstream of the I-805 bridge crossing. Existing development along the lower reaches of this creek combined with new residential development along the creek's upper reaches will completely transform this stream to an urban creek over the next couple of years.

No facilities were visible along the upper reaches of this creek. However, the significant residential development along Olympic Parkway in this area will include improvements to the creek. Preliminary improvements associated with this development include culvert crossings (anticipating future road crossings) and grade control structures.

As the creek nears I-805, it enters a previously developed area of Chula Vista and contains a number of flood control improvements. Near Valley Lindo Elementary, the creek uses a large circular culvert to cross under streets and other improvements. Downstream of this culvert, the creek is sometimes confined to a concrete channel extending under the I-805 Bridge crossing towards Main Street. At Main Street, the creek crosses under the road in a box culvert and discharges into a creek channel lined with rock gabions to protect the side slopes. Finally, the creek crosses under Rancho Drive via a 3-cell box culvert before confluencing with Otay River.

Salt Creek

Salt Creek runs from north to south just west of Otay Reservoir. The Salt Creek watershed is experiencing significant residential development. Major road crossings associated with this development include Duncan Ranch Road, Proctor Valley Road, Otay Lakes Road, and Olympic Parkway.

Otay River

The Otay River flows from the Lower Otay Reservoir downstream through the County of San Diego and the Cities of Chula Vista, San Diego, and Imperial Beach. This area is part of the OVRP, which acts as a buffer between the river and existing development. Between the Lower Otay Reservoir dam and Heritage Road, the river passes through largely undeveloped terrain. No facilities were observed in this area. The Coors Amphitheater is immediately downstream of the Heritage Road Bridge crossing. From this point on, the river flows through a developed corridor with a mix of residential, commercial, and industrial development. However, the river retains a natural channel in this area and there are no visible flood control improvements.

Upon crossing under I-805, the river retains a relatively natural channel, but it is fragmented by a number of bridge crossings. The channel is highly vegetated with sections of riprap along the channel banks. After crossing under Interstate-5, the river meanders through an open field passing through a drop structure and under a pedestrian bridge. Downstream of the pedestrian bridge, the river parallels the salt flats for a brief distance before discharging into the southern portion of San Diego Bay. Levees guide the Otay River around the salt ponds.

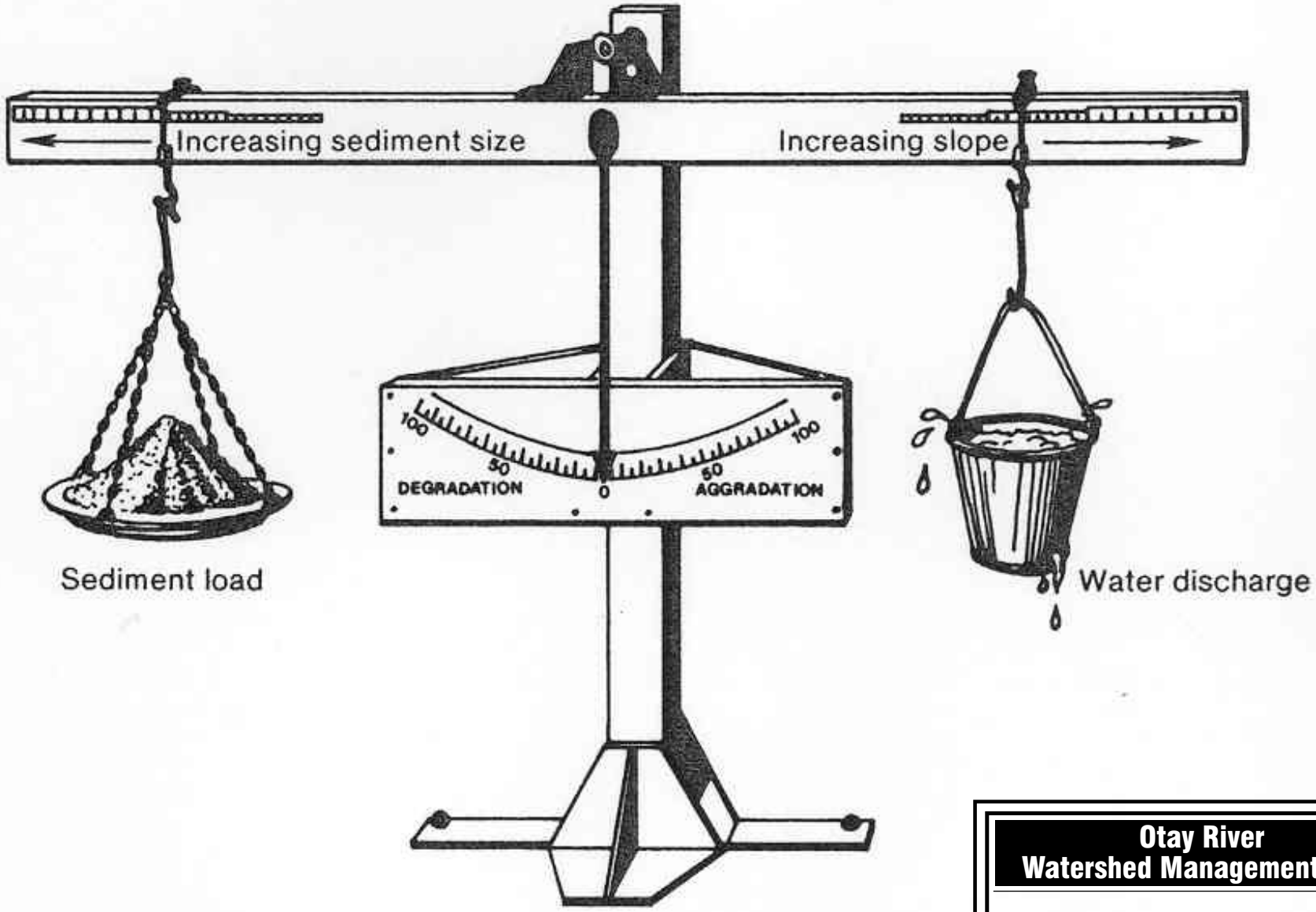
B.5.3 Geomorphology

Rivers operate as systems in quasi-equilibrium. Channel characteristics such as channel slope and geometry will attempt to adjust to changes in geomorphologic drivers such as discharge, sediment characteristics, and sediment supply. The classic metaphor for this quasi-equilibrium relationship is a balance scale comparing sediment size and load to channel slope and discharge (Figure B.5-9). A change in either side of the balance will result in either degradation or aggradation of the stream system as the stream attempts to reestablish equilibrium.

Comparing channel characteristics such as planform (i.e., channel width and alignment), longitudinal profile, and cross section over time can provide a record of past change and help to predict future channel integrity. Geomorphologic drivers tend to be closely correlated to watershed processes such as changes in land use (urbanization), and installation of hydraulic structures (dams, stream crossings). In this way, it is possible to evaluate the effect of past changes to the watershed and forecast future changes based on planned land use and facilities.

The Otay River as a Fluvial System

A fluvial system consists of three basic parts, namely: a drainage basin or watershed, river, and a downstream reservoir, lake, or ocean (Schumm, 1977). These three parts serve different functions within the fluvial system and correlate to component zones within the system: source (erosion) zone, a transfer zone, and a deposition (response) zone. The erosive zone is the part of the watershed where typically the majority of the water and sediment for the river originate. This zone is characterized by diffuse laminar flow, as well as small streams, which are often steep, unstable, braided channels. In the erosive zone, stream morphology can be accomplished only on a gross scale. The transfer zone is an area where the stream configuration is usually the most stable. The deposition zone is frequently located



Source: RBF, 2004; from Chang, 1988

Otay River Watershed Management Plan

Figure B.5-9
Lane's Stable Channel Balance

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near a rivers mouth and is often, as is the case with the Otay River, under the influence of tidal forces. In this zone, delta growth requires aggradation to maintain channel slope and channel capacity, often resulting in a braided river planform.

The Otay River watershed exhibits multiple instances of the three fluvial zones as it flows down to San Diego Bay. For instance, all three zones can be seen as Jamul Creek descends from its headwaters near Lee Valley, travels through Jamul Valley, and ends up in the Lower Otay Reservoir. The three zones again appear as the Otay River proceeds from the Lower Otay Reservoir to San Diego Bay.

Scope

The Otay Reservoir (treating the Upper and Lower Otay Reservoirs as one unit for this assessment) is a significant factor in the geomorphology of the Otay River watershed. The construction of Savage Dam in 1897, and its constant presence except for the 4 years between its failure and subsequent reconstruction in the 1910s, has governed the watershed for over a century. Information about the Otay River watershed before construction of the first dam at Otay Reservoir in 1897 is extremely limited. Consequently, this watershed assessment uses a post-dam, pre-modern-development condition as a "modern historic condition" as a baseline for evaluating the probable effects of modern watershed changes on the river system. The watershed below the Otay Reservoir is experiencing significant and rapid urbanization. The effects of this urbanization will be seen on a river system that has had 100 years to adapt to the hydrologic regime imposed by the dam.

This geomorphic assessment is based upon examination of topographic maps and aerial photography covering the period from 1903-2003. Data sources included USGS topographic maps from 1903, 1941, and 1965/1975, and aerial photographs from 1928, 1979, and 2002.

This section summarizes a qualitative geomorphologic assessment of streams on the Otay River watershed. The assessment classifies streams in the Otay River watershed into three general categories, namely: (1) the Otay River Main Stem, which is significantly affected by operation of the Otay Reservoir; (2) rapidly urbanizing watersheds below Otay Reservoir; and (3) watersheds above the Otay Reservoir, which are in a relatively un-developed state.

Otay River Mainstem

The Otay River mainstem is operating under the influence of significant anthropogenic changes to the watershed. Savage Dam impounds the runoff from over 60 percent of the Otay River's tributary watershed, along with its sediment supply. The dam was constructed at the turn of the 20th century, and is expected to remain in place for the foreseeable future under existing operating rules. Historically, the lower Otay River has been a significant source of sand and gravel for the region. While there is no mining currently in operation within the Otay River, the effects of materials extraction can still be seen on the river in the form of minor avulsions, cutoffs, and abandoned channels.

General Watershed Characteristics

The watershed of the Otay River below Otay Reservoir totals approximately 46 mi^2. The Otay River Valley from San Diego Bay to Otay Reservoir is narrow, approximately 11 miles long and 0.5 mile wide, narrowing slightly as the River proceeds upstream. The valley is surrounded by steep walls with Otay Mesa on the south side of the valley. Significant tributaries to the Lower Otay River include Poggi Canyon, Salt Creek, O'Neal Canyon, Johnson Canyon, Wolf Canyon, and Dennery Canyon. Nestor Creek confluences with the Lower Otay River as it empties into San Diego Bay.

Two major freeways transect the Lower Otay River watershed, I-5 near the coast and I-805 approximately 5 miles inland. In addition, the future SR-125 alignment will cross the main stem of the Otay River approximately 4 miles east of I-805, about halfway between Heritage Road and the Otay Reservoir. Otay Valley Road runs almost the entire length of the watershed just north of the River. The watershed west of I-805 is heavily urbanized and characterized by huerhuero-series soils. The watershed east of I-805 up to the Otay Reservoirs is the focus of rapid urbanization, and is characterized by diablo-series soils. Overall, severely erodible NRCS hydrologic Soil Type D (i.e., soils with poor infiltration) predominate in the watershed, with soils more amenable to infiltration located in valley floors.

Geomorphologic Characteristics

The planform of the Otay River below the Otay Reservoir remained relatively stable during the 20th century. The dam failure of 1916 was extremely transitory, and had temporary effects on the shape of the River. However, river planform is governed by channel-forming (also known as bankfull) discharges. Channel forming discharges are typically on the order of a 2-year to 10-year flood, which would be much smaller than the disastrous flood of 1916. The lower Otay River has a low degree of sinuosity (Total Sinuosity or TS=1.2, which is calculated by dividing the total length of the stream by the length of the valley), and exhibits the general characteristics of a braided stream with multiple bars and islands. Material extraction operations have likely been a major factor in thalweg (i.e., the deepest part of the river) migration through the years. As a result, braiding patterns are somewhat difficult to evaluate.

The most significant change in the planform of the Otay River during the 20th century occurred near its mouth (Figure B.5-10). The 1903 quadrangle map indicates a typical delta configuration with several alternative or abandoned pathways to San Diego Bay. Between the 1903 survey and 1928 aerial photographs, the outlet of the river was channelized through the salt flats on San Diego Bay. Anecdotal information (Nolte, 1974) indicates there was significant sediment deposition by the Otay River into San Diego Bay during the period 1910-1920. This sediment deposition is one of many possible reasons for why such channelization occurred during this period.

The longitudinal profile has remained relatively stable in the past 100 years (Figure B.5-11). The average longitudinal slope of the lower Otay River is on the order of 0.5 percent. The Otay River steepens significantly as the stream approaches the last 1.25 mile below Savage Dam, where the Valley virtually disappears. The historical profile comparison indicates possible down-cutting in the reach downstream of Savage Dam. However, due to the low resolution of the topographic mapping, it is difficult to assign a precise degree to the degradation on the Otay River below Otay Reservoir.

Stream Morphology Drivers

Otay Dam and Reservoir

Savage Dam and the Otay Reservoir exert significant hydraulic control on the Otay River watershed. Sixty-nine percent of the approximately 145-square mile Otay River watershed is above the reservoir. The Otay Reservoir was designed for water supply, and has limited capacity for flood control. Nevertheless, the reservoir effectively controls most flows from small storms in the upstream watershed. The storage levels in the reservoir determine the amount of runoff retained by the dam. It typically completely impounds all upstream runoff from smaller storms, and effectively leaves the mainstem of the Otay River downstream dry except in extreme events. The dam and reservoir also distort the sediment equilibrium of the Otay River by retaining nearly all the bed sediment from the upper part of the watershed. This causes a sediment deficit for the lower reaches of the Otay River and

distorts the sediment equilibrium of the Otay River (Chang, 1991). A sediment deficit typically results in channel degradation.

The first dam at the Otay Reservoir was constructed in 1897 (Hill, 2002). It was 125 feet tall and had 38,300 acre-feet of storage. The Lower Otay Dam was a rock-fill structure based on a massive masonry pour. Riveted steel plates acted as a diaphragm to control seepage through the dam. Records show that 100,000 pounds of blasting powder loosened 150,000 tons of rock during construction of the dam.

The first Otay Dam failed catastrophically on the evening of January 28, 1916 (Nolte, 1974). Joseph P. Hill, a civil engineer retired from the San Diego County Department of Public Works Flood Control Section, explained the reasons for the dam failure in his history of flood control in the San Diego region:

> "The spillway did not have sufficient capacity for the flood flows and the dam was overtopped. Water filled the observation shafts on the downstream side of the steel core, and the pressure blew out the rock that provided the structural stability. The steel core swung out like a gate, releasing the full depth of water, which created a flood wave in the canyon of gigantic proportions. The dam was about 130 feet high, and the depth of the wave in the canyon a short distance below the dam site was about 100 feet high. The force of the water was so great that it stripped every bit of vegetation from the canyon walls, leaving a clear trace of the wave crest. The lower canyon is much wider, and the wave height decreased to approximately 20 feet, which was still devastating to the people living in the valley below. Every structure was destroyed and many people lost their lives."

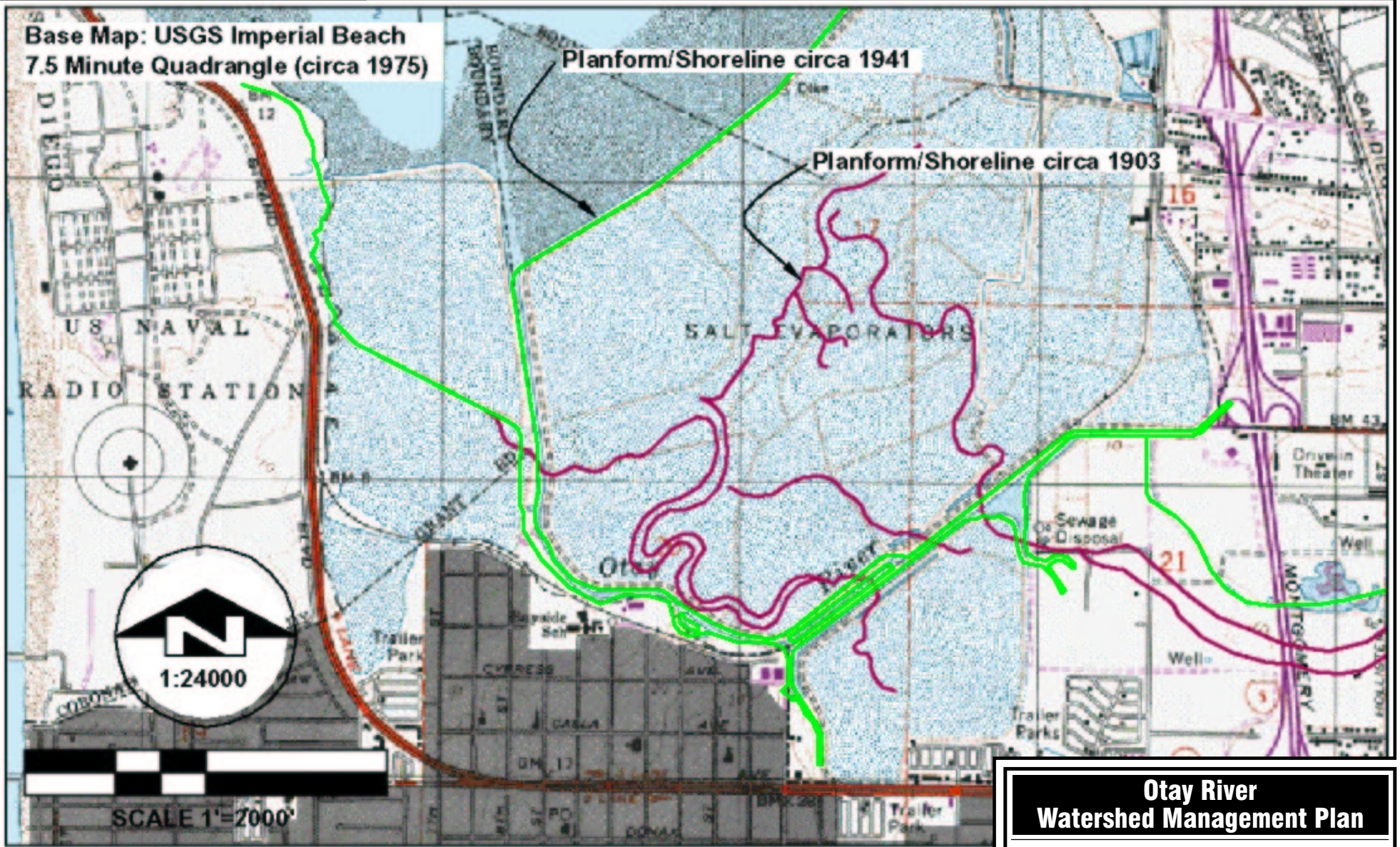
Debris from the 1916 flood filled the South Bay area, and it was impossible for the larger keeled boats to sail there (Nolte, 1974). Figure B.5-12 documents the aftermath of the 1916 failure of Otay Dam. The flood of 1916 scoured river channels to bedrock and left scars on the landscape of San Diego County for many years (Patterson, 1970). The floods washed out miles of highway and railroad track, stopping train service for over a month, and took down telephone and telegraph lines all around. Patterson (1970) described the floods of 1916 as follows:

> "Brush-covered hillsides, probably overgrazed, were saturated to the consistency of slush and the soil gave way in great slides. The scars permanently changed the contour of hills and disappeared only as new brush grew and the new contours became familiar. Springs previously unknown to the back country flowed for years afterward. Lower Otay Dam went out and loosed a flood that demolished everything in front of it. Many lives were lost."

The Lower Otay Dam was reconstructed in 1917-1919, this time with a concrete gravity-arch configuration that still stands today. Figure B.5-13 documents reconstruction of the dam. The new Savage Dam is 149 feet tall, with a 700-foot long crest, and can provide up to 56,300 acre-feet of storage. Since its construction, the dam spilled in 1927, 1932, 1937, 1941, 1980, 1981, 1982, 1983, 1993, 1998, and 2005. However, none were of the magnitude of the 1916 event.

Other Hydraulic Structures

The Otay River flows from the Lower Otay Reservoir downstream through the County of San Diego and the Cities of Chula Vista, San Diego, and Imperial Beach. The San Diego County Flood Insurance Study FIS (2002) lists major structures such as levees, street and highway crossings, railroad crossings, culverts, roads, and other crossings on the Otay River Main Stem from San Diego Bay to the Otay Reservoir. Table B.5-5 summarizes the hydraulic structures on the Otay River mainstem that are listed by the San Diego FIS.



Source: RBF, 2004

Otay River Watershed Management Plan

Figure B.5-10
Historic Planform Comparison, Mouth of Otay River

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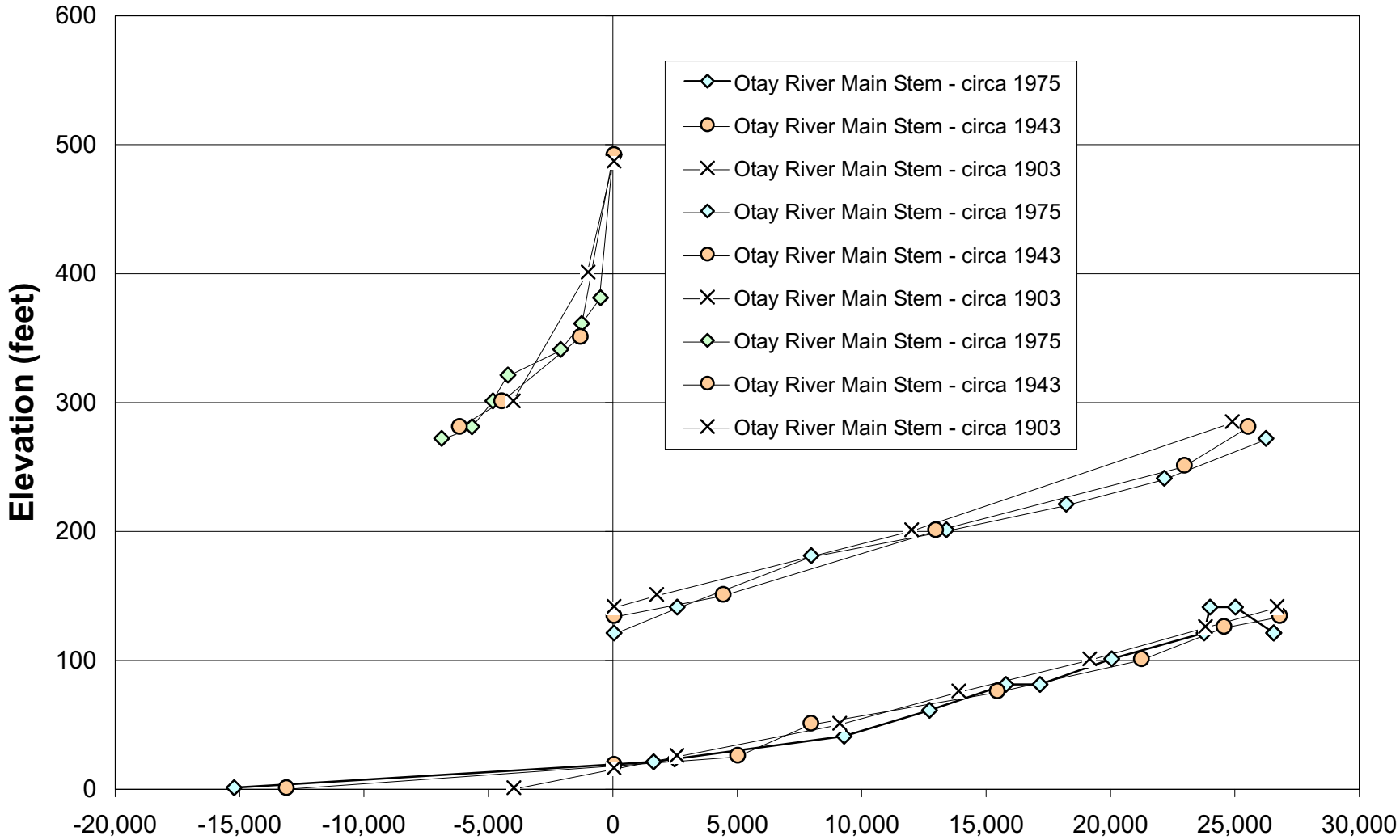

Lower Curves - Distance above Hollister Avenue (feet)
Middle Curves - Distance above Otay Valley Road (feet)
Upper Curves - Distance below Savage Dam (feet)

Source: RBF, 2004

Otay River Watershed Management Plan

Figure B.5-11
Historic Profile Comparison, Otay River

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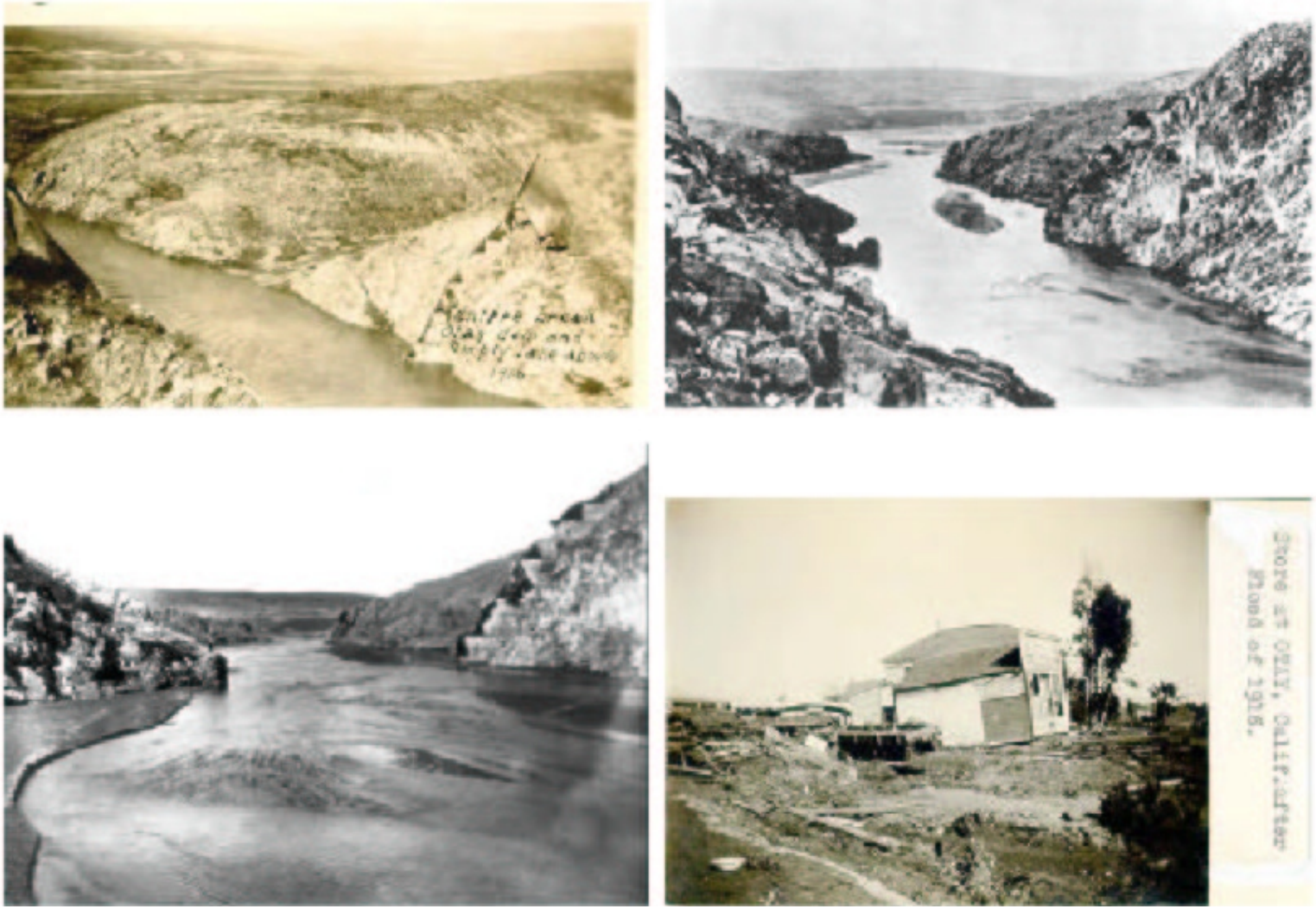

Source: RBF, 2004

Otay River Watershed Management Plan

Figure B.5-12
The First Otay Dam Failed on January 28, 1916

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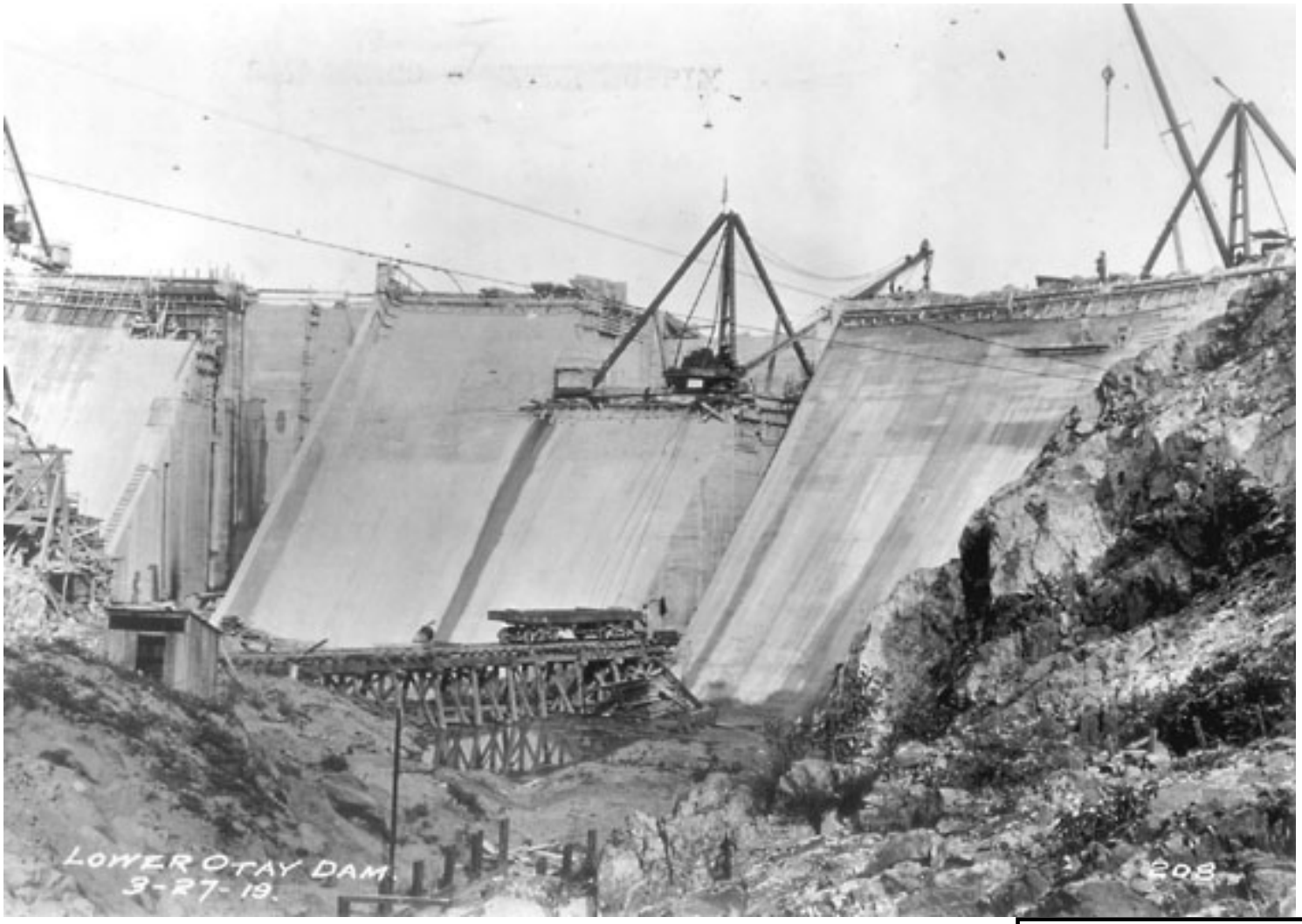

Source: RBF, 2004

Otay River Watershed Management Plan

Figure B.5-13
Otay Dam Reconstruction, 1917-1919

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Table B.5-5 Hydraulic Structures on the Otay River Main Stem

River Station (miles)	Description
0.00	San Diego Bay / Limit of FIS
0.45	Saturn Boulevard
0.52	Charles Avenue
0.59	Louret Avenue
	Drop Structure/Pedestrian Bridge
0.77	I-5 Southbound
0.79	I-5 Northbound
1.02	Hollister Street
1.03	San Diego & Eastern RR (San Diego Trolley Blue Line)
1.52	Private Road
1.67	Broadway
2.13	Private Road
2.36	Beyer Way
3.40	Palm Avenue
3.66	Confluence w/Poggi Canyon Creek
3.96	I-805
5.86	Otay Valley Road
6.74	Private Road
7.08	Aqueduct (Underground)
8.70	Confluence w/Johnson Canyon Creek
9.39	Confluence w/Salt Creek
9.98	Private Road
10.36	Private Road
11.74	Limit of FIS
11.77	Savage Dam

Source: FEMA, 2002.

The FIS only considers crossings such as bridges and culverts that will have a significant impact on the regulatory floodplain. As such, the FIS models will not model structures such as underground pipeline crossings or the underground aqueduct (RM 7.08) that traverse the Otay River. These underground structures might act as a grade control and affect changes to stream longitudinal profile only if exposed to flow during a major flood event. Properly designed pipeline crossings (i.e., those buried deeper than maximum calculated scour depth) will not have any effect on either floodplain dynamics or river morphology. Minor crossings, such as at-grade crossings for private roads and trails, will likely be washed out during major flood events. Therefore, the FIS hydraulic models generally ignore these structures as well. However, these structures might have important effects during smaller flood events that are nearer to the 'channel-forming discharge.' (which occur every few years on average), and can therefore, influence river morphology on a localized basis. Examples of these effects might be a road crossing serving as a hinge point in the longitudinal profile stream or a bridge abutment limiting or pinning the meander pattern of a stream's thalweg.

Urbanization and Land Use

The increase in impervious area associated with urban land uses tends to increase peak flow from the watershed and simultaneously decrease the overall sediment load delivered downstream. Depending on how much of the developed area is directly connected (either with storm drains, underground culverts, or lined flood control channels), urbanization can have a substantial effect on the peak runoff from the watershed. For instance, Waananen and Crippen (1977) estimated that urbanization of 30 percent of a watershed with complete improvement of drainage channels could double the predicted peak runoff from a watershed during a 10-year event. In addition, urbanized watersheds often see an increase in

localized channel erosion. This can be due to several factors, including: increase in peak flow and velocity of runoff; concentration of runoff at storm drain outfalls; and the fact that urban runoff is usually sediment-starved in comparison to runoff from natural areas.

Land use is a significant driver to stream morphology, because it affects both the amount of runoff from the watershed and sediment delivered to the stream. Urbanization typically increases the peak flow and volume of runoff from a watershed and changes the temporal distribution of the runoff. These changes in the hydrologic and sediment regime manifest themselves in several ways, including:

Increased Flood Potential. Urbanization typically causes an increase in flood peaks, particularly affecting floods with lower return periods. This is of particular importance to the geomorphology of a stream because the bank-full or channel-forming discharge generally has a return period of between 1.5 years to 10 years.

Increased Erosion Potential. Concentration of flows at storm drain outfalls and other locations within an urbanized drainage system can accelerate erosion processes. In addition, impervious area reduces sediment delivery rate from the watershed by compacting or covering the soil so it cannot naturally erode. This leaves runoff sediment-starved, because water has a certain competence to convey sediment that is dependent on its velocity. Therefore, as this low-sediment runoff enters a natural stream, it erodes the channel to regain its sediment load.

Channel Degradation. Urbanization often increases the channel-forming discharge and lengthens its duration during a flood event. This disruption to the watershed hydrology, paired with disequilibria in the sediment transport regime, will tend to cause streams to adjust their planform and profile, often causing degradation of channel conditions.

Modified Hydrologic Regime. Urbanization tends to “perennialize” streams, changing them from ephemeral or intermittent systems into systems that have a constant low flow. This dry-weather flow can support increased channel vegetation, which can have effects on a channel’s hydraulic characteristics and geomorphology.

Land use on the Otay River watershed has been an issue since European settlement of the region in the 1800s. Over-grazing has been mentioned as a possible factor in the increased runoff that caused the catastrophic floods of 1916 (Patterson, 1970). Though this information is only anecdotal, it is true that over-grazing has the potential to increase the amount of runoff and increase the amount of sediment supplied to the river system. Contemporary land-use changes in the form of urbanization will also challenge the equilibrium of the Otay River watershed.

The watershed of the lower Otay River has been subject to urbanization for much of the past century. Initially, watershed urbanization was focused on a few blocks of development near San Diego Bay, near present-day downtown Chula Vista. Early urbanization was relatively “low intensity” (i.e., with fewer paved streets and parking lots), and did not involve the same degree of impervious area that would be associated with contemporary development.

Over the next century, the scope and intensity of urbanization increased substantially. Except for the salt flats and preserved areas near San Diego Bay, the majority of the Otay River Valley downstream of I-805 is currently urbanized with greater than 30 percent impervious cover (Figure B.3-10). East of I-805, there is significant urbanization on the north edge of the Otay River watershed along Poggi Canyon and in the Salt Creek watershed north of Olympic Parkway.

Sand and Gravel Extraction

Sand and gravel mining has significant effects on the geomorphology of a stream system. In-stream mining can degrade and destabilize a stream by causing headcutting, reduction in downstream sediment supply, erosion, degradation and damage to infrastructure. Off-stream mining can avoid many of these effects, but can have similar effects in the floodplain during large floods.

Sand and gravel extraction on the Otay River, with a history dating back to the 1910s, has further affected the fluvial equilibrium of the stream. At present, most of the useful material has been depleted and there are currently no in-stream extraction activities on the River. Both the Fenton Materials and Nelson & Sloan Materials companies maintained major extraction operations on the Otay River through much of the 20th century. Fenton Materials extracted materials between I-5 and I-805 through the 1970s. The Nelson & Sloan Materials operations extended from I-805 to Otay Ranch near the Lower Otay Dam. The excavation covered most of the riverbed, with an average depth of 12 to 15 feet from original bed levels. The majority of the excavation of the lower 75 percent of the Nelson & Sloan reach was accomplished before 1973, while the Otay Ranch portion of the extraction was accomplished later. The Nelson & Sloan operations ended in approximately 1985.

The riverbed of the Otay River has a wide variation of bed materials, including sand, clay, silt, and gravel. Extensive sand and gravel extraction and the subsequent migration of foreign materials into the area have changed the original sediment distribution on the Otay River, which may have implications to future geomorphic changes to the system.

Stream Bank Stability and General Scour Forecast

Future Trends of Stream Morphology Drivers

There will be limited changes to stream morphology drivers such as the Otay Reservoir and other hydraulic structures. The City of San Diego anticipates no significant changes to the configuration of Savage Dam or to the operation of the Otay Reservoir. Proposed major hydraulic structures are limited to a crossing for the SR-125 freeway, and potential improvements to the Heritage Road Bridge.

There have been no sand and gravel mining operations in the Otay River for two decades, and no plans to restart such operations because most of the useful materials have been extracted. Because the operations ended before contemporary environmental reclamation regulations took effect, there are no plans to reclaim or restore the former mining operations.

The lower Otay River watershed will continue to experience significant changes to land use in the form of increased urbanization. Future urbanization in the Otay River Valley is planned to primarily take place on the north side of the river. Except for isolated pockets of development such as the East Otay Mesa Business Park and nearby development, the south side of the valley should remain relatively undisturbed.

Existing development generally has improved drainage systems with a substantial amount of directly-connected impervious area. However, because of new regulatory requirements such as the NPDES Municipal Permit, future development on the watershed will be likely to have less directly connected impervious area. In addition, the Municipal Permit and resultant SUSMPs require all significant development or redevelopment projects to attenuate increases in peak flow and velocity, or demonstrate the lack of negative effects from an increase. This will help mitigate increases in peak flow, but does not address possible sediment depletion, and might exacerbate the input of sediment-starved water into the lower Otay River.

Forecast Stream Response

The present channel configuration essentially represents the final configuration of the River for the current set of conditions. Qualitatively, the reduction in flow to the lower Otay River will continue to have a significant effect on the fluvial system. According to basic relationships, the reduction of streamflow and sediment load due to the Reservoirs will tend to reduce channel width and width-depth ratio and increase the sinuosity. The effect of the Reservoirs will be to increase general scour through most of the river system; and, depending on structures and bank material, may cause the stream to meander (with associated lateral bank migration) more than would otherwise occur.

Chang (1991) conducted a quantitative analysis of general and local scour for pipeline crossings traversing the lower Otay River, which included an evaluation of long-term trends for the channel. He concluded that the Otay River would continue to undergo severe morphologic changes during major flood events. His simulations of long-term changes to the longitudinal profile of the Otay River revealed substantial degradation starting from the Lower Otay Reservoir, and gradually lessening as the stream approached Otay Valley Road. The simulations predicted that the uneven channel profile due to materials extraction below I-805 would eventually smooth out. These results corroborate qualitative evaluation that the stream would lower its slope over time and migrate from a braided to a more meandering planform.

The increase in impervious area due to urbanization, as depicted in Figure B.3-14, will tend to increase the peak flow and the volume of runoff from the watershed. In addition, it will tend to reduce the amount of sediment delivered to the stream. Theoretically, an increase in peak flow would tend to counteract degradation trends by replacing water impounded by the reservoir and helping the River maintain its original planform. However, because the water from an urbanized watershed tends to be sediment-poor, it might actually serve to reinforce a trend of increased sinuosity instead.

On a long-term time scale, the Otay River will continue to adjust its slope during major flood events, downcutting in upper reaches and aggrading in lower reaches. Perennialization of flows will serve to help entrench the channel within its existing thalweg as the stream, reinforcing the push for the stream to migrate from a braided to a more sinuous channel pattern.

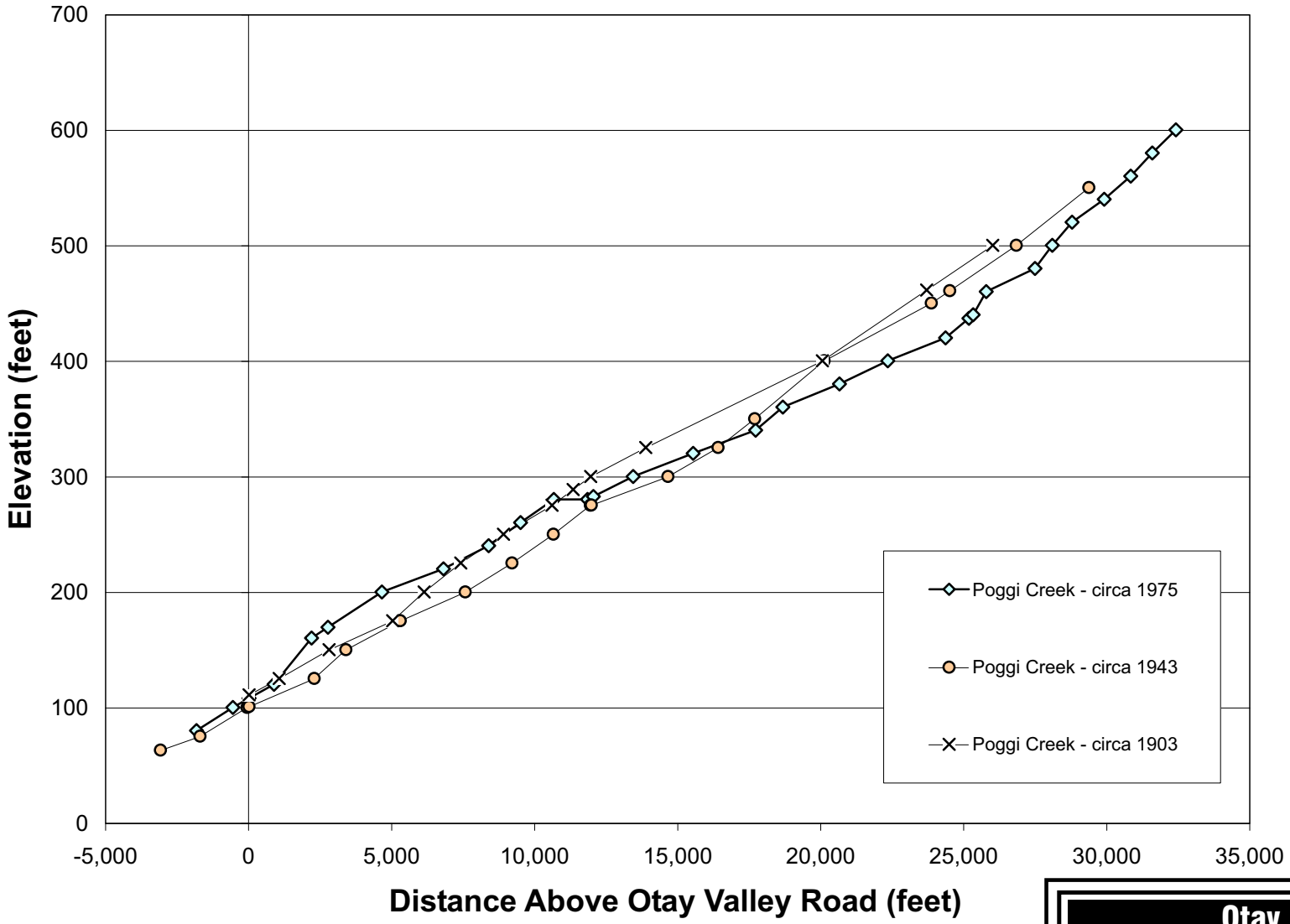
Poggi Canyon Creek and Salt Creek

Poggi Canyon and Salt Creek represent rapidly urbanizing sub-watersheds within the Otay River watershed. They are not directly influenced by the construction or operation of the Otay Reservoir. Therefore, the emphasis of this section will be evaluating the effect of urbanization on the hydrology and sediment supply of the tributary watersheds, and the consequent effects on stream geomorphology.

Geomorphologic Characteristics

Poggi Canyon and Salt Creek watersheds are both small, relatively steep watersheds that drain to the main stem of the Otay River below the Otay Reservoir.

Poggi Canyon Creek watershed drains approximately 4.6 square miles, and confluences with the Otay River just downstream of I-805. Olympic Parkway runs parallel to the creek on its north side, starting upstream of Brandywine Avenue and continuing for almost the entire length of the creek before it finally crosses the creek as the road turns southward to accommodate an interchange with the future alignment of the SR-125. Poggi Canyon has a narrow valley that is approximately 750-feet wide. Based on measurements from 1975 topographic mapping, Poggi Canyon Creek has very little sinuosity (Total Sinuosity or TS=1.1). Olympic Parkway has since realigned Poggi Canyon Creek and confined it to



Source: RBF, 2004

Otay River Watershed Management Plan

Figure B.5-14
Historic Profile Comparison, Poggi Canyon Creek

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the south side of the canyon, and essentially allowing no sinuosity at all. It is not meaningful to evaluate the current planform of Poggi Creek under its current condition.

The longitudinal profile of Poggi Canyon Creek has a slope on the order of 1.5 percent. A historical profile comparison of the creek indicates that there might have been degradation in the upper reaches of the creek, accompanied by aggradation in the lower reaches, during the period 1903-1975 (Figure B.5-14). The creek appears to have rotated slightly around a hinge point located approximately 2.5 miles above Otay Valley Road. The actual degree and extent of aggradation or degradation is difficult to ascertain given the resolution of available topography. However, the issue is somewhat a moot point because a significant portion of the upper reach of Poggi Canyon has been undergrounded or otherwise artificially stabilized since 1975.

Salt Creek resides in a narrow valley approximately 700 feet wide. Development on the Salt Creek sub-watershed has generally avoided encroachment into the floodplain of Salt Creek. Within the valley, the planform of Salt Creek has very little sinuosity (Total Sinuosity or TS=1.1). Salt Creek exhibits the general characteristics of a steep, multiple bar/multiple island braided stream. Further downstream, Salt Creek has a slightly more sinuous pattern, exhibiting the characteristics of braided point bar stream. The longitudinal profile of Salt Creek has a slope on the order of 1.5 percent. The profile of Salt Creek appears to have remained relatively stable during the 20th century (Figure B.5-15).

Stream Morphology Drivers

Hydraulic Structures

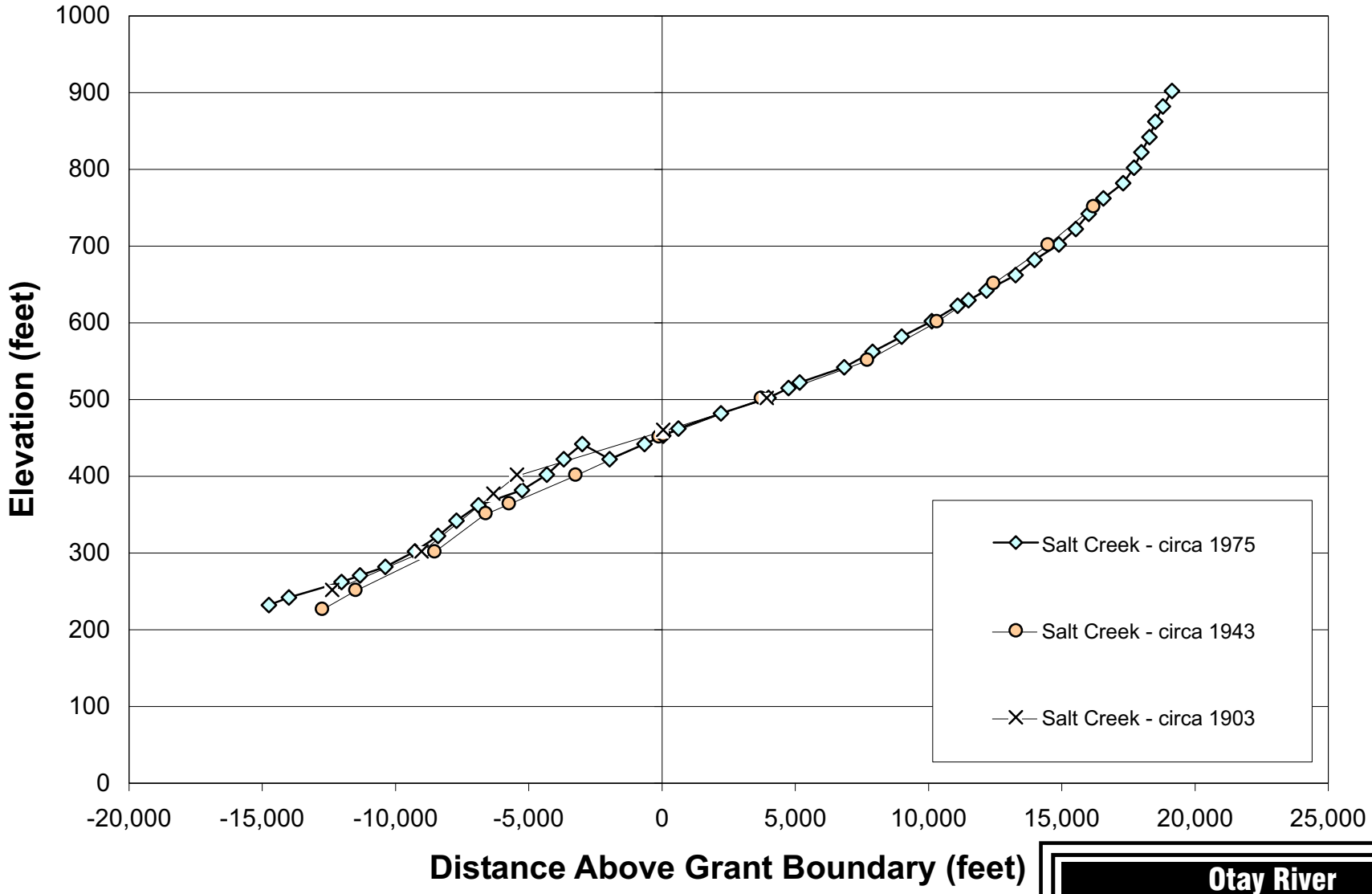
The San Diego County Flood Insurance Study FIS (2002) lists major structures such as levees, street and highway crossings, railroad crossings, culverts, roads, and other crossings on Poggi Canyon Creek. Table B.5-6 lists the major hydraulic structures listed in the FIS. In addition to the structures listed in the FIS, there are several additional structures on the upper part of Poggi Canyon Creek. Olympic Parkway runs parallel to the creek on its north side, starting upstream of Brandywine Avenue and continuing for almost the entire length of the creek before it finally crosses the creek as it turns southward to accommodate an interchange with the future alignment of the SR-125. There are several unnamed road crossings with culverts, as well as grade-control structures that have been installed in anticipation of future local development.

Table B.5-6 Hydraulic Structures on Poggi Canyon Creek

River Station (miles)	Description (Culvert Length)
0.23	Rancho Drive Culvert (60 ft)
0.39	Otay Valley Road Culvert (140 ft)
0.81	I-805 Culvert (740 ft)
1.25	Oleander Avenue Culvert (420 ft)
1.67	Brandywine Avenue
1.77	Limit of FIS
	Olympic Parkway Culvert No. 1 (High School)
	Olympic Parkway Culvert No. 2
	Future SR-125

Source: FEMA, 2002.

FEMA currently maps Salt Creek as a Zone A Special Flood Hazard Area, which means there is no flood profile developed with base flood elevations. Major road crossings associated with the local development include Duncan Ranch Road, Proctor Valley Road, Otay Lakes Road, and Olympic Parkway.



Source: RBF, 2004

Otay River Watershed Management Plan

Figure B.5-15

Historic Profile Comparison, Salt Creek

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Urbanization and Land Use

Urbanization on the Poggi Canyon watershed originated at the downstream reach of the creek along the I-805 corridor and proceeded upstream along the north side of the creek. Currently, there is very little development on the south side of the canyon upstream of Brandywine Avenue. The most significant development on the upstream side of the Poggi Canyon watershed is the Eastlake Greens development, which also occupies the west side of the Salt Creek watershed. The Salt Creek watershed has taken opposite track, generally working its way downstream from residential neighborhoods near the Auld Golf Course north of Proctor Valley Road. The urbanization on the Poggi Canyon and Salt Creek watershed is relatively intense, adding development with greater than 30 percent impervious area (Figure B.3-10).

Stream Bank Stability and General Scour Forecast

Future Trends of Stream Morphology Drivers

The Poggi Canyon and Salt Creek watersheds will both experience substantial urbanization in the next in the next decades (Figure B.3-14). Significant and intense (greater than 30 percent impervious area) development is planned for the south side of Poggi Canyon, and the eastern side of the Salt Creek watershed. The exception to the intense development is on Salt Creek south of Olympic Parkway, which will have substantial amounts of open space on the west side of the creek to buffer it from the newly developed areas. The SR-125 alignment will cross Poggi Canyon Creek near its headwaters.

Forecast Stream Response

The Poggi Canyon and Salt Creek watersheds are expected to experience a significant intensification of land use, which will challenge the equilibrium of the hydraulic and sediment transport regimes that might have existed prior to urbanization. In the short term, the major construction projects on the watershed have the potential to increase both the peak flows generated by the watershed and sediment load to the streams. Regulatory requirements such as the NPDES Construction Permit will reduce the potential for these increases in sediment load, although erosion control plans can have their limitations. A simultaneous increase in discharges and sediment load will tend to push the streams to widen their channels and reduce their sinuosity. Depending on the extent and duration of construction, there may not be time to effect substantial morphological change in the streams during the construction period. It is more probable, however, that the dominant change will be an increase in the peak discharge, and potentially the duration of flow (as a result of detention), in the stream. This would tend to reduce the channel slope through general scour and/or increase sinuosity if bank materials allow it.

In the longer term, the change in land use on the Poggi Canyon and Salt Creek watersheds can be expected to increase peak flows and decrease the sediment load. A simultaneous increase in peak discharge and reduction in sediment load tends to push streams to flatten their slope and increase their sinuosity. Channels will also tend to deepen their cross sections, thus reducing their width-depth ratio. Local regulations and the California Environmental Quality Act require the attenuation of peak discharge rates to levels equivalent to pre-development condition for major projects. Therefore, these rules will tend to mitigate the increase in peak flow. Decreasing sediment load without changing peak flow will still tend to push streams flatten their slope and increase their sinuosity, with their channel cross-sections tending to narrow and deepen (incise).

Jamul Creek and Dulzura Creek

Jamul Creek and Dulzura Creek are located in the upper half of the Otay River watershed above the Lower Otay Reservoir. The watersheds tributary to Jamul and Dulzura Creek cover approximately 70 square miles. Historically, these watersheds have maintained a rural character, with low-density residential housing supported by small commercial zones in the communities of Jamul, Lee Valley, Lyons Valley, Bratton Valley, and Engineer Springs.

Other creeks that drain the watershed include Hollenbeck Canyon Creek and Honey Springs Canyon Creek. Hollenbeck Canyon Creek originates in Lyons Valley at an elevation of approximately 2,200-feet MSL and confluences with Dulzura Creek just downstream of the intersection of SR-94 and Honey Springs Road. Honey Springs Canyon Creek originates near Bratton Valley and joins Dulzura Creek just upstream of the SR-94/Honey Springs Road intersection. These creeks are very steep and have extremely narrow valleys, and are not amenable to the general qualitative planform geomorphic evaluation method outlined in this assessment.

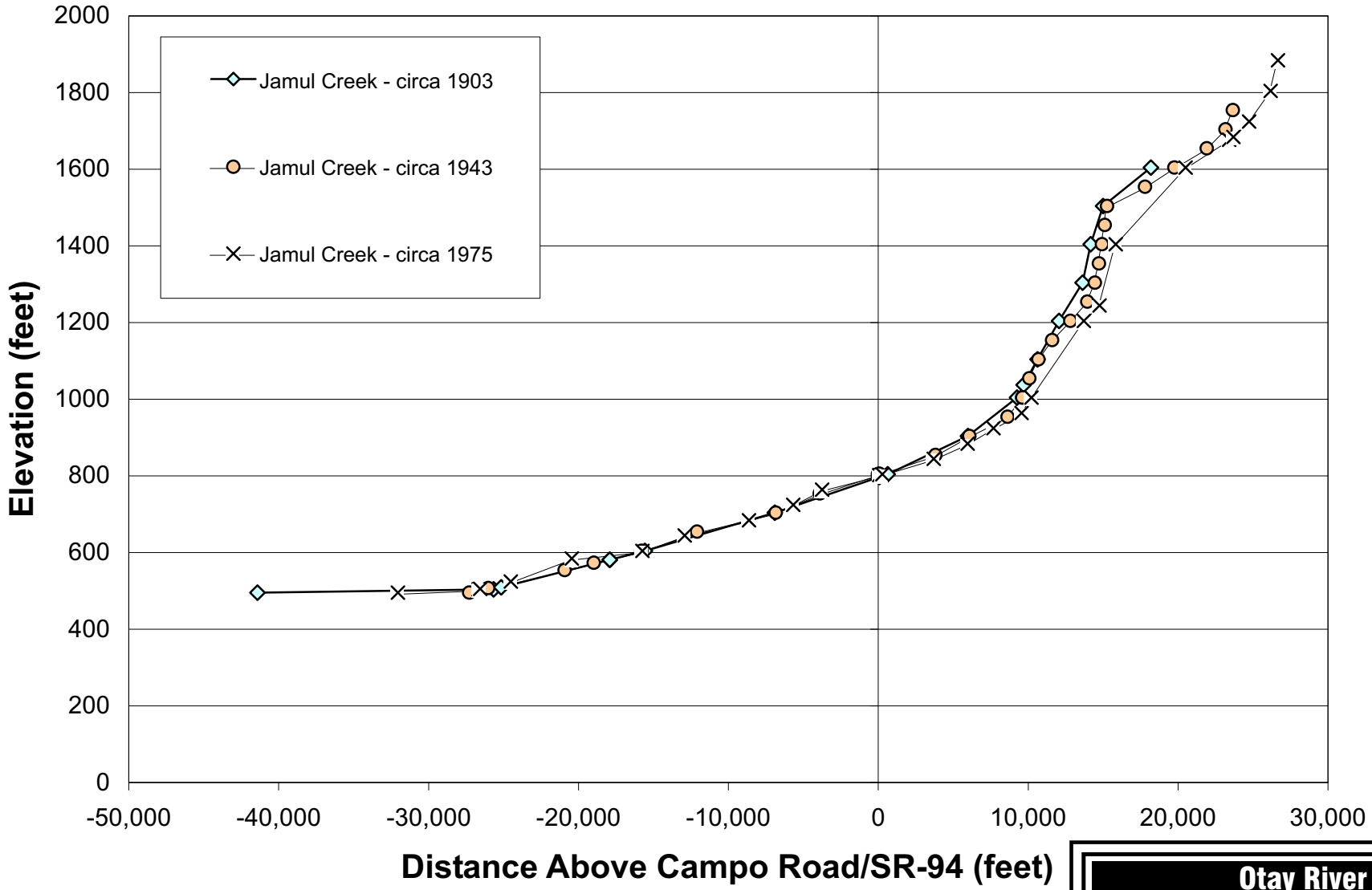
General Geomorphic Characteristics

State Route 94, also known as Campo Road, bisects the watershed from northwest to southeast. Pockets of low-density "rural residential" development are currently located in the communities of Jamul, Lee Valley, Lyons Valley, and Engineer Springs. The watershed east of Campo Road is characterized by igneous and cienaba-series soils, while the watershed west of the highway is comprised of friant-series soils.

The headwaters of the east branch of Jamul Creek are located near Lee Valley, which is actually a 'perched' valley with its own headwaters. Jamul Creek steps down from Lee Valley through a steep canyon, descending approximately 600 feet at a gradient of approximately 7.5 percent to the head of the Jamul Creek Valley. Jamul Valley is relatively long and narrow. The Valley measures approximately 5 miles in length from its head to the confluence with Dulzura Creek. At its head, the Valley is approximately 1,000 feet wide. The Valley widens to approximately 3,500 feet (0.66 miles) as it accommodates the confluence with the north branch of Jamul Creek before narrowing down to its original width. Within the Valley, Jamul Creek exhibits the characteristics of an intermediate point bar braided channel type stream, and mild sinuosity (Total Sinuosity or TS=1.2). The longitudinal slope of Jamul Creek through Jamul Valley is slightly over 1 percent, and has remained stable through the 20th century (Figure B.5-16).

The headwaters of Dulzura Creek are located near Engineer Springs. Dulzura Creek flows down to Dulzura Valley, beginning near Sycamore Canyon. Similar to Jamul Valley, Dulzura Valley is also long and narrow. The Valley measures approximately 4.5 miles in length from its head to the confluence of Dulzura and Jamul Creeks. At its head, the Valley is approximately 1,000 feet wide. The Valley widens to approximately 2,500 feet to accommodate confluence with Honey Springs Canyon and then Hollenbeck Canyon Creeks, and then narrows again as it approaches confluence with Jamul Creek. Within the Valley, Dulzura Creek exhibits the characteristics of an intermediate single point bar/single island braided stream, and is mildly sinuous (Total Sinuosity or TS=1.3). The longitudinal slope of Dulzura Creek through Dulzura Valley is on the order of 0.9 percent, and has remained stable through the 20th century (Figure B.5-17).

Below the confluence of Jamul Creek and Dulzura Creek, the stream (called Jamul Creek) maintains the general characteristics of the upstream reaches. The Valley remains relatively narrow, but the stream experiences some aggradation as it empties into the Lower Otay Reservoir.



Source: RBF, 2004

Otay River Watershed Management Plan

Figure B.5-16

Historic Profile Comparison, Jamul Creek

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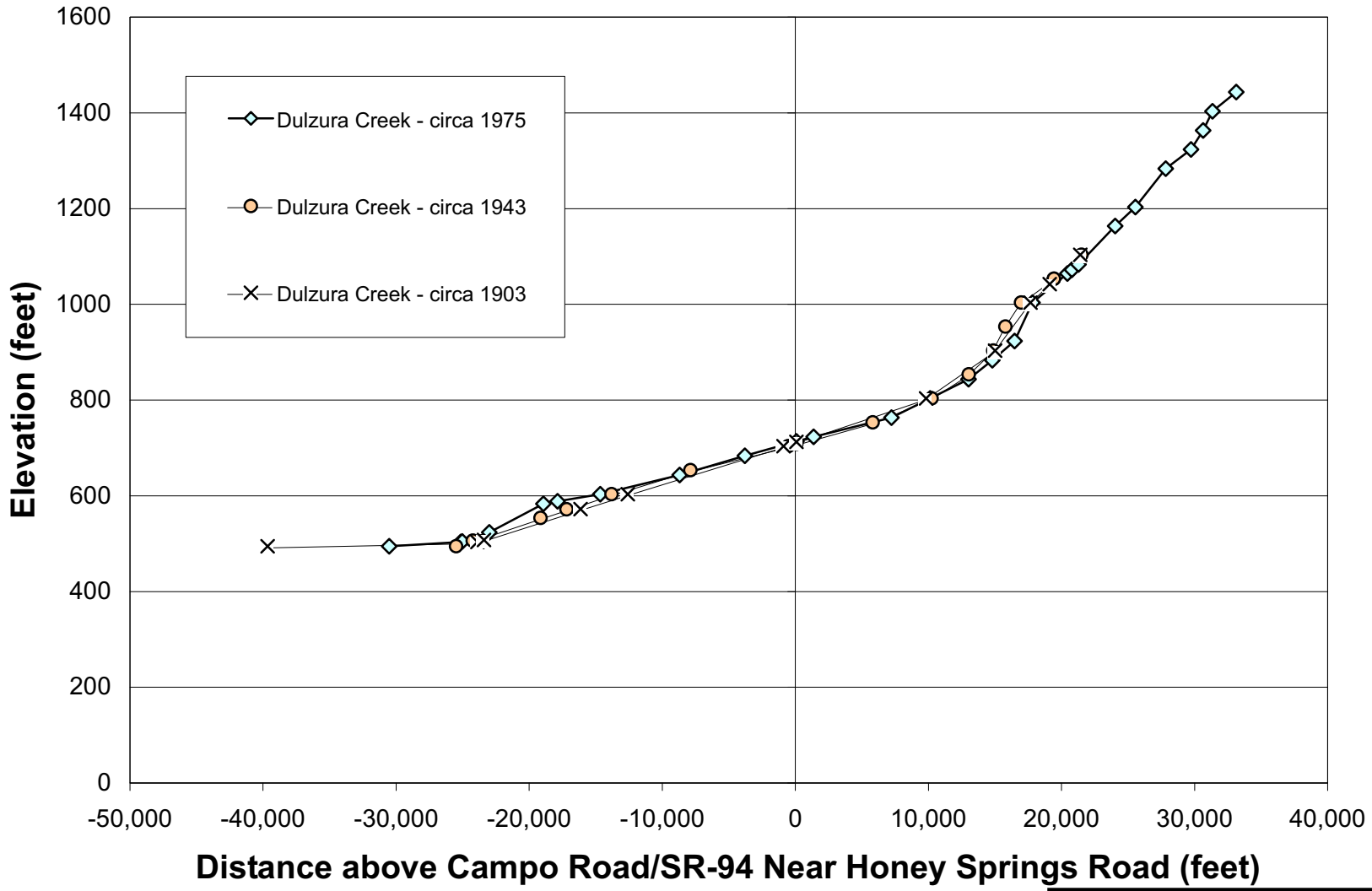


Source: RBF, 2004

Otay River Watershed Management Plan

Figure B.5-17

Historic Profile Comparison, Dulzura Creek

Aspen Environmental Group

Stream Morphology Drivers

Hydraulic Structures

The major hydraulic structures of note on the Jamul Creek and Dulzura Creek sub-watersheds are associated with SR-94, also known as Campo Road. Campo Road/SR-94 crosses Jamul Creek approximately 2 miles north of the intersection Honey Springs Road. In addition, there is a bridge crossing over Dulzura Creek immediately south of the SR-94/Honey Springs Road intersection. The highway parallels Dulzura Creek as it proceeds towards Engineer Springs, and there are several culverts through the road to allow minor tributaries (such as Sycamore Canyon Creek) to confluence with Dulzura Creek. These roadway culverts and crossings can function as grade control points on the longitudinal profile and prevent lateral migration in the planform of the streams.

Roadways such as SR-94 and Otay Lakes Road can also have an effect upon the geomorphic characteristics of a stream when they parallel the watercourse. The roadways effectively act as levees and can force an artificial boundary condition on channel meander patterns. This is evidenced by the fact that portions of as Otay Lakes Road and SR-94 have been armored with riprap to prevent them from washing out during flood events.

Topographic mapping and aerial photographs also indicate that minor levees or berms have been constructed to protect local facilities throughout the Valley. These will likely have little effect on the geomorphic condition of the streams. In addition, several small impoundments are located throughout the watershed. These facilities could be characterized as “farm ponds” that might be used for livestock or minor irrigation. These ponds are too few in number and too small in magnitude to have significant effect on the overall geomorphology of the watershed.

Because it serves as the deposition zone for Jamul Creek, the Lower Otay Reservoir must be considered in the evaluation of the geomorphic system. The operation of the Reservoir has the potential to affect the stream system through water transfers and reservoir operating levels. During wet operation years, the City of San Diego conveys water supply from Morena and Barrett Reservoirs into the Otay Reservoir through Jamul Creek. The transfer rate is small and relatively ephemeral in time span. Therefore, the geomorphic effect of water transfers through the creek will be minor. Water transfer might have potential to indirectly affect stream morphology by supporting creek vegetation that might not usually inhabit the system. Because the water transfers through the creek primarily occur during wet years, when vegetation would naturally be abundant, this effect should be minor.

Reservoir operation levels have potential to affect the geomorphology of Jamul Creek. A small delta has developed as the creek enters the reservoir. Fluctuations in reservoir level will affect the size and location of the delta.

Urbanization and Land Use

The Jamul Creek and Dulzura Creek watersheds have been subject to relatively little urbanization. Most urbanization that has occurred has been relatively low-intensity in nature, with less than 15-percent impervious cover (Figure B.3-10). Examples of this type of development are the rural residential areas located in the communities of Jamul, Lee Valley, and Engineer Springs. While there are smaller pockets of more intense urbanization (greater than 30 percent impervious cover) located in each of these areas, their size is not enough to significantly affect the stream morphology.

Stream Bank Stability and General Scour Forecast

Future Trends of Stream Morphology Drivers

Planned land use in the Jamul Creek and Dulzura Creek watersheds indicates a significant increase in low-intensity rural development in several areas (Figure B.3-14). The northern half of the Jamul Hydrologic Sub-Area (HSA 910.33) is zoned for low-density "rural residential" development. Similar low-intensity urbanization is zoned for virtually the entire watershed east of a line drawn from Lee Valley to Engineer Springs. County ordinances limiting development on steep slopes will likely limit the extent of development within this part of the watershed significantly. While low-intensity in nature, many of these new residential developments will qualify as priority projects under the Municipal NPDES Permit and the resulting SUSMP requirements (i.e., ten or more residential units). Therefore, their effect on peak flow and sediment delivery should be small in comparison to similar but previous developments.

The expansion of rural residential development in the watershed may increase pressure to widen roads, which in turn would require expansion of existing hydraulic structures or additional facilities. On the other hand, major portions of the watershed are being protected from urbanization as part of land and wildlife management preserves owned by government agencies. These areas will remain as open space areas, with very little impervious area.

Forecast Stream Response

The Jamul Creek and Dulzura Creek watershed above the Otay Reservoir is expected to experience a mild intensification of land use, which would be softened slightly by contemporary watershed development regulations. The change in land use will likely not increase peak flow or disrupt the sediment transport regime significantly enough to result in macro-scale geomorphic changes to stream planform and profile. Geomorphic changes will more likely occur on a local scale, with small areas of channel incisement due to localized concentrations of flow or disruptions to the sediment transport regime.

Geomorphic Assessment of the Overall Watershed

This qualitative geomorphic watershed assessment has developed three general cases of stream conditions on the Otay River watershed. The first case is the Otay River mainstem, where the Savage Dam has significantly curtailed channel discharges and disrupted the sediment equilibrium of the river by impounding sediment in the Otay Reservoirs. Because of the significant and permanent changes to both the hydrologic and sediment regimes, basic geomorphic relationships predict that the Otay River will flatten its slope and downcut in upper reaches and aggrade in lower reaches.

The second case is rapidly urbanizing watersheds such as Poggi Canyon Creek and Salt Creek. Land use changes will significantly challenge the geomorphic regimes of these creeks by simultaneously increasing peak discharge and, to a lesser extent, decreasing their sediment load. While the hydrologic regime will be significantly modified, Poggi Creek is anticipated to remain relatively stable due to installation of grade control structures and other structures that will artificially stabilize the channel. Several road crossings will serve to stabilize the longitudinal profile of Salt Creek by fixing its elevation at several locations. A more focused, quantitative assessment of changes to the hydrologic and sediment regime of the Salt Creek watershed can address whether additional measures might be necessary to help protect stream integrity.

Finally, there are creeks such as Jamul Creek and Dulzura Creek upstream of the Lower Otay Reservoir, which are anticipated to experience only a mild intensification of land use. These creeks will likely not experience any macro-scale changes to their geomorphic characteristics, but may still be subject to areas of channel instability due to localized concentration of surface flows or disruptions in sediment regime.

These three cases of stream conditions on the Otay River watershed are intended to demonstrate the spectrum of possible changes to hydrologic regime and resultant geomorphic response. This spectrum ranges from extremely regulated systems to relatively undisturbed regimes. The many other streams on the Otay River watershed might experience similar changes to drivers in their stream morphology and respond in a similar manner. Section B.7 provides additional discussion on how the various subbasins within the watershed are expected to respond to changes in land use, in consideration of geology, soils, and land use/vegetation.

B.5.4 Surface Water Supply

Otay Reservoirs

The City of San Diego and other municipalities in the San Diego region regularly import 80 to 90 percent of their annual domestic water supply from other regions. This diversion from other watersheds has the potential to affect the hydrology of the semi-arid Otay River watershed. To put the magnitude of this water importation into context, if the average annual water importation into the Otay Reservoirs were metered out over the 29,663-acre watershed below the Otay Reservoirs, the municipal water supply would be the equivalent of approximately 4 to 5 inches of precipitation annually, or approximately a 50-percent increase over the naturally occurring precipitation.

The Otay Reservoirs are part of the City of San Diego municipal drinking water supply system and have served and will continue to serve as a drinking water source serving the San Diego Region, including the City of Chula Vista. The Lower Otay Dam was originally constructed at the turn of the 20th century, and then re-constructed in 1917-1919 after a catastrophic failure of the first dam in 1916. The current dam is a 149-feet-tall concrete gravity-arch dam with a 700-foot-long crest and a maximum storage capacity of 49,510 acre-feet at its spillway elevation. The Lower Otay Reservoir receives raw water from other regions via aqueduct, and water from Morena and Barrett Dams in the adjacent Tijuana River watershed arrives via flume and surface conveyance in Jamul Creek. The Lower Otay Reservoir is kept approximately 75 to 85 percent full in order to meet emergency water storage requirements. Water levels in the Morena and Barrett Reservoirs are allowed to fluctuate much more in order to help maintain minimum water levels in the Lower Otay Reservoir.

The Otay Water Treatment Plant is located near Savage Dam, and is currently the only water treatment plant in the Otay River watershed. The Otay Water Treatment Plant is a conventional water treatment plant using flocculation, sedimentation and dual media filters. The treatment plant currently has a capacity of approximately 34 million gallons/day (mgd), and serves a demand that averages approximately 22 mgd. This demand varies in seasonal cycles, with maximum demand during the summer months. The average annual demand has been increasing, and the City's current capital improvement program calls for the Otay WTP to be upgraded to a capacity of approximately 40 mgd. Long-range projections expect the plant to supply up to 60 mgd of drinking water to the area.

The City of San Diego evaluates reservoir operations annually in order to optimize the use of local storage and provide water to its customers in an economically efficient manner. As a result, the relative amount of precipitation in a given year significantly affects the operation of the Reservoirs. During a normal (i.e., dry) year, the City of San Diego may import between 9,000 and 12,000 acre-feet of water

from sources such as the Metropolitan Water District of Southern California. This water is placed into the Reservoir during the late fall and winter months. During wet years, local runoff may fill the reservoirs (Morena, Barrett, and Otay) in the system sufficiently so that there may be little or no need to place imported water into the reservoir from other sources. Generally, the operation plan for the Otay Reservoir during wet years is to move water water out of the reservoirs and into the distribution system as quickly as possible in order to reduce excessive evaporation in the reservoir and avoid or minimize spills from the reservoir.

Monthly storage measurements for the reservoirs are available starting in 1956. Figure B.5-18 illustrates the historic storage statistics for the Otay Reservoirs. Storage in the reservoirs increased significantly beginning in the 1980s. Since that time, the Otay Reservoirs have stored an average of approximately 41,000 acre-feet of water, with a deviation of approximately 6,000 acre-feet (Figure B.5-19). According to sources at the City Water Department, the most recent spills at the Otay Reservoirs occurred in 2005, in 1998, and in 1993 (Meda, 2005). After a succession of wet years, it may take 2-3 years to draw down the reservoirs to minimum operating levels.

Recycled Water

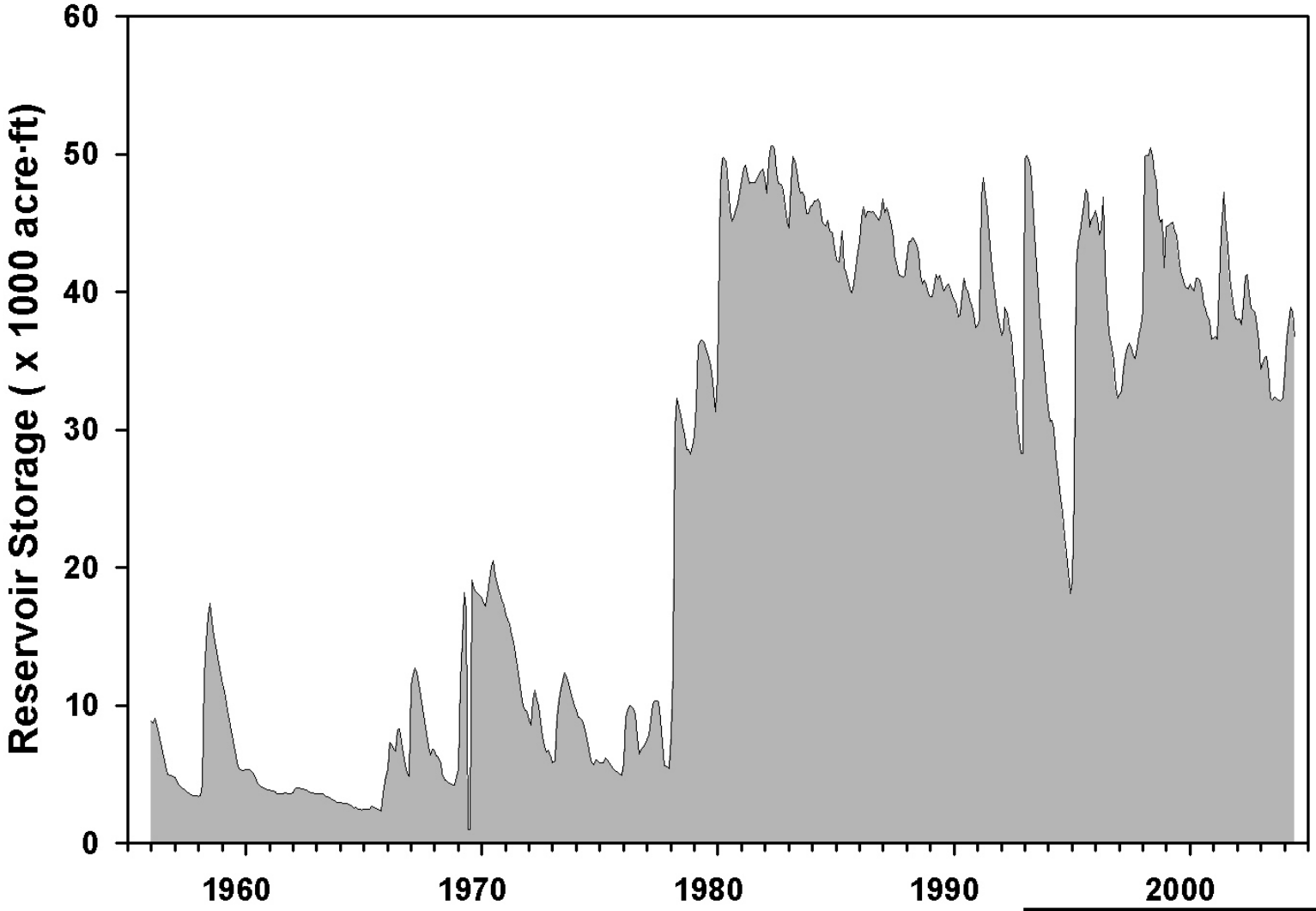
An important consideration in water supply for the San Diego region is recycled water. The projected growth in the San Diego region, coupled with increasing uncertainty regarding the availability of imported supplies, is placing increasing pressure on municipalities to identify alternative and supplemental sources of water supply. These supplemental supply sources will extend the limited potable water supplies available to meet growing water demands. Recycled water represents both an important potential local supply source and a method to increase water-use efficiency.

The San Diego County Water Authority commissioned a "Regional Recycled Water System Study" to help plan for recycled water in the San Diego Region (SDCWA, 2002). This study identified potential sources of recycled water, identified the infrastructure required for distribution, and estimated the potential demand for recycled water throughout the San Diego Region. This section summarizes these components for the South Bay Region, which includes much of the Otay River watershed.

Supply. Recycled water originates from wastewater reclamation facilities. The City of San Diego and the Otay Water District (OWD) provide both water and wastewater service to the South Bay Region, including parts the Otay River watershed. The OWD wastewater system is owned and operated in cooperation with the City of Chula Vista and the City of San Diego. In October 2003, the OWD entered an agreement with the City of San Diego to acquire 6 million gallons per day (mgd), or 6,600 acre-feet/year, of recycled water capacity from the South Bay Water Reclamation Plant to assist in meeting projected recycled water demands within the District.

There are two primary sources of recycled water in the South Bay Region. The Ralph W. Chapman Water Recycling Facility is located on Singer Lane in the community of Spring Valley, and provides tertiary treatment for up to 1.3 mgd. The South Bay Water Reclamation Plant is located along the United States border with Mexico is anticipated to ultimately produce approximately 13.5 mgd, or nearly 15,000 acre-ft/year, of recycled water for distribution and use in South Bay.

Distribution. The City of San Diego has infrastructure along Dairy Mart Road and to the International Boundary and Water Commission (IBWC) Waste Water Facility within South Bay for distribution of recycled water. The OWD will connect to the City of San Diego's Dairy Mart Road pipeline and construct and distribute the recycled water within their District. The OWD is constructing portions of their master planned recycled water system as new development projects are implemented. A significant



Source: RBF, 2004

Otay River Watershed Management Plan

Figure B.5-18

Historic Average Storage in Otay Reservoir (1956-2003)

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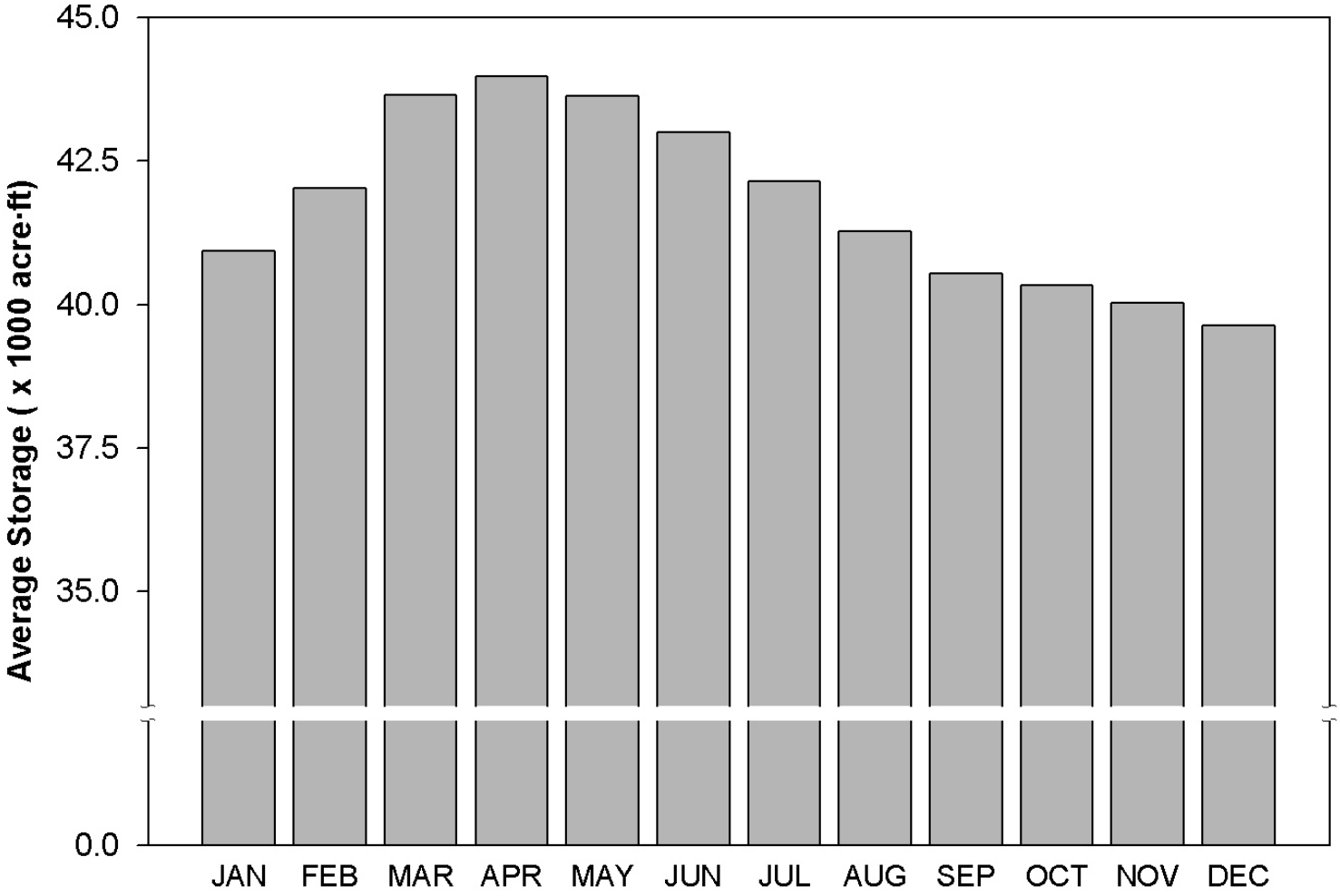


Source: RBF, 2004

Otay River Watershed Management Plan

Figure B.5-19

Monthly Average Storage in Otay Reservoir (1981-2000)

Aspen Environmental Group

portion of the system was also constructed as part of their Inter-Connection piping system. Upon completion, the recycled water system will include a series of reservoirs, pumping stations and pipelines.

Demand. Demand for recycled water within the City of San Diego in the South Bay region is projected to utilize the full capacity of the South Bay Plant. The City of San Diego is preparing *Water Resource Study 2005*, which will outline potential uses in the region.

The land within the OWD continues to convert from its agriculture roots to modern master planned subdivisions. With the increase in planned communities, there are parks, green belts, and golf courses that can be served from the recycled water system. Currently, the recycled water from the Chapman facility is used at District facilities, including the Auld Golf Course located north of Proctor Valley Road (in the Salt Creek sub-watershed). Additional recycled water demands within Eastlake are also served from their existing system.

Demands within the OWD are projected to reach approximately 7,800 acre-feet/year by 2030. The Chapman facility will be responsible for approximately 1,200 acre-feet/year, and the remaining 6,600 acre-ft/year is expected to be served from the City of San Diego South Bay WRP supply.

B.5.5 Groundwater

Previous investigations of groundwater in the San Diego region have generally not considered the Otay River watershed as a major source of groundwater. For instance, Ellis and Lee (1919) characterized the Otay River Valley as a 'minor valley' in terms of groundwater resources, because wells in the Otay River Valley indicated relatively shallow alluvium compared to the major valleys of the Santa Margarita, San Luis Rey, San Dieguito, San Diego, Sweetwater, and Tijuana Rivers. They hypothesized that because the Otay River was younger and smaller, it was unable to erode its valley to the same depth as the other major rivers during the geologic time when the land stood higher than present. Therefore, when land was subsequently lowered, only a part of the Otay River Valley was submerged, and to a comparatively shallow depth.

B.5.5.1 Groundwater Basins and Aquifers

Groundwater within the Otay River watershed occurs within the unconsolidated alluvium, semi-consolidated sedimentary bedrock (San Diego and Otay Formations), and to a lesser degree, the bedrock surrounding the alluvium. In the western portion of the watershed, groundwater exists in the alluvium and semi-consolidated formations of the Otay Groundwater Basin. The Otay Groundwater Basin, as defined by the California Department of Water Resources (DWR, 2003), is generally coextensive with the topographic Otay Valley (Figure B.5-20).

Unconsolidated alluvium within the Otay River watershed occurs principally in the active drainage channels of the Otay River and its tributary streams. The maximum thickness of the alluvium is about 200 feet in the lower Otay River Valley (DWR, 1967). Ellis and Lee (1919) and DWR (2003) describe the alluvium of the Otay River Valley as no greater than 50 feet thick. Although wells completed in Quaternary alluvium discharge as much as 300 gallons per minute, the alluvium is too thin to be considered a viable aquifer (DWR, 2003).

The Linda Vista and Bay Point Formations of unconsolidated Pleistocene alluvium are found along the coastal plain, but as a rule these sediments are located above the water table and are non-water bearing. However, these formations readily transmit percolating rainfall and runoff to underlying sediments

(DWR, 1967). Recent alluvium also occurs in beach deposits on the Coronado Peninsula, but these deposits are not fresh water-bearing.

Most groundwater in the Otay River watershed is found in the semi-consolidated San Diego Formation, which is generally more than 1,000 feet thick and extends over most of the western portions of the Otay River watershed (see Figure B.5-20). Transmissivities in the San Diego Formation aquifer range from approximately 15,000 to 37,000 gallons per day per foot (gpd/ft) (2,000 to 5,000 ft^2/day; Huntley, et al., 1996b). Groundwater is also found in the underlying clays and clayey sands of the Otay Formation, but the yield from this formation is much lower. A study of well OTSW-1, located in the City of Chula Vista and screened in the Otay formation, found transmissivities of approximately 750 to 2,200 gpd/ft (100 to 300 $feet^2$/day; Huntley et al., 1996b; see Figure B.5-20).

In the eastern portion of the watershed, groundwater is obtained from wells completed in bedrock. A study of the bedrock aquifer in Lee Valley, located along Jamul Creek in the northeastern portion of the watershed, found horizontal hydraulic conductivities in unweathered bedrock ranging from immeasurably small to 0.45 gpd/ft^2 (0.06 ft/day), and well yields that varied from a few gallons per minute to more than 100 gpm (USGS, 1994). Unweathered bedrock is frequently overlain by a layer of weathered material known as regolith (i.e., an uncemented mixture of soil and rock particles), and horizontal hydraulic conductivity in the regolith was found to be approximately 45 to 127 gpd/ft^2 (6 to 17 ft/day). Where wells in the unweathered bedrock had unusually high yields, it was observed that water in the unweathered bedrock was hydraulically connected with water in the regolith. High yielding bedrock wells were also located near photolineaments, linear structural features that are frequently associated with increased bedrock fracture intensity (USGS, 1994).

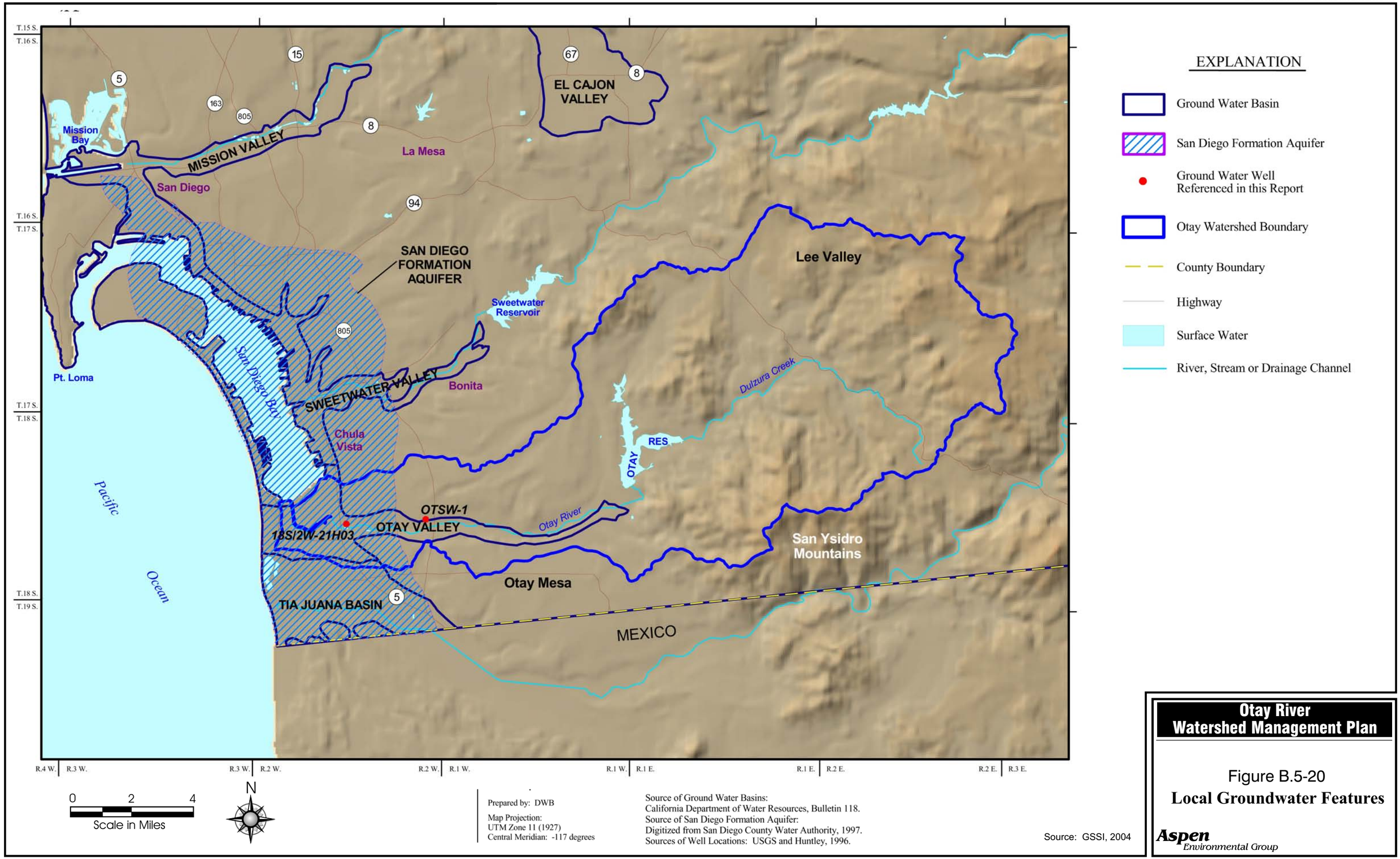
B.5.5.2 Groundwater Recharge and Discharge

Groundwater recharge in the Otay River watershed is derived from direct infiltration of precipitation, infiltration of surface water from drainage channels during periods of high flow, and return flow from irrigation (DWR, 2003). Groundwater discharges into streams during periods of low surface water flow, and into the San Diego Bay (DWR, 1967). Some groundwater may also be extracted by wells (DWR, 1967), although SANDAG (1985) characterizes the Otay Groundwater Basin as presently unused. The Otay Groundwater Basin is in hydrologic equilibrium, meaning that recharge and discharge are approximately equal (SANDAG, 1985).

B.5.5.3 Groundwater Elevation and Flow

Groundwater flow in the Otay River watershed generally mimics surface topography. East of the Otay Reservoirs, groundwater flows from valley sides to drainage channels such as Jamul and Dulzura Creeks. When groundwater levels are high, groundwater discharges into these drainages and flows as surface water to the Lower Otay Reservoir. West of the Reservoir, groundwater flow is generally westwards, and the basin discharges into the San Diego Bay (SANDAG, 1985). Depth to groundwater varies from less than 7 feet in parts of San Diego to greater than 100 feet in Lee Valley (USGS, 1994; USGS, 2004c).

No comprehensive program exists to monitor groundwater elevations in the Otay River watershed. A 15-year record of groundwater elevation at Well 18S/2W-21H03, located in the City of San Diego near the mouth of the Otay River, shows a slight increase in groundwater levels over time, from about 5 feet above mean sea level (amsl) in 1978 to 8 feet amsl in 1994 (see Figure B.5-21 for water levels and Figure B.5-20 for well location). Groundwater levels in the bedrock wells of Lee Valley display seasonal and annual fluctuations due to precipitation patterns – water levels rise with winter rains, and



Otay River Watershed Management Plan

Figure B.5-20
Local Groundwater Features

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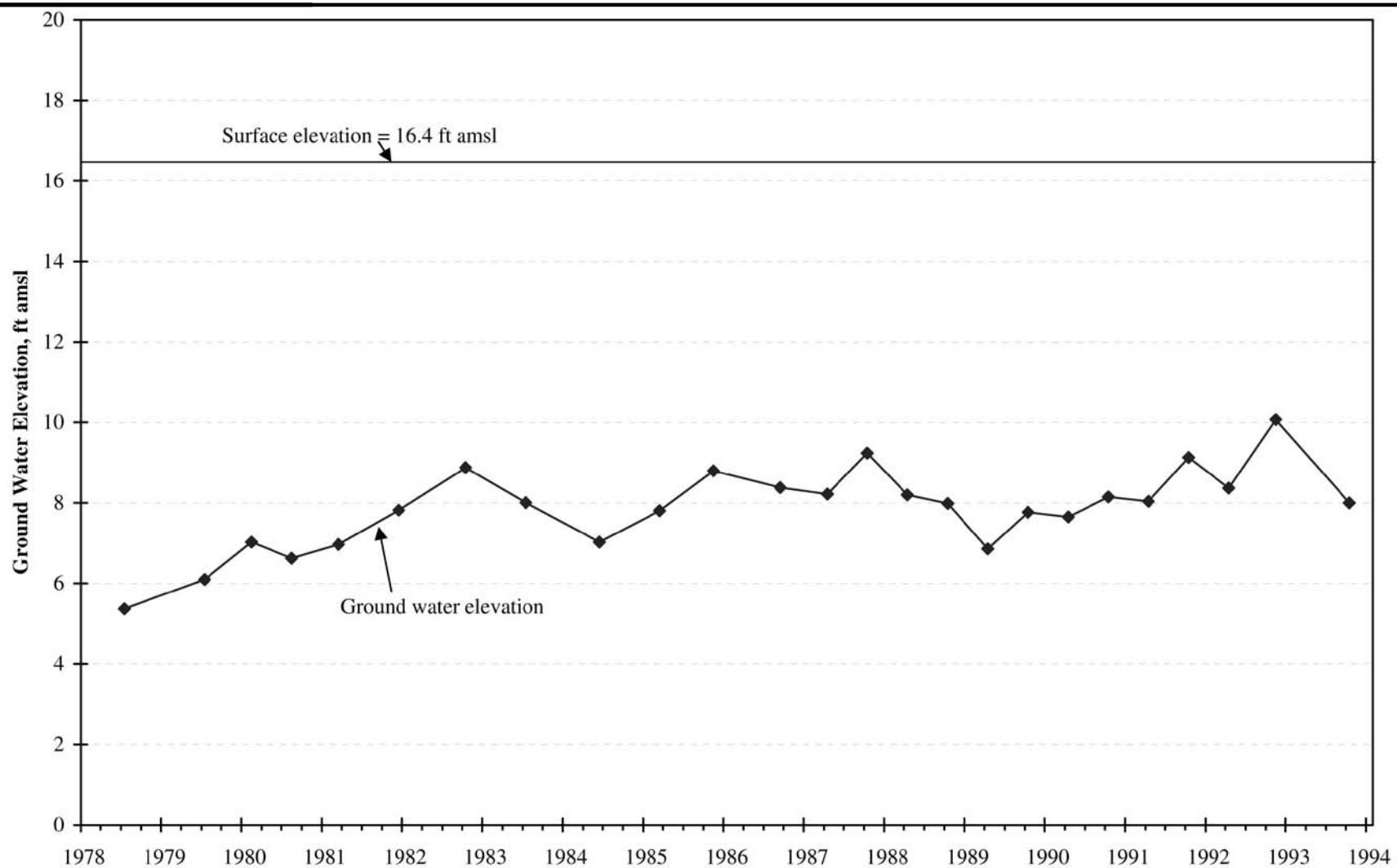

Source of Data: United States Geological Survey (USGS)

Source: GSSI, 2004

Otay River Watershed Management Plan

Figure B.5-21

Hydrograph of USGS Well 323530117050701 State Well No. 18S/2W - 21H03

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fall in the summer, and are generally higher in wet years. These fluctuations are more pronounced in wells screened in the weathered regolith layer, and more muted in wells screened in the unweathered bedrock aquifer (USGS, 1994).

B.5.5.4 Groundwater Production

Approximately 90 percent of water demand in San Diego County is met with imported water, purchased from the Metropolitan Water District of Southern California and through a water transfer agreement with the Imperial Irrigation District (County of San Diego, 2003). The water is brought in from Northern California through the State Water Project, and from the Colorado River via the Colorado River Aqueduct. Groundwater constitutes roughly 23 percent of locally produced water supplies, and 3 percent of the overall water supply in the San Diego County Water Authority service area (County of San Diego, 2003).

The majority of groundwater production wells in the Otay River watershed are private wells for domestic use and irrigation in the rural eastern portions of the watershed. Production in this area is largely from bedrock regolith and alluviated drainage channels. Production yields in bedrock wells are generally low (approximately 15 gpm), but can exceed 100 gpm (USGS, 1994). In the western portion of the watershed, groundwater production is mainly derived from the San Diego Formation (DWR, 1967). Wells drilled in this formation typically produce between 150 and 400 gpm, but can yield as high as 1,500 gpm (DWR, 2003).

B.5.5.5 Existing and Planned Groundwater Development Projects

Major water purveyors within the Otay River watershed include the California American Water Company, City of San Diego Water Department, Sweetwater Authority, and Otay Water District – the latter three of which are members of the San Diego County Water Authority (SDCWA). SDCWA is San Diego County's regional water wholesaler, formed in 1944 for the purpose of supplementing local supplies with imported water. SDCWA and its member agencies serve approximately 97 percent of County residents, corresponding to a service area encompassing roughly the western one-third of San Diego County.

Groundwater comprises only a minor portion of water supplies in the SDCWA service area. Since 1980, 70 to 95 percent of SDCWA annual water supplies have been imported from the Colorado River Aqueduct and State Water Project. Local supplies primarily come from surface water reservoirs that have yields correlating to annual rainfall (long-term average production of 85,600 acre-ft/yr). Minor sources of local supply include groundwater (approximately 24,000 acre-ft/yr), recycled water (13,700 acre-ft/yr), and, in the future, desalinated seawater (SDCWA, 2002). Residents living in the portions of the Otay River watershed outside of the SDCWA service area (generally, east of the Lower Otay Reservoir) are wholly dependent on groundwater supplied by community water systems or individual wells (County of San Diego, 1993). In the western portion of the watershed, however, water purveyors have abandoned former well supplies because of poor water quality (high dissolved solids concentrations). Sweetwater Authority produces groundwater from the San Diego Formation at its National City wellfield, north of the Otay River watershed.

SDCWA's 1997 Groundwater Resource Development Report indicates that there are no current or planned groundwater development projects within the Otay River watershed, and that there are no plans to explore the San Diego Formation aquifer between the Sweetwater and Tijuana River Valleys. Virtually all of the current, proposed, and potential groundwater development projects identified by SDCWA are located in the groundwater basins of the Santa Margarita, San Luis Rey, San Dieguito,

San Diego, Sweetwater, and Tijuana River Basins. However, the report identifies the potential for extracting and treating as much as 2,000 acre-ft/yr of groundwater from the San Diego Formation in the City of San Diego.

B.5.6 Water Quality

B.5.6.1 Surface Water Quality

Ambient and wet weather water quality data for the Otay River watershed are extremely limited. This Section summarizes contemporary water quality sampling efforts, summarizes the results of some of these efforts, and discusses the water quality impairments of the Otay River Watershed.

Monitoring Programs

County of San Diego Storm Water Co-permittees. The San Diego Storm Water Co-permittees are currently sampling storm water at various locations throughout San Diego County. One station was established in the Otay River watershed. However, this station never received any storm water flows and was subsequently taken offline. The Co-permittees determined that the hydrographic conditions within the Otay River drainage area would not produce adequate flow for sample collection, and removed the station from the Wet Weather Monitoring Program (SDUPD, 2003b).

California Department of Water Resources. The California DWR has done some sampling in San Diego County. No data for the Otay River watershed were available though the online data. The California DWR queried all data available and found no data for the Otay River watershed.

City of Chula Vista. The City of Chula Vista conducts dry weather sampling at 15 outfalls that discharge to the Otay River. Constituents monitored include: phenols, detergents, zinc, chlorine, copper, ammonia, glycol, and conductivity, as well as pH, temperature and flow rate. Sampling dates were from 2000 to 2003, during the dry season only (May through September).

City of San Diego. The City of San Diego conducts dry weather sampling at seven outfalls that discharge to the Otay River. Constituents monitored include: ammonia, turbidity, nitrate, reactive phosphorus, surfactants, oil and grease, total hardness, cadmium, copper, lead, zinc, diazinon, chlorpyrifos, total coliform, fecal coliform, enterococcus, and conductivity as well as pH, temperature and flow rate. Sampling dates were during August 2002 and September 2003.

City of San Diego Water Department. The City of San Diego Water Department has extensive water quality data for the Otay Reservoir. Nutrients (including NH_4, NO_2, NO_3, Total Nitrogen, PO_4, and Total Phosphorous) are collected monthly (when water is flowing) at two sites above the reservoir. Bacteria (*E. coli* and enteroccoccus) are monitored monthly at five sites above the reservoir (again, when water is flowing). Metals and organics are monitored quarterly at these sites. Table B.5-7 summarizes the City of San Diego Water Department water quality monitoring program in the Otay River watershed.

City of Imperial Beach. The City of Imperial Beach conducts dry weather sampling once annually at two outfalls that discharge to the Otay River.

Table B.5-7 City of San Diego Water Department Water Quality Monitoring Program.

Location	Station Code	Nutrients	Bacteria	TSS	TDS	Pesticides and Other Organics(2)	Metals(2)
Jamul Creek at Otay Reservoir	Jam4	X	X	X	X	X	X
Upper Otay Reservoir (West Arm)	Uor1		X	X	X	X	X
Proctor Valley Creek at Upper Otay Reservoir	Pvr2	X	X	X	X	X	X
Hollenbeck Canyon Creek	Hol3		X	X	X	X	X
Dulzura Creek (Flume)	Dul1a		X	X	X	X	X

Source: City of San Diego, 2005
Notes: (1) Nutrients include NH_4, NO_2, Total N, PO_4, and Total P; (2) Pesticides, organics, and metals sampled quarterly

San Diego Regional Water Quality Control Board. The San Diego Regional Water Quality Control Board (SDRWQCB) conducted a Surface Water Ambient Monitoring program in the Otay River watershed. Samples were taken in the upper areas of the watershed at Jamul Creek and Poggi Creek. Three dates were sampled (January 2003, April 2003, and May 2003). Constituents monitored included: dissolved metals, pesticides, PCBs, PAHs, total phosphate, ortho-phosphate, total ammonia, nitrate, nitrite, TKN, sulfate, alkalinity, and TSS.

San Diego Stream Team. The San Diego Stream Team, a volunteer organization, conducts sampling for biological assessment in the region, including the Otay River.

Water Quality Data

Co-Permittee Sampling Programs. The Urban Runoff Monitoring Report developed by the San Diego Co-permittees (MEC Analytical, 2004) provides estimated Event Mean Concentrations (EMCs) for the Otay River. An EMC represents the average concentration of a specific pollutant contained in storm water runoff coming from a watershed. EMCs generally reflect the land uses on the tributary watershed. Table B.5-8 presents these estimated EMCs, which are based upon water quality observed in similar watersheds in the area. However, given the lack of data for the Otay River itself, these estimates may not be that reliable. A number of factors might hinder a direct correlation between these "peer watersheds" and the Otay River watershed, including the type and distribution of land use and other hydrologic characteristics. Development of statistically defensible constituent concentrations would likely require several years of water quality monitoring on the Otay River watershed itself.

The dry weather sampling of Otay River storm water outfalls by the Cities of Chula Vista, San Diego, and Imperial Beach characterize the quality of dry weather discharges to the River, but do not give any indication of the river quality itself. Wet weather water quality in natural systems can be highly variable. Development of statistically defensible estimates of average constituent concentrations would likely require several years of monitoring. Should incremental changes occur to water quality because of urbanization, differences observed in a monitoring program would likely not be statistically significant.

Table B.5-8 Estimated Event Mean Concentrations for Otay River

Constituent	Event Mean Concentration
Biochemical Oxygen Demand	13 mg/L
Chemical Oxygen Demand	39 mg/L
Total Kjeldahl Nitrogen	1.15 mg/L
Dissolved Phosphorus	0.16 mg/L
Total Suspended Solids	87 mg/L
Total Lead	22.1 μg/L
Total Copper	21 μg/L
Total Zinc	115 μg/L
Total Cadmium	0.6 μg/L

Source: MEC Analytical, 2004.

Watershed Sanitary Survey. The City of San Diego Water Department carefully monitors water quality in its drinking water reservoirs, including the Otay Reservoir (City of San Diego, 2003). The purpose of these watershed sanitary surveys is to identify actual or potential sources of contamination in the watersheds, and any other watershed-related factors that are capable of producing adverse effects on the quality of water used for domestic drinking water purposes. The watershed sanitary survey was recently updated in 2001.

Monitoring results from the sanitary survey found that for raw water in the watersheds, in the reservoirs, and at the influent of the water treatment plan sometimes exceeded maximum contaminant levels (MCLs) for drinking water. When compared to standards for drinking water (i.e., treated water), raw water in the watersheds and in the reservoirs commonly exceeded limits for pH, turbidity, color, odor, coliform bacteria, manganese and aluminum. The source water sometimes exceeded drinking water limits for iron, total dissolved solids, and conductivity. The only organic contaminant measured in source waters at levels greater than drinking water standards was the gasoline additive Methyl Tertbutyl Ether (MTBE). MTBE levels exceeded the secondary MCL of 3 ug/l at the Otay Reservoir, but never exceeded the secondary MCL in any of the water treatment plant influents. No other organic constituents, heavy metal, nor radiological constituent, was found at levels greater than drinking water standards in the reservoirs or watersheds. The combination of blending of various sources plus effective treatment at the plant produced water that consistently met all drinking water standards.

San Diego Stream Team. The San Diego Stream Team has conducted bioassessments in the Otay River watershed. This is a measurable assessment of the long-term health of a stream by examination of the aquatic invertebrates that live in the water. Bioassessments are considered an excellent way to measure the health of a receiving water. Rather than measuring concentrations of individual constituents and then assuming an impairment exists, direct measurement of the biological health provides the ultimate answer as to whether conditions in the Otay River support a healthy biological community. In addition, bioassessments integrate the effects of all potential changes in the river due to changes in runoff volumes, runoff rates, and changes in the chemical characteristics, including the synergistic effects of multiple pollutants. Table B.5-9 summarizes the bioassessment data available from the Otay River watershed; Section D.2.3 and Table D-3 describe each bioassessment metric in more detail. Though these particular bioassessment data represent only a snapshot of conditions, they indicate that the biological community is relatively healthy.

Table B.5-9 Bioassessment Data from the Otay River Watershed (Spring 2001)

Bioassessment Metric	Dulzura Creek	Jamul Creek
Richness Measures		
Taxa Richness	6 *	5.3
Ephemeroptera Taxa	2	1
Plecoptera Taxa	0	0
Trichoptera Taxa	2	1
EPT Taxa	4	2
Composition Measures		
EPT Index	98	46.4
Sensitive EPT Index	1	0
% Hydropsychidae	92.9	24.8
% Baetidae	0	21.6
Tolerance/Intolerance		
Tolerance Value	4	5.2
% Intolerant Organisms	0	0
% Tolerant Organisms	0	3.1
% Dominant Taxa	92.9	43.9
Feeding Groups		
% Collectors (c)	5.1	55.1
% Filterers (f)	92.9	42.9
% Scrapers (g)	1	0.3
% Predators	1	1.7
% Shredders (s)	0	0

* Value based on average of three composite samples per site

The California Department of Fish and Game's 2002 Biological Assessment Report reviewed bioassessment data for Jamul Creek and classified the overall integrity of the biota at Jamul Creek to be "fair" to "good." The 2002 Biological Assessment report categorized Jamul Creek as a reference site (i.e., one relatively undisturbed by human activities). Given that these data were obtained for streams upstream of the Lower Otay Reservoir in a relatively undeveloped part of the watershed, they could provide a useful basis of comparison with more urbanized parts of the watershed downstream.

Impairments

Section 303(d) of the federal Clean Water Act requires states to identify waters that do not meet applicable water quality standards. As defined in the Clean Water Act and federal regulations, water quality standards include the designated uses of a water body, the adopted water quality criteria, and the State policies against degradation of water resources.

The California State Water Resources Control Board (SWRCB) maintains a Section 303(d) List of impaired water bodies in compliance with the CWA. The Section 303(d) List includes descriptions of pollutants causing the violation of water quality standards and a priority ranking of the water quality limited segments. The priority ranking takes into account the severity of the pollution and the uses to be made of the waters. States review their Section 303(d) lists in even-numbered years, making changes as necessary, and submit the list to U.S. Environmental Protection Agency for approval. The SWRCB is currently completing their 2004 revisions to the 303(d) list of water quality limited segments.

The inland surface waters of the Otay River watershed are free of any significant impairment, according to the most recent Section 303(d) List. The one impairment (San Diego Bay Tidelands Park) associated with the Otay River Hydrologic Unit (HU 910) is located on Coronado Island, and is not attributed to the mainland Otay River watershed.

The SWRCB may propose Total Maximum Daily Load (TMDL) limitations for 303(d)-listed water bodies. A TMDL is the sum of the individual waste load allocations for point sources, load allocations

for nonpoint sources, and natural background loads from tributaries or adjacent stream segments. The SWRCB has not proposed TMDLs for any water bodies within the Otay River watershed.

The SWRCB also maintains a "Monitoring List" concurrent with the 303(d) and TMDL lists. The Monitoring List includes water bodies where minimal, contradictory, or anecdotal information suggests that standards are not being met, but available data are inadequate to draw a definitive conclusion. In these cases, the SWRCB lists water bodies on the Monitoring List in order to prioritize the collection of additional information to resolve whether water quality objectives and beneficial uses are attained. Waters on the Monitoring List are a high priority for evaluation as to whether they will be listed on subsequent Section 303(d) and/or TMDL lists.

Several inland surface waters on the Otay River watershed are on the 2002 Monitoring List. These surface waters include Dulzura Creek, Proctor Valley Creek, and the Lower Otay Reservoir. Table B.5-10 summarizes the Monitoring List for Otay River Watershed.

Table B.5-10 Otay River Watershed Water Quality Monitoring List

Water Segment	Hydrologic Unit	Potential Impairment
Dulzura Creek	910.36	Eutrophic Conditions
		Hydromodification
		Sediment/Siltation
Lower Otay Reservoir	910.31	Color
		Odors
Proctor Valley Creek	910.32	Trash

Source: SWRCB, 2003.

Dulzura Creek. The Monitoring List includes Dulzura Creek, which is listed for eutrophic conditions, hydromodification, and sediment/siltation. Eutrophic conditions indicate water that is rich in nutrients, which can have negative effects upon biological communities. Hydromodification refers to changes in the volume and duration of runoff, which can have negative effects upon creek bed and bank erosion and sediment deposition, and also cause the loss or conversion of habitat. Similarly, sediment/siltation impairments adversely affect the biological community and other beneficial uses.

According to the staff report for the Monitoring List, Agency staff has the reason to believe eutrophication problems exist through direct observation and "prior experience with the watershed/water body," but data were unavailable to support a Section 303(d) listing. Therefore, additional monitoring is needed to confirm the possible extent of deleterious effects to beneficial uses. Agency staff included hydromodification on the Monitoring List for Dulzura Creek because there is reason to believe that a significant erosion/incised channel water quality problem exists, based on personal observations and prior experience with the watershed/water body. The staff report cites similar reasons for listing sediment and/or siltation on the Monitoring List.

Lower Otay Reservoir. Agency staff placed the Lower Otay Reservoir on the Monitoring List for color and odor because sampling by the City of San Diego 1997 to 2000 indicated a possible exceedance of Basin Plan objectives. Color and odor impairments primarily affect drinking water supply because of the increased cost of treatment to remove undesirable appearance, taste, and odors from drinking water.

Proctor Valley Creek. Agency staff placed Proctor Valley Creek on the Monitoring List for trash due to "prior experience with, and personal observations in, the watershed/water body." Trash refers to gross (large) solids, as opposed to solids dissolved or suspended in the water. Most visibly, trash creates negative aesthetic effects that adversely affect recreational beneficial. In addition, trash and debris harbor bacteria and create additional oxygen demand to aquatic systems, which is detrimental to biological communities and other beneficial uses.

B.5.6.2 Groundwater Quality

Groundwater quality in the San Diego Formation aquifer is highly variable; total dissolved solids (TDS) concentrations range from below the Secondary Maximum Contaminant Level of 500 mg/L to as much as 12,000 mg/L (SDCWA, 1997). The water is of sodium chloride type, indicating that the high TDS concentrations are probably of marine origin. It is thought that the highest concentrations are due to the continuing presence of connate ocean waters—waters emplaced during the formation's deposition—rather than to widespread seawater intrusion. In general, TDS concentrations are highest near the coast and decrease in the eastern portions of the basin (DWR, 1967). Native groundwater in the eastern portions of the Otay River watershed, as observed in the Otay Reservoir water before the importation of Colorado River water began, is of sodium-calcium bicarbonate to sodium-magnesium bicarbonate type. This composition is consistent with the mineral composition of the gabbro and granodiorite in the watershed (DWR, 1967).

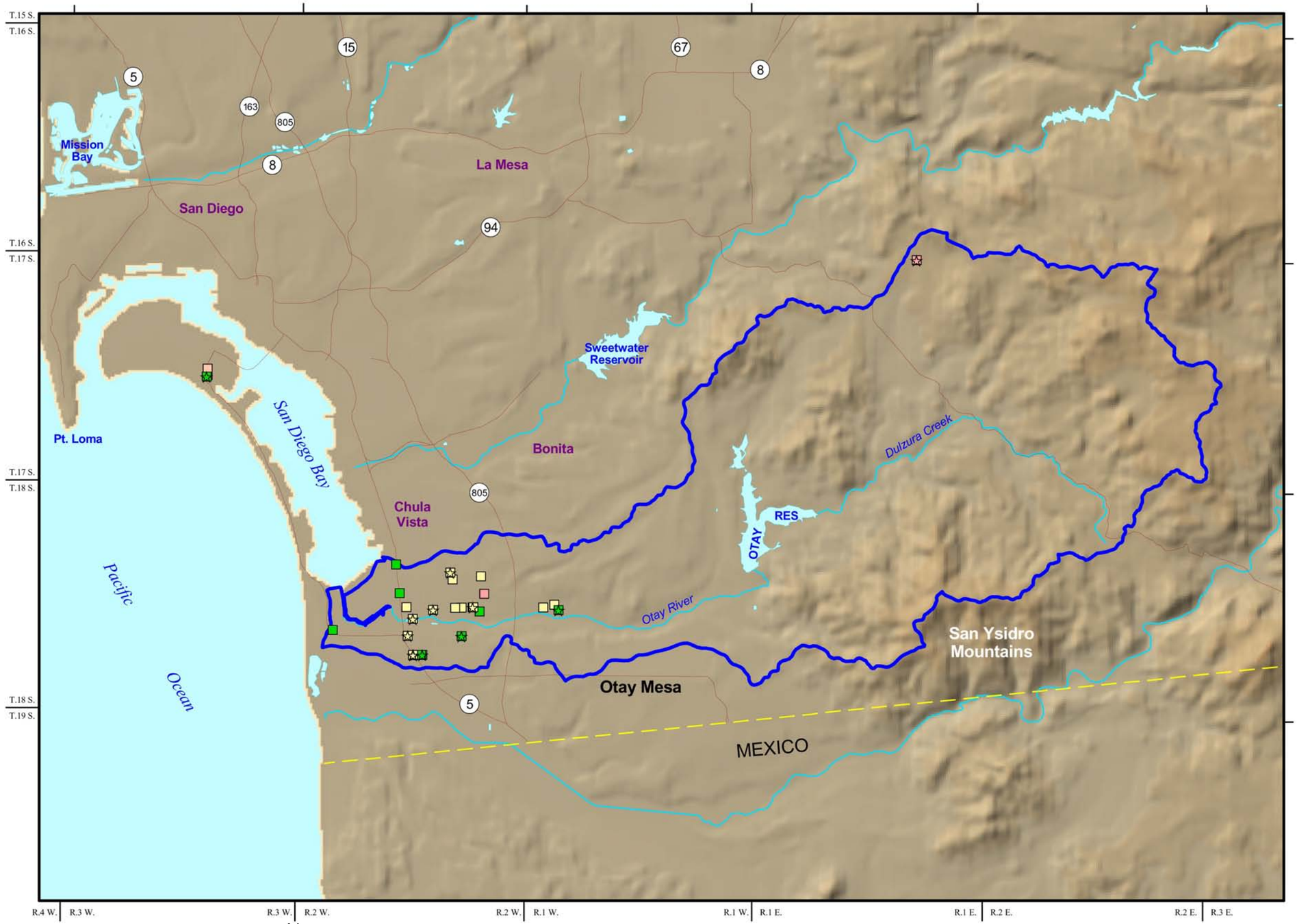
Groundwater quality rates as marginal to inferior for domestic and irrigation purposes in the coastal plain because of high TDS and high chloride concentrations, respectively (DWR, 1967). Principal sources of salt load to groundwater within the lower Otay River watershed are urban and agricultural return flows which together account for nearly 90 percent of the salt load (SANDAG, 1985). The majority of water supply needs in the SDCWA service area for the past 50 years have been met with imported water. Average historical TDS concentrations of imported water delivered to the SDCWA are 700 mg/L for Colorado River water and 250 mg/L for State Project water. However, the application of imported water through agricultural, residential, and commercial irrigation systems adds more TDS to groundwater because of additive effects, such as evapoconcentration and leaching of soils. Salinity loads to groundwater in San Diego County are expected to increase because of projected increases in TDS concentrations in imported water and increases in water use (County of San Diego, 2003).

Groundwater in the eastern watershed area typically meets safe drinking water standards, although there are some locations with high iron, manganese, chloride, nitrate, and/or TDS concentrations (USGS, 1994; DWR, 1967). In general, there are no significant septic system problems within the eastern watershed because parcels are quite large with sufficient areas for leach fields, and most septic systems are relatively new and designed by a qualified engineer (City of San Diego, 2003).

An additional groundwater quality concern in the Otay River watershed includes leaking underground storage tanks (LUSTs). Active LUST sites are shown on Figure B.5-22. Groundwater impacts have been identified at 12 of these sites; leaked constituents include gasoline, diesel fuel, MTBE, and other fuel additives.

B.5.7 Pertinent Regulations, Programs, and Plans

Three federal and State agencies have primary regulatory responsibility over activities within streams, lakes, wetlands, riparian zones, and other aquatic areas in California. The U.S. Army Corps of Engineers (Corps) regulates discharges of dredged and fill material into waters of the United States, pursuant to Section 404 of the federal Clean Water Act (CWA); the California Regional Water Quality Control Boards regulate discharges into waters of the State, pursuant to Sections 401 and 402 of the CWA and the California Porter-Cologne Water Quality Control Act; and the CDFG regulates several types of activities within streams and lakes under the Fish and Game Code Sections 1600-1616. The U.S. Environmental Protection Agency (USEPA) has oversight responsibility over the various Clean Water Act programs. The State Department of Health Services is responsible for administering the federal and State Safe Drinking Water Acts, which apply to surface and groundwater. The local jurisdictions also have water resource plans and ordinances to protect aquatic resources.



EXPLANATION

LUST Classification

- Leak Being Confirmed
- Preliminary Site Assessment Underway
- Remedial Action Underway
- Post Remedial Action
- Ground Water-Impacted Site
- Otay Watershed Boundary
- County Boundary
- Highway
- Surface Water
- River, Stream or Drainage Channel

0 2 4
Scale in Miles

N

Prepared by: DWB

Map Projection:
UTM Zone 11 (1927)
Central Meridian: -117 degrees

Source of Leaking Underground Storage Tank Locations:
DHS, 2004 - http://geotracker.swrcb.ca.gov

Source: GSSI, 2004

Otay River Watershed Management Plan

Figure B.5-22

Active Leaking Underground Storage Tank (LUST) Locations Within the Watershed

Aspen Environmental Group

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back of color figure

B.5.7.1 The Section 404 Regulatory Program

Section 404 of the CWA of 1972, as amended, regulates the discharge of dredged material, placement of fill material, and certain types of excavation (i.e., those resulting in more than incidental fallback of excavated material) within "waters of the United States" and authorizes the Secretary of the Army, through the Chief of Engineers, to issue permits for such actions. "Waters of the U.S." are defined by the CWA as "rivers, creeks, streams, and lakes extending to their headwaters and any adjacent wetlands." Wetlands are defined by the CWA as "areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions." Permits can be issued for general categories of projects (General Permits) or for individual projects (Individual Permits). General Permits are issued for projects with minimal impacts to the aquatic ecosystem on an individual and cumulative basis. These include Nationwide Permits (NWPs), issued by Corps headquarters, and Regional General Permits (RGPs), which are issued by Corps Districts or Divisions. Individual Permits include Standard Permits (SP), which are issued for projects that could have a greater than minimal impact on the aquatic ecosystem, and therefore, require a more rigorous review process.

The jurisdictional extent of Corps regulatory control changed with the January 9, 2001 *SWANCC* case ruling (*Solid Waste Agency of Northern Cook County vs. United States Army Corps of Engineers*, No. 99 1178). The U.S. Supreme Court held that the Corps could not apply Section 404 of the CWA to extend Corps jurisdiction over an isolated quarry pit. The Court ruled that the CWA does not extend federal regulatory jurisdiction over non-navigable, isolated, intra-state waters with a nexus to interstate or foreign commerce solely limited to use by migratory birds. However, the Court made it clear that non-navigable wetlands adjacent to inter-state waters or to navigable waters of the U.S. are still subject to Corps jurisdiction. As a result of this ruling, the Corps has lost its authority to regulate many mudflats, sandflats, wetlands, prairie potholes, wet meadows, playa lakes, natural ponds, and vernal pools, that are not hydrologically connected to or adjacent to other navigable or inter-state "waters of the United States."

Currently, the Corps' Section 404 regulatory program is administered on a project-by-project basis. They process permit applications as they receive them. While direct effects are straightforward to evaluate, this approach to permitting makes it difficult to evaluate the indirect and cumulative effects of their permit actions on the larger system. As a result, there can be a net loss in functions and values within the watershed, which is inconsistent with the no net loss of wetland functions and values policy. Because the Otay River watershed is under intense development pressure and has valuable aquatic resources, the Corps is working with the County of San Diego and other jurisdictions with an interest in the watershed to develop a SAMP to balance reasonable economic development and uses with aquatic resource protection and restoration in this watershed. Once completed, the SAMP will provide the basis for the Corps to issue streamlined, programmatic permits authorizing impacts for particular types of activities in specific areas and requiring the establishment of an aquatic resource preserve to ensure there is not a net loss of aquatic resource functions and values watershed-wide.

Section 7 Consultation Pursuant to the Endangered Species Act

The Corps undertakes Section 7 consultation pursuant to the federal Endangered Species Act (ESA) of 1973, as amended, when the activities requiring Corps authorization (i.e., involving discharges of dredged or fill material within waters of the U.S.) would affect a federally listed threatened or endangered species or its designated critical habitat. Conferencing occurs for species or habitats proposed for listing or designation, respectively. The process begins when the lead federal agency

completes and submits a biological report (i.e., in the case of an EIS, a Biological Assessment [BA] fully describing these effects with a written request to initiate Section 7 consultation). The federal lead agency, in cooperation with the applicant, coordinates with the USFWS or NMFS, as appropriate, regarding avoidance and minimization of impacts to listed species and designated habitat. After these avenues have been exhausted, the USFWS/NMFS will recommend mitigation, which will allow incidental "take" of individual animals or plants along with occupied habitat. The USFWS will then issue a Biological Opinion (BO), which is required before the Corps can make a permit decision. By the regulations, the USFWS has 90 days from the initiation of consultation in which to complete the biological assessment and 45 days to write the BO. However, the federal lead agency and the USFWS/NMFS can agree to a 60-day extension without approval from the applicant. If there are substantial impacts to listed species or an adverse modification to designated critical habitat, the USFWS/NMFS can issue a BO that the proposed project would jeopardize the continued existence of the species, which would result in a permit denial from the Corps. If there are no substantial impacts to federally listed species or adverse modification to designated critical habitat, the USFWS/NMFS will issue a "no jeopardy" decision with specific terms and conditions to allow the project to move forward.

Projects within the County or the City of Chula Vista MSCP areas are granted third-party beneficiary status for permitting under federal and California ESAs as long as projects conform to the requirements of the respective MSCP Plans.

Section 106 Consultation Pursuant to the National Historic Preservation Act

The Corps undertakes consultation pursuant to Section 106 of the National Historic Preservation Act of 1966, when the work requiring Corps authorization (i.e., involving discharges of dredged or fill material in waters of the U.S.) would adversely affect historic properties listed or eligible for listing on the National Register of Historic Places (NRHP). Historic properties include any prehistoric or historic structure, district, site, building, or object included on or eligible for inclusion on the NRHP. Listing eligibility is determined by the State Historic Preservation Officer (SHPO) or Tribal Historic Preservation Officer (THPO) and the federal lead agency, using the criteria listed in 36 CFR 60.4 (e.g., the site yielded, or may be likely to yield, information important to prehistory or history). If the Corps is the federal lead and the proposed work in the Corps' permit area would affect a historic property, the Corps would coordinate with in-house archaeological staff and the SHPO/THPO to determine whether the site is eligible for listing (if it is not already listed). If the site is listed or is eligible, consultation for the effects on the historic property would begin, culminating in a Memorandum of Agreement (MOA) that specifies the measures the Corps would take to avoid or reduce effects on the historic property. These MOAs are normally signed by the Corps, SHPO/THPO, and the Advisory Council on Historic Preservation. The consultation process can take 6 months or more to complete.

B.5.7.2 The Section 1600 et seq. Regulatory Program

Section 1602 of the California Fish and Game Code requires any person, State or local governmental agency, or public utility which proposes a project that will substantially divert or obstruct the natural flow or substantially change the bed, channel, or bank of any river, stream, or lake or use materials from a streambed to notify the CDFG before beginning the project or result in the disposal or deposition of debris, waste, or other material containing crumbled, flaked, or ground pavement where it can pass into any river, stream, or lake, it must first notify the CDFG of the proposed project. Notification is generally required for any project that will take place in or in the vicinity of a river, stream, lake, or their tributaries. This includes rivers or streams that flow at least periodically or permanently through a bed or channel with banks that support fish or other aquatic life and watercourses having a surface or subsurface flow that support or have supported riparian vegetation.

Based on the notification materials submitted, the CDFG will determine if the proposed project may impact fish or wildlife resources.

If the CDFG determines that a proposed project may substantially adversely affect existing fish or wildlife resources, a Lake or Streambed Alteration Agreement (SAA) will be required. A completed CEQA document must be submitted to the CDFG before they will issue a SAA. Within 60 days of receipt of a complete notification package, the CDFG will propose measures necessary to protect the fish or wildlife that your project could affect. These measures may be the same as those included as part of the project and/or measures proposed by the CDFG. The applicant has 14 days after receiving the CDFG's proposed measures to notify in writing whether they accept them, unless this time period is extended by mutual agreement. If the measures are acceptable, the SAA will be issued. If the measures are not acceptable, the applicant may request a meeting with the CDFG within seven days from the date the CDFG receives the response or by some other mutually agreed upon date for the purpose of developing measures that are acceptable to both the applicant and the CDFG. Once the applicant and the CDFG accept or agree on measures necessary to protect fish or wildlife resources, the CDFG will incorporate these measures into a draft SAA for review and signature.

Similar to the Corps, the CDFG currently administers their Section 1600 program on a project-by-project basis. As discussed, this approach can lead to a net loss of aquatic functions and values. The CDFG is also participating in the development of the SAMP, which could provide the basis for the CDFG to prepare a Master Streambed Alteration Agreement (MSAA) that would apply to activities throughout the watershed. This holistic permitting approach could help the CDFG better protect important State aquatic resources.

Section 2081 of the California ESA

Sections 2081(b) and (c) of the California ESA allow the Department to issue an incidental take (harm, harass, kill, etc.) permit for a State listed threatened and endangered species only if specific criteria are met. These criteria include that the authorized take is incidental to an otherwise lawful activity; the impacts of the authorized take are minimized and fully mitigated; the measures required to minimize and fully mitigate the impacts of the authorized take are roughly proportional in extent to the impact of the taking on the species, maintain the applicant's objectives to the greatest extent possible, and are capable of successful implementation; adequate funding is provided to implement the required minimization and mitigation measures and to monitor compliance with and the effectiveness of the measures; and issuance of the permit will not jeopardize the continued existence of a State-listed species. This process is very similar to the Section 7 process conducted for compliance with the federal ESA. If a project needs take authorization for a State-listed species, the 2081 process needs to be completed before the CDFG issues their Streambed/Lake Alteration Agreement (this is similar to the Corps needing the Section 7 process to conclude before they can issue a federal permit for projects that may affect or take federally listed species). Often, the 2081 process can be coordinated with the Section 7 process, and the federal Biological Opinion can be referenced by the CDFG in completing their 2081 process (i.e., issuance of their take permit).

As noted under the Section 7 discussion, projects within the County or the City of Chula Vista MSCP areas are granted third-party beneficiary status for permitting under the federal and California ESAs as long as the projects conform to the requirements of the respective MSCP Plans.

B.5.7.3 The Section 401 Water Quality Certification Program and State Porter-Cologne Water Quality Control Act Authority

Pursuant to Section 401 of the CWA, any federal permit (e.g., Corps Section 404 permit) or license that may result in a discharge of pollutants into "waters of the United States," must obtain a Water Quality Certification (WQC) or waiver from the state water quality agency that the activity complies with all applicable state water quality standards, limitations, and restrictions. In California, the RWQCBs issue WQCs within their respective jurisdictions, and the SWRCB hears only appeals. Typically, for smaller projects, these certifications are handled administratively by a "Conditional Water Quality Certification and Waiver of Waste Discharge Requirements" drafted by staff and approved by the Executive Officer of the RWQCB. These typically take two to six months to obtain. For larger, more complex projects, the RWQCBs may require Waste Discharge Requirements (WDRs) under their State authority (Porter-Cologne Water Quality Control Act) in lieu of a WQC. WDRs are prepared by staff and approved by the RWQCB at a public hearing. Generally, the Corps cannot continue the action or issue a Corps permit if the state has denied certification.

The conditional water quality certification or WDRs will often include requirements for construction and post-construction Best Management Practices (BMPs) to address both storm and non-storm water discharges from the project site. The water quality certification/WDRs will also often refer to and incorporate the requirements of other aquatic resource and water quality programs, and applicants can encounter difficulty coordinating these program requirements.

Since the January 9, 2001 *SWANCC* decision, the RWQCBs have been using their Porter-Cologne Water Quality Control Act authority to regulate isolated aquatic features such as vernal pools. The State may take additional regulatory action in the future to ensure that these isolated aquatic resources are adequately protected.

As with the Corps and the CDFG, the SDRWQCB currently issues WQCs and WDRs on a project-by-project basis in this watershed. As with the Section 404 and 1600 et seq. programs, the SAMP could provide a basis for large-scale authorization by the RWQCB that would balance aquatic impacts with resource protection, enhancement, and restoration. However, there are some key impediments. For example, WQCs are only valid for 5 years, which is a shorter period of time than could be authorized by the Corps and the CDFG. While it is unlikely the RWQCB would issue a blanket WQC for the SAMP, they could issue WQCs for specific Corps RGPs (e.g., for channel or basin maintenance). This would provide some permit streamlining in this watershed.

B.5.7.4 Safe Drinking Water Act

The federal Safe Drinking Water Act (SDWA) was enacted in 1974 to protect public health by regulating the nation's public drinking water supply. The law was amended in 1986 and 1996, and it requires many actions to protect drinking water and its sources-rivers, lakes, reservoirs, springs, and groundwater wells. SDWA does not regulate private wells serving fewer than 25 individuals. SDWA authorizes the USEPA to set national health-based standards for drinking water to protect against both naturally occurring and man-made contaminants that may be found in drinking water, such as inorganic and organic chemicals, radionuclides, and microbes. USEPA, states, and water systems then work together to make sure that these standards are met. Primary drinking water standards are legally enforceable; secondary standards are not.

The California Safe Drinking Water Act (CA SDWA) was passed in 1989 (AB 21) and amended in 1996 (SB 1307) to build upon and strengthen the federal SDWA. The CA SDWA authorizes the State's Department of Health Services (DHS) to protect the public from contaminants in drinking water by

establishing maximum contaminants levels (MCLs) that are at least as stringent as those developed by the USEPA, as required by the federal SDWA. The California DHS lists any contaminants that may have any adverse health effects, based on expert opinion, and may occur in public water systems, including all the substances for which federal MCLs exist. As with the federal Act, only the primary drinking water standards developed under the CA SDWA are legally enforceable. Secondary standards, such as those developed for taste and odor, are not enforceable. The 1996 Amendment created the first public "right to know" legislation about drinking water in the U.S. and led the USEPA to require development of "consumer confidence reports" by all water utilities in the U.S. in the year 2000.

B.5.7.5 National Pollutant Discharge Elimination System (NPDES) Permit Program (Municipal Permit, JURMPs, SUSMPs)

Pursuant to Section 402 of the CWA, in February 2001, the SDRWQCB adopted RWQCB Order No. 2001-01 (NPDES No. CAS0108758), "Waste Discharge Requirements For Discharges of Urban Runoff from the Municipal Separate Storm Sewer Systems (MS4s) Draining the Watersheds of the County of San Diego, the Incorporated Cities of San Diego County, and the San Diego Unified Port District". More commonly known as the "Municipal Permit," this document defines urban runoff as a waste that degrades the water quality of receiving waters and impairs the beneficial use of those waters.

To protect the water quality and beneficial use of local water resources, the Municipal Permit prohibits discharges into and from MS4s that cause pollution, contamination, or nuisance that might result in exceedance of receiving water quality objectives for surface water or groundwater. The Municipal permit requires that measures be taken to reduce storm water pollutants to the maximum extent practicable (MEP), and essentially prohibits non-storm water discharges into MS4s.

The Municipal Permit defines a list of Copermittees, each of which owns or operates an MS4, through which it discharges urban runoff into waters of the United States within the San Diego Region. The Municipal Permit orders each Co-permittee to reduce discharges of pollutants and runoff flow during each of the three major phases of urban development (i.e., the planning, construction, and existing development [or use]).

The Permit requires each Co-permittee to implement a Jurisdictional Urban Runoff Management Program (JURMP) that contains the following components:

- Land-Use Planning for New Development and Redevelopment Component
- Construction Component
- Existing Development Component
- Municipal
- Industrial
- Commercial
- Residential
- Education Component
- Illicit Discharge Detection and Elimination Component
- Public Participation Component
- Assessment of Jurisdictional URMP Effectiveness Component
- Fiscal Analysis Component.

One of the most important aspects of the JURMPs is the Land-Use Planning for New Development and Redevelopment Component. This component requires four basic things from each Co-permittee: (1) an assessment of their respective General Plan(s) in regard to water quality and watershed protection principles; (2) modification of their development project approval process, requiring each proposed project to implement measures to protect local water resources; (3) revision of their current environmental review processes to include requirements for evaluation of water quality effects and identification of appropriate mitigation measures; and (4) implementation of education programs to ensure that its planning and development review staffs, as well as project applicants, understand new water quality regulations.

The JURMP requires Co-permittees to incorporate a Standard Urban Storm Water Mitigation Plan (SUSMP) into their project approval process. In turn, the SUSMP requires that priority projects meet certain minimum requirements, including the implementation of source control and structural treatment BMPs. The SUSMP lists recommended source controls that will protect local water resources to the MEP. The SUSMPs also require that treatment control BMPs must capture, filter, or otherwise treat all runoff from the 85th percentile rainfall event.

The JURMPs mandated by the Municipal Permit also require that Copermittees revise environmental review processes. The revised environmental review processes are to include requirements for evaluation of water quality effects and identification of appropriate mitigation measures. In addressing each project, the environmental review process must assess whether the proposed development would result in increased pollutants and flows, whether these pollutants would have detrimental effects on local water resources, and whether the proposed project adequately mitigates for these potential detrimental effects.

A second important aspect of the Municipal Permit is its Existing Development component. The Municipal Permit requires each Co-permittee to implement a water quality program for municipal, industrial, commercial, and residential development sectors. Each program includes a component for pollution prevention, source identification and prioritization with respect to water quality, BMP implementation, and enforcement.

In addition to JURMP development, the Municipal Permit requires each Co-permittee to collaborate with all other Copermittees discharging urban runoff into the same watershed to develop and implement a Watershed Urban Runoff Management Program (WURMP) for each respective watershed. The purpose of the WURMP is to identify and mitigate the highest priority water quality issues/pollutants in the watershed(s).

B.5.7.6 San Diego Basin Water Quality Control Plan

The Water Quality Control Plan for the San Diego Basin (Basin Plan) designates beneficial uses for surface and groundwaters in the San Diego Region, and establishes water quality objectives and implementation plans to protect those beneficial uses. The terms “water quality objectives” and “beneficial uses” are analogs to the term “water quality standards” referred to in federal law.

The Basin Plan categorizes the Otay River and its tributaries as a Hydrologic Unit (910.00). The Otay Hydrologic Unit consists of three Hydrologic Areas (HA), including: Coronado (HA 910.10), Otay Valley (HA 910.20), and Dulzura (HA 910.30). The Coronado HA consists of Coronado Island and the Silver Strand, and is not within the limits of the Otay River watershed. The Otay Valley HA (910.20) consists of the Otay River watershed below Otay Dam (Figure B.3-10). The Dulzura HA (910.30) makes up the remainder of the Otay River watershed, and is further subdivided into seven Hydrologic

Sub-Areas (HSAs): Savage (HSA 910.31), Proctor (HSA 910.32), Jamul (HSA 910.33), Lee (HSA 910.34), Lyons (HSA 910.35), Hollenbeck (HSA 910.36), and Engineer Springs (HSA 910.37).

The SDRWQCB first adopted the Basin Plan in 1974, pursuant to California Water Code (CWC) section 13240 and the federal Clean Water Act Section 303(c). The Board has subsequently amended the Basin Plan approximately 43 times, with an extensive update in 1994 that, with minor amendments, serves as the basis for current policy.

The Basin Plan is a dynamic document that is subject to change based on changing needs and circumstances. Therefore, the RWQCB reviews the Basin Plan on a triennial basis. The purpose of these reviews is to review water quality standards (i.e., water quality objectives and beneficial uses) and to take public comment on issues the RWQCB might address in the future through the Basin Plan amendment process. In itself, the Triennial Review does not constitute a Basin Plan amendment. The RWQCB has completed its 2004 Triennial Review, which is currently undergoing required public hearings before adoption by the RWQCB.

One of the primary objectives of the Basin Plan is to define the beneficial uses for water resources in the region, including coastal waters, inland surface waters, lakes and reservoirs, and groundwater resources.

The Basin Plan also designates water quality objectives for the Otay River watershed. Water quality objectives are limits or levels of water quality constituents or characteristics established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area. Water quality objectives are designed to protect the most sensitive of the beneficial uses designated for a water body. For instance, we can infer that the most sensitive beneficial use for the overall watershed is the Otay Reservoir, because the water quality objectives for the Dulzura Hydrologic Area (HA 910.3) (upstream of the Reservoir) have lower threshold than those defined for the Otay Valley Hydrologic Area (HA 910.2), located downstream of the Reservoir. Tables B.5-11 and B.5-12 summarize the water quality objectives for inland surface waters and groundwater in the Otay River watershed.

Table B.5-11 Water Quality Objectives for Inland Surface Waters

Receiving Water (Hydrologic Unit Code)	Constituent (mg/l or as Noted)												
	Total Dissolved Solids (TDS)	Chlorides (Cl)	Sulfate (SO_4)	Percent Sodium (Na)	Nitrogen and Phosphorus	Iron	Manganese	MB-Activated Substances	Boron	Odor	Turbidity (NTU)	Color Units	Fluoride
Otay Hydrologic Unit (910.00)													
Coronado HA (910.10)	-	-	-	-	-	-	-	-	-	-	-	-	-
Otay Valley HA (910.20)	1000	400	500	60	(a)	0.3	0.05	0.5	0.75	None	20	20	1.0
Dulzura HA (910.30)	500	250	250	60	(a)	0.3	0.05	0.5	0.75	None	20	20	1.0

(a) Maintained at levels below that which stimulate algae and emergent plant growth. See Basin Plan for more detailed discussion.
Source: RWQCB, 1998

Table B.5-12 Water Quality Objectives for Groundwater

Receiving Water (Hydrologic Unit Code)	Constituent (mg/l or as Noted)												
	Total Dissolved Solids (TDS)	Chlorides (Cl)	Sulfate (SO_4)	Percent Sodium (Na)	NO_3	Iron	Manganese	MB-Activated Substances	Boron	Odor	Turbidity (NTU)	Color Units	Fluoride
Otay Hydrologic Unit (910.00)													
Coronado HA (910.10)	-	-	-	-	-	-	-	-	-	-	-	-	-
Otay Valley HA (910.20)	1500(b)	500(b)	500(b)	60	10(b)	0.3(b)	0.05(b)	0.5	0.75(b)	None	5	15	1.0
Dulzura HA (910.30)	1000	400	500	60	10	0.3	0.05	0.5	0.75	None	5	15	1.0

(b) The Basin Plan recommends detailed salt balance studies to help define limiting mineral concentration levels for discharge.
Source: RWQCB, 1998

The San Diego Basin Plan does not provide numeric water quality objectives specific to bays and estuaries for most inorganic substances, aside from stating, "the natural color and odor of fish, shellfish, or other resources shall not be impaired." The Basin Plan does, however, provide a specific turbidity objective for San Diego Bay:

> "The transparency of bay waters, insofar as it may be influenced by any controllable factor, either directly or through induced conditions, shall not be less than 8 feet in more than 20 percent of the reading in any zone, as measured by a standard Secchi disk. Wherever the water is less than 10 feet deep, the Secchi disk reading shall not be less than 80 percent of the depth in more than 20 percent of the readings in any zone."

Similarly, the Basin Plan does not provide numeric water quality objectives specific to reservoirs. It is worth noting that the water quality objectives for the Dulzura Hydrologic Area (HA 910.3), which is tributary to the Otay Reservoir system, generally correspond to the secondary drinking water standard Maximum Contaminant Levels (MCLs) defined by the California Department of Health Services.

The Basin Plan also outlines an implementation program to achieve and maintain the water quality objectives necessary to protect the beneficial uses of water resources designated by the plan. The Basin Plan outlines several broad categories of implementation strategies, including: controlling point sources of pollution; controlling non-point source pollutants; clean-up and abatement of existing pollution, and utilizing other avenues such as the California Water Quality Assessment program and the federal Section 303(d) process to pursue water quality goals.

Aside from the programs specifically elaborated on in the Basin Plan, the RWQCB and SWRCB have adopted several policies and plans that provide detailed direction on the implementation of certain Plan provisions. The Basin Plan provides a summary of SWRCB resolutions and that might pertain to water quality within the San Diego Basin. The Basin Plan also summarizes State-wide and regional surveillance, monitoring, and assessment programs that exist within the San Diego Basin, including the biennial water quality inventory and water quality assessment reports conducted under Section 305(b) of the CWA.

Other RWQCB Resolutions Important to Implement the Basin Plan

The SDRWQCB has adopted many resolutions that are important to the implementation of the Basin Plan. The following is a list of RWQCB resolutions that might have relevance to the Otay River watershed:

Resolution No. 79-44. Adopted June 25, 1979. A Resolution Concerning 'Guidelines for New Community and Individual Sewerage Facilities.'

Resolution No. 80-48. Adopted September 22, 1980. A Resolution Concerning the San Diego County Department of Health Services Minimum Criteria for the Design and Construction of Evapotranspiration and Evapotranspiration-Infiltration Systems.

Resolution No. 83-21. Adopted July 18, 1983. A Resolution Conditionally Waiving Adoption of Waste Discharge Requirements for Certain Specific Types of Discharges.

Resolution No. 83-21. Addendum No 1. Adopted November 15, 1993. An Addendum Conditionally Waiving Adoption of Waste Discharge Requirements for Temporary Discharge of Specified Contaminated Soils.

Resolution No. 83-21. Addendum No 2. Adopted November 15, 1993. An Addendum Conditionally Waiving Adoption of Waste Discharge Requirements for Disposal / Reuse of Dredge Spoils in Industrial or Commercial Applications.

Resolution No. 85-92. Adopted December 16, 1985. Designation of Class III Landfills Within the San Diego Region to Accept Shredder Wastes as Required by Section 25143.6 of the Health and Safety Code.

Resolution No. 86-06. Adopted March 24, 1986. A Resolution Adopting Amendments to the Comprehensive Water Quality Control Plan for the San Diego Region. This resolution established a goal and action plan for encouraging and promoting water reclamation.

Resolution No. 87-71. Adopted November 16, 1987. A Resolution Adopting Amendments to the Comprehensive Water Quality Control Plan for the San Diego Region. This resolution established a policy on dairy waste management.

Resolution No. 87-91. Adopted December 21, 1 987. A Resolution Adopting Amendments to the Comprehensive Water Quality Control Plan for the San Diego Region. This resolution established a policy on erosion and sediment control.

Resolution No. 88-25. Adopted March 14, 1988.A Resolution Regarding the Proposed State Water Resources Control Board Policy for Water Quality Control Defining 'Sources of Drinking Water' for the Purposes of Discharge Prohibitions.

Resolution No. 89-33. Adopted April 10, 1989. Incorporation of 'Sources of Drinking Water' Policy into the Water Quality Control Plan (Basin Plan) of the San Diego Region.

Resolution No. 90-61. Adopted November 5, 1990. A Resolution Amending Resolution No. 90-40, A Region wide Groundwater Amendment to the Comprehensive Water quality Control Plan for the San Diego Region.' This resolution revised the language regarding use of reclaimed water contained in Resolution No. 90-40, A Resolution Reconsidering and Amending Resolution No. 90-26, 'A Region wide Groundwater Amendment to the Comprehensive Water Quality control Plan for the San Diego Region,' and Resolution No. 90-26, A Resolution Adopting A Region wide Groundwater Amendment to the Comprehensive Water Quality Control Plan for the San Diego Region.

Resolution No. 91-46. Adopted May 20, 1991. A Resolution Rescinding and Replacing Resolution No. 88-91 and Addenda, and Establishing a RWQCB Drought Policy.

Resolution No. 91-79. Adopted December 9, 1991. A Resolution Amending Resolution No. 90-55, 'Adopting Amendments to the Comprehensive Water Quality Control Plan for the San Diego Region.' This resolution establishes revised Basin Plan chapters for beneficial uses and water quality objectives.

The Basin Plan lists two RWQCB resolutions listed in the Basin Plan that specifically address the Otay River watershed. These resolutions implement, interpret, or make specific the Basin Plan with respect to the Otay River watershed. The Basin Plan effectively supersedes these resolutions because it has incorporated them into itself as the RWQCB's primary water quality control policy document. The resolutions are listed here to provide some history of the water quality plan for the Otay River watershed and to serve as a reminder that water quality plans are dynamic documents that change over time.

Resolution No. 88-49. Adopted April 25, 1988. A Resolution Adopting Amendments to the Comprehensive Water Quality Control Plan for the San Diego Region for a Portion of the Otay Hydrographic Subunit.

Resolution No. 89-53. Adopted July 10, 1989. Addition of Portions of the Otay Valley Hydrologic Area to the List of Waters Excepted From the 'Sources of Drinking Water' Policy.

B.5.7.7 State Water Resources Control Board Policies

The SWRCB has adopted several Statewide Water Quality Control Plans that provide detailed direction on the implementation of certain plan provisions. In the event that inconsistencies exist among various plans and policies, the more stringent provisions apply. This section summarizes some of the state-wide policies that might be relevant to the Otay River watershed.

Antidegradation Policy (SWCB Resolution No. 68-161)

One of the most significant water quality control policies is the Statement of Policy with Respect to Maintaining High Quality of Waters in California (SWRCB Resolution No. 68-16), also known as the State Antidegradation Policy. The SWRCB adopted this policy on October 28, 1968 to satisfy the federal Clean Water Act antidegradation policy requirement (40 CFR 131.12). The State Antidegradation Policy requires that high quality waters of the state are maintained to the maximum extent possible, even where that quality is better than needed to protect beneficial uses. Specific findings must be made in order to allow any changes in water quality. Changes in water quality are allowed only if the change is consistent with maximum benefit to the people of the State, does not unreasonably affect present and anticipated beneficial uses, and does not result in water quality less than that prescribed in water quality control plans or policies.

Actions which may adversely affect surface water quality must satisfy both Resolution No. 68-16 and the federal antidegradation policy (40 CFR 131.12). The requirements of the two policies are similar: the federal policy requires that existing instream uses and the level of water quality necessary to protect them must be maintained and protected. In addition, a reduction in water quality can be allowed only if there is a demonstration that such a reduction is necessary to accommodate important economic or social development.

Enclosed Bays And Estuaries Policy (Resolution No. 74-43)

Because the tidal prism of the Otay River is linked with San Diego Bay, the Enclosed Bays and Estuaries Policy is relevant to the Otay River watershed. The SWRCB adopted the Water Quality Control Policy for Enclosed Bays and Estuaries of California (Enclosed Bays and Estuaries Policy) on

May 16, 1974 (Resolution No. 74-43). This policy is designed to prevent water quality degradation and protect beneficial uses in enclosed bays and estuaries. The policy outlines water quality principles and guidelines to achieve these objectives. Decisions by the RWQCB must be consistent with the provisions designed to prevent water quality degradation.

The policy lists principles of management that include the SWRCB's desire to phase out all discharges of municipal wastewaters and industrial process waters (exclusive of cooling waters) to enclosed bays and estuaries as soon as practicable. Exceptions to this provision may be granted by a RWQCB only when the RWQCB finds that the wastewater in question would consistently be treated and discharged in such a manner that it would enhance the quality of the receiving waters above that which would occur in the absence of the discharge. In addition, the policy prohibits several classes of discharges.

Powerplant Cooling Water Policy (Resolution No. 75-58) and Thermal Plan (Resolution No. 75-89)

The Water Quality Control Policy on the Use and Disposal of Inland Waters Used for Powerplant Cooling (Policy on the Use and Disposal of Inland Waters Used for Powerplant Cooling, SWRCB Resolution No. 75-58) and Water Quality Control Plan for the Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California (Thermal Plan, Resolution No. 75-89) are somewhat relevant to the Otay River watershed because of the South Bay Power Plant.

Duke Energy operates the SBPP on the southern portion of San Diego Bay. The intake and outflow from this power plant are on San Diego Bay, so operation of the SBPP will primarily be a stressor on that water body; Nonetheless, the SDPP outlets very near the outlet of Otay River and its thermal influence might make the receiving waters of San Diego Bay more sensitive to water quality conditions of Otay River waters.

The SWRCB adopted the Powerplant Cooling Water policy on June 19, 1975. The policy provides consistent statewide water quality principles and guidance for adoption of discharge requirements. In addition, this policy is intended to protect the beneficial uses of the State's water resources by keeping the consumptive use of freshwater for powerplant cooling to a minimum.

The SWRCB adopted the Water Quality Control Plan for the Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California (Thermal Plan) was in 1971, and revised the policy in 1972 and again on September 18, 1975. The Thermal Plan specifies water quality objectives and general water quality provisions for new and existing discharges into enclosed bays, estuaries, cold interstate waters, warm interstate waters and coastal waters.

Water Reclamation Policy (Resolution No. 77-1)

Reclaimed water (see Section B.5.4) is a vital component of the water supply for the Otay River watershed. Therefore, SWRCB's Policy with Respect to Water Reclamation in California (Reclamation Policy) is relevant to the Otay River watershed. The SWRCB adopted the Reclamation Policy on January 6, 1977. The Reclamation Policy provides that the water resources of the State be put to beneficial use to the fullest extent of which they are capable. The policy provides that water resources shall not be wasted, nor be put to an unreasonable use, nor be used in an unreasonable method.

This policy commits both the State and RWQCB to support reclamation and to undertake all possible steps to encourage the development of water reclamation facilities to reclaim water to supplement existing surface and ground water supplies. It requires the RWQCB to conduct reclamation surveys and specifies actions to be implemented by the State and RWQCB and other agencies.

Shredder Waste Disposal Policy (Resolution No. 87-22)

The Otay Landfill is a major regional municipal solid waste landfill located within the Otay River watershed. Therefore, the Policy on the Disposal of Shredder Wastes (Shredder Waste Disposal Policy) will be relevant to activities on the Otay River watershed. The SWRCB adopted the Shedder Waste Disposal Policy on March 19, 1987 (Resolution No. 87-22). This policy permits the disposal of shredded wastes produced by the mechanical destruction of car bodies, old appliances and similar castoffs, into certain landfills under specific conditions designated and enforced by the RWQCBs. Hazardous and nonhazardous shredder waste may be disposed of in appropriate Class Ill landfills where doing so would not cause water quality impairment. The policy specifies the shredder waste must not exceed PCB levels of 50 mg/kg. Also, the shredder waste must be disposed on the last and highest lift in a closed disposal cell or in an isolated cell solely designated for the disposal of shredder waste.

Sources of Drinking Water Policy (Resolution No. 88-63)

The Otay Reservoir represents an important source of drinking water on the Otay River watershed. Therefore, the SWRCB's Sources of Drinking Water Policy will have implications on the Otay River watershed. The SWRCB adopted the Sources of Drinking Water Policy on May 19, 1988 (Resolution No. 88-63). The policy provides that all surface and ground waters of the State are considered to be suitable or potentially suitable for municipal or domestic water supply and should be so designated by the RWQCBs.

Nonpoint Source Management Plan (Resolution No. 88-123)

The Otay River watershed includes many nonpoint (diffuse) sources of water quality stressors. Therefore, the SWRCB's Nonpoint Source Management Plan will have implications on the Otay River watershed. The SWRCB adopted the Nonpoint Source Management Plan on November 15, 1988, pursuant to Section 319 of the federal Clean Water Act. Section 319 requires each state to prepare a Nonpoint Source Management Plan and to conduct an assessment of the impact nonpoint sources have on the state's water bodies. In response to these requirements, the SWRCB adopted the Nonpoint Source Management Plan (NPSMP) in 1988 and the Water Quality Assessment in 1990. The NPSMP established a statewide policy for managing polluted runoff in California.

California Wetlands Conservation Policy

Because the Otay River watershed is home to many wetlands, the California Wetlands Conservation Policy will be relevant to the Otay River watershed. The Governor of California established the California Wetlands Conservation Policy on August 23, 1993. The goal of the California Wetlands Conservation Policy is to establish a policy framework and strategy that aims to accomplish three things:

- Ensure no overall net loss and achieve a long-term net gain in the quantity, quality, and permanence of wetlands acreage and values in California in a manner that fosters creativity, stewardship, and respect for private property;
- Reduce procedural complexity in the administration of State and Federal wetlands conservation programs; and
- Encourage partnerships to make landowner incentive programs and cooperative planning efforts the primary focus of wetlands conservation and restoration.

B.5.7.8 County of San Diego Watershed Protection, Stormwater Management, and Discharge Control Ordinance and Other Important County Ordinances

The County of San Diego Watershed Protection, Stormwater Management, and Discharge Control Ordinance (Watershed Protection Ordinance or WPO) was first adopted in 2002 to "protect water

resources and to improve water quality; to cause the use of management practices by the County and its citizens that will reduce the adverse effects of polluted runoff discharges on waters of the state; to secure benefits from the use of Stormwater as a resource; and to ensure the County is compliant with applicable state and federal law" (County of San Diego, 2002). The WPO seeks to accomplish this through:

- Prohibiting polluted non-stormwater discharges to the Stormwater conveyance system;
- Establishing minimum requirements for stormwater management, including source control requirements, to prevent and reduce pollution;
- Establishing requirements for development project site design, to reduce stormwater pollution and erosion;
- Establishing requirements for the management of stormwater flows from development projects, both to prevent erosion and to protect and enhance existing water-dependent habitats;
- Establishing standards for the use of off-site facilities for stormwater management to supplement on-site practices at new development sites; and
- Establishing notice procedures and standards for adjusting stormwater and non-stormwater management requirements where necessary.

In short, the WPO effectively prohibits non-stormwater discharges into the stormwater conveyance system and seeks to reduce pollutants in stormwater discharges to the MEP. The WPO also includes exemptions, including discharges permitted separately under site-specific NPDES permits or RWQCB Waste Discharge Requirements (not including a State General Permit). These specific permits are regulated exclusively by the RWQCB. Also exempted are State General Permit discharges (regulated under the State General Industrial Stormwater Permit or State General Construction Stormwater Permit) and certain agricultural discharges. Both of these exemptions are contingent upon certain RWQCB standards. Exemptions are also allowed for certain categorical discharges, discharges necessary to protect public health and safety, and discharges from permitted and properly functioning on-site wastewater systems. All exemptions are contingent on discharges remaining a less-than-significant source of pollutant to waters of the United States.

The WPO also includes numerous Best Management Practices (BMP) applicable to all dischargers, including those pertaining to:

- Eroded soils;
- Pollution Prevention;
- Prevention of Illegal Discharges;
- Slopes;
- Storage of Materials and Wastes; and
- Use of Materials.

The WPO also contains requirements for completion and approval of a Stormwater Pollution Prevention Plan (SWPPP), if needed; provides additional BMP for residential, commercial, industrial, agricultural, land disturbance, and municipal activities and facilities, and incorporates by reference the County Stormwater Standards Manual. In addition, it provides for inspection, enforcement, violations, and penalties for the breach of any of its terms.

Another very important County Ordinance is the RPO, which is focused on protecting or limiting impacts to a variety of natural resources, including wetlands, wetland buffers, floodways, floodplains, steep slopes, sensitive habitat lands (as defined by Section 15380 of the CEQA Guidelines), and significant prehistoric and historic sites. Under the RPO, an area only needs to meet one parameter (i.e., hydrophytic vegetation, wetland hydrology, hydric soils) to be considered a wetland; in contrast to the Corps' definition, which usually requires that all three parameters be met. The RPO only allows the use of grade control structures, hardscaping, or riprap in streams to those cases in which there is no

other less environmentally damaging feasible alternative. The RPO also includes provisions intended to ensure there is "no net loss" of wetland functions and values, consistent with national policy.

The BMO implements, through the individual Subarea Plans (see Section B.6), the Multiple Species Conservation Program. This program seeks to conserve natural habitats and species, while allowing for reasonable economic development. While the focus of the MSCP is habitat (e.g., coastal sage scrub) and species generally, significant aquatic resources occur in the areas to be preserved. The Grading Ordinance includes provisions for projects working within and outside the County's MSCP Subarea to ensure protection of preserve areas and species. It also requires compliance with NPDES Permit (CAS 0108758) as well as proof of authorization from the Corps and the CDFG for grading activities in streams, rivers, lakes and other waters of the U.S./State.

The County's groundwater ordinance is particularly relevant for residents in the unincorporated areas east of the Otay Reservoirs, who are primarily dependent on groundwater. It limits development in these areas to no more than 1 dwelling unit per 8 acres unless a groundwater study demonstrates that there would not be an adverse effect on groundwater. There are exemptions for certain agricultural and ranching activities or structures.

B.5.7.9 Important City and Port Ordinances and Other Controls

City of Chula Vista

Similar to the County, the City of Chula Vista has ordinances regulating stormwater, grading, and coastal sage scrub loss. The Stormwater Ordinance is similar to the County's, in that it incorporates and implements the SDRWQCB's NPDES Permit (No. CAS 0108758), and any amendments thereto, for the San Diego Region, as well as other RWQCB permit programs. Therefore, it effectively prohibits non-stormwater discharges to the stormwater conveyance system and it seeks to reduce pollutants in stormwater discharges to the MEP. This ordinance is intended to protect and enhance water quality of City watercourses, water bodies, and wetlands consistent with State and federal law. Moreover, development is precluded within 30 feet of the centerline of streams or within 20 feet of the edge of the creek bed, whichever is the greater distance from the top of the bank, without the appropriate City permits. In further fulfillment of its obligations under the NPDES Permit, the City has also prepared a Development and Redevelopment Projects Stormwater Management Standards Requirements Manual, which includes SUSMP requirements. The City's Grading Ordinance also includes provisions intended to protect streams, other water bodies, and other biological resources. The City also has a fully approved MSCP Subarea Plan, having received an executed Implementation Agreement and incidental take permits from the resource agencies on January 11, 2005. Prior to that date, the City relied on their Interim Coastal Sage Scrub Habitat Loss Permit Process Ordinance to control parties seeking a 4(d) permit from the City for coastal sage scrub loss and incidental take of coastal California gnatcatcher within Chula Vista. As discussed in Section B.3.1, their MSCP Subarea Plan includes a Wetlands Protection Program (Section 5.2.4 of the Subarea Plan) to ensure no net loss of wetland functions or values throughout the Subarea; as well as Adjacency Management Guidelines (Section 7.5.2 of the Subarea Plan) to protect the Preserve from proximate land uses. Moreover, the Otay Ranch RMP, also described in Section B.3.1, addresses the preservation, enhancement, restoration, and management of sensitive resources in the Otay Ranch Preserve. This RMP includes policies, standards, and guidelines for minimizing adverse effects to the Otay Ranch Preserve.

City of Imperial Beach

The City of Imperial Beach's Stormwater Ordinance (Urban Runoff Management and Discharge Control) also implements the SDRWQCB's NPDES Permit (No. CAS 0108758). As such, it seeks to

prevent non-storm water discharges to the stormwater conveyance system and requires BMPs to reduce pollutants in stormwater to the MEP. Moreover, it intends to protect and enhance water quality of its watercourses, other water bodies, and wetlands consistent with the Clean Water Act, including the NPDES Permit. In furtherance of this permit, the City has prepared Urban Runoff Standards Manuals, which include the City of Imperial Beach's JURMP and SUSMP. The Manuals specify appropriate BMPs to be implemented for the category and priority of activity or facility intending to discharge. The City's Grading Ordinance has been updated to ensure compliance with the NPDES Permit and the Clean Water Act. Of particular interest, any grading within the 100-year floodplain requires City review and a grading permit.

City of San Diego

The City of San Diego's Stormwater Management and Discharge Control Ordinance implements the SDRWQCB's NPDES Permit (Number CAS 0108758) and seeks compliance with the Clean Water Act. The City also has a Stormwater Runoff and Drainage Regulations Ordinance seeking to limit water quality impacts from development, to minimize hazards due to flooding while minimizing the need for construction of flood control facilities, to minimize impacts to environmentally sensitive lands (e.g., wetlands), to implement the provisions of federal and State regulations, and to protect public health, safety, and welfare. This Ordinance requires all stormwater runoff control, drainage, and flood control facilities to be constructed in accordance with the Land Development Manual, which includes Coastal Bluffs and Beaches Guidelines, Biology Guidelines, Historical Resources Guidelines, and Submittal Requirements for Deviations with the Coastal Overlay Zone. This Ordinance includes updates to the Grading Ordinance to ensure compliance with the NPDES Permit (Number CAS 0108758) and other federal and State requirements. Grading must also comply with the Land Development Manual. The Ordinance also intends to protect and, if necessary, restore environmentally sensitive lands, such as wetlands (e.g., vernal pools) and wetland buffers in the Coastal Overlay Zone. Furthermore, it implements the MSCP within the City, by placing priority on preservation of biological resources within the MHPA, as defined in the City of San Diego MSCP Subarea Plan. Pollution from new development and significant redevelopment projects is subject to the City's Storm Water Standards Manual, which includes the model SUSMP developed by the NPDES Permit's Copermittees.

San Diego Unified Port District

As with the County and Cities, the San Diego Unified Port District's Stormwater Ordinance implements the SDRWQCB's NPDES Permit (Number CAS 0108758) and seeks compliance with the Clean Water Act. As required by the NPDES permit, the Port has prepared and implemented their JURMP and SUSMP. Their SUSMP is based on the model SUSMP jointly developed by the Copermittees, which the Port has tailored to Port specific conditions and requirements.

B.5.7.10 City of San Diego Water Department Source Water Protection Guidelines

The City of San Diego Water Department has developed its *Source-Water Protection Guidelines* (Guidelines) (City of San Diego Water Department, 2004) to guide future activities in watersheds that drain into drinking water reservoirs (including the Otay Reservoirs) in San Diego County. The Guidelines facilitate site design, planning, and selection of BMPs that protect or improve the quality of runoff draining into the reservoirs. The Guidelines specifically address pollutants of concern to drinking water supply, and tailor a BMP selection process that emphasizes BMPs that will best protect drinking water supplies. The Guidelines provide an evaluation form, decision guides, a BMP treatment technologies matrix, and BMP summary data.

The Guidelines identify nutrients, total organic carbon (TOC), and total dissolved solids (TDS) as the three primary pollutants of concern that should be given the highest priority in order to protect reservoir source waters. Nutrients promote excessive algae growth and associated low dissolved oxygen conditions in the summer and fall. Algal blooms also produce taste and odor producing compounds that are undesirable for drinking water and require special treatment of drinking water supplies. High levels of TOC can be a precursor to disinfection by-products (DBPs), which can be formed in the water treatment disinfection process and may have adverse human health effects at low levels. Total organic carbon in the reservoirs can be associated with algae produced from excess nutrients, and/or from decomposing vegetative material in storm water runoff. Reducing TOC levels in source waters can help prevent DBP problems and reduce overall treatment cost. The City of San Diego must blend water supplies in order to offset higher levels of TDS in imported water sources and avoid exceeding the objective of 500 mg/L. Thus, future increases in TDS in local watersheds make achieving water quality objectives more difficult and more expensive.

B.5.7.11 Project Clean Water

The County of San Diego Board of Supervisors initiated Project Clean Water in July 2000 to provide a forum for exploring water quality issues in the region. The mission of Project Clean Water is to improve water quality in San Diego County through the commitment, dedication, and hard work of the stakeholders. This is a stakeholder-driven approach and relies on consensus strategies.

Project Clean Water is organized such that three specific technical advisory committees (TACs) report to a Policy Advisory Committee (PAC). The PAC meets twice a year, organizes an annual Clean Water Summit, and oversees and integrates efforts of all the working bodies within the Project. The PAC is co-chaired by County Supervisors Greg Cox and Pam Slater-Price and includes representatives from the specific TACs, legal advisors, and experts and consultants. The TACs and working groups within each TAC, meet independently and on an ad-hoc basis to analyze local water quality issues, formulate strategies for solutions, and often develop products such as the Project Clean Water website within their subject areas (Education, Watershed Planning, and Legislation and Regulation).

In the first two years of Project Clean Water, a focused assessment of the scientific, educational, planning, and legal issues surrounding water quality in San Diego County was compiled (Phase I Results Report: Baseline Inventory, June 2001). This existing conditions document provided the direction necessary to develop a Clean Water Strategic Plan and a Clean Water Action Plan. The Clean Water Strategic Plan (June 2001) is a 19-page document including a mission statement, general goals and specific objectives, identification of common water quality contaminants, guiding principles, and specific actions items for working groups.

The Clean Water Action Plan details the status of implementation and future direction of each action item, along with the addition of other action items (there are currently 52 action items). The Clean Water Action Plan is set up similar to a report card, grading each action item based on its completion and success. Project Clean Water was developed with an understanding that to positively affect water quality throughout San Diego County on a long-term basis, stakeholder involvement was essential. This regional approach of assessing water quality problems is different from the standard project-by-project or contaminant-by-contaminant approach to dealing with point-source or non-point-source water within existing regulations.

Finally, Project Clean Water emphasizes the need for a multi-use approach, balancing water quality with the economical needs of San Diegans. Project Clean Water's stakeholder-driven process, large-scale, holistic assessment of threats to resources, strategies for addressing problems, and multi-use

approaches are all consistent with what the Otay River Watershed Management Plan seeks to accomplish.

B.6 BIOLOGICAL RESOURCES

B.6.1 Vegetation

The watershed supports 14 aggregated natural community/land cover types, as illustrated on Figure B.1-4 and summarized in Table B.6-1. These categories can be further subdivided into more specific categories, which are described below. The plant communities within the Otay River watershed were originally mapped by Ogden Environmental and Energy Services Company, Inc. in preparation of the MSCP (1993). The Otay River watershed is completely within the MSCP Planning Area. Mapping for the MSCP was completed interpreting aerial photographs (minimum of 1 inch = 24,000 feet) with minimal field checking. Subsequent updates were performed using detailed project-level information that was incorporated with the generalized vegetation information and edge-matched, thus creating an apparently seamless database (SANDAG, 1995) and creating a regional map that included the Otay River watershed. In December 2005, TAIC mapped urban/developed areas within the Otay River watershed using a 2004 orthophoto (AirPhoto USA 2004). In addition, detailed project level vegetation information was incorporated using the approach described above for four large areas within the watershed. These include the OVRP Habitat Restoration and Exotic/Non-Native Plant Removal planning effort by the County of San Diego Department of Parks and Recreation, East Otay Mesa by the County of San Diego, the Rancho Jamul Ecological Reserve by the CDFG, and the Hollenbeck Canyon Wildlife Area by the CDFG. These four mapping efforts ranged in scale from 1 inch = 100 feet to a minimum of 1 inch = 500 feet, a significantly finer scale than the regional mapping effort described. A fifth data source developed as part of the Corps *Planning-Level Delineation and Geospatial Characterization of Aquatic Resources for Otay Watershed*, San Diego County, California (March 2004) was also incorporated for areas within the watershed outside of the four detailed mapping efforts described above. Riparian and wetland areas from the Corps data source were incorporated where mapping fell outside of the previously mapped regional vegetation communities of riparian/welands types. In both the 1995 regional mapping effort and the 2005 Otay River watershed update, plant communities were mapped according to the nomenclature of the CDFG's Preliminary Descriptions of the Terrestrial Natural Communities of California (Holland, 1986 and 1990 update).

Substantial differences between the 1995 regional vegetation layer and the updated 2005 vegetation layer include seven vegetation communities not previously described in the watershed, including non-native vegetation, Arundo, southern arroyo willow riparian forest, southern cottonwood-willow riparian forest, open coast live oak woodland, Engelmann oak woodland, and riparian scrub. In addition, the following three vegetation communities previously mapped in the watershed are no longer represented: alkali meadows and seeps, estuarine habitat, and riparian forest. Differences are primarily a result of refining the regional vegetation map from a 1 inch = 24,000 feet scale with detailed mapping efforts completed at 1 inch = 100 to 500 feet scale. The secondary cause of the differences was the conversion of one type of vegetation community to a different type or developed for commercial or residential use. For example, approximately 6,022 acres of agricultural land was replaced by urban developments. Conversely, the acreage of sage scrub within the watershed was reduced by approximately 2,200 acres, which is mostly attributable to refining the mapping within the OVRP and to a much lesser extent to recent fires on the east side of the Otay Reservoir. The refined map also shows an approximately 4,800-acre increase in non-native grassland in areas previously mapped as sage scrub or native grassland communities. The refined map allows for a more accurate picture of where preservation and restoration opportunities exist within the Otay River watershed.

Table B.6-1 Vegetation Acreages for the Otay River Watershed

Vegetation Type	Acres	Percent of Watershed
Ocean		
Shallow Bay	9	<1
Coastal Dunes and Beaches		
Saltpan/Mudflats	118	<1
Open Water		
Disturbed Wetland	943	<1
Freshwater	120	<1
Non-vegetated Channel/Floodway/Lakeshore Fringe	52	<1
Meadow and Marsh		
Southern Coastal Salt Marsh	44	<1
Cismontane Alkali Marsh	125	<1
Coastal and Valley Freshwater Marsh	91	<1
Freshwater Marsh	105	<1
Riparian Scrub/Woodland/Forest		
Southern Riparian Forest	3	<1
Southern Coast Live Oak Riparian Forest	875	1
Southern Arroyo Willow Riparian Forest	75	<1
Southern Cottonwood-willow Riparian Forest	124	<1
Southern Sycamore-Alder Riparian Woodland	55	<1
Riparian and Bottomland Habitat	2	<1
Riparian Scrubs	2	<1
Southern Willow Scrub	427	<1
Southern Riparian Scrub	33	<1
Tamarisk Scrub	307	<1
Woodlands		
Engelmann Oak Woodland	1	<1
Open Engelmann Oak Woodland	321	<1
Open Coast Live Oak Woodland	49	<1
Dense Coast Live Oak Woodland	1,077	2
Coast Live Oak Woodland	197	<1
Woodland	5	<1
Montane Coniferous Forest		
Southern Interior Cypress Forest	3,975	4
Maritime Succulent Scrub		
Maritime Succulent Scrub	173	1
Coastal Sage Scrub		
Diegan Coastal Sage Scrub	28,906	31
Coastal Sage Scrub/Chaparral		
Coastal Sage Scrub/Chaparral	1,704	2
Chaparral		
Mafic Northern Mixed Chaparral	151	<1
Scrub Oak Chaparral	54	<1
Northern Mixed Chaparral	2,266	2
Granitic Northern Mixed Chaparral	1,325	1
Southern Mixed Chaparral	2,819	3
Chamise Chaparral	2,725	3
Chaparral	11,578	12
Grassland		
Native Grassland	158	<1
Valley Needlegrass Grassland	256	<1
Valley and Foothill Grassland	2,259	3
Non-native Grassland	6,176	7

Vegetation Type	Acres	Percent of Watershed
Agricultural Land		
Extensive Agriculture	3,248	3.5
Intensive Agriculture	46	<1
Orchards and Vineyards	147	<1
Developed/Disturbed Land/Eucalyptus		
Eucalyptus Woodland	102	<1
Arundo	14	<1
Non-native Vegetation	144	<1
Disturbed Habitat	3,001	3
Urban/Developed	15,486	17
Total	92,920	

Source: SANDAG Regional Information System, 1995. Geographic Information System Vegetation Community Database, updated by TAIC, 2005.

B.6.1.1 Ocean

In the case of this study area, ocean represents shallow areas at the extreme southern end of San Diego Bay, totaling approximately 9 acres. These areas are within the South San Diego Bay Unit of the San Diego Bay NWR (Figure B.3-8 and Section B.6.4), and therefore, would be conserved.

B.6.1.2 Coastal Dunes and Beaches

In the watershed, this category is represented by saltpan and mudflats. Saltpans are unvegetated to sparsely vegetated flat, alkaline areas near the coast (City of San Diego, 1993). Approximately 118 acres of this habitat occur in a single block south of the Otay River and west of Interstate-5.

B.6.1.3 Open Water

Open water within the watershed includes freshwater, non-vegetated channel/ floodway/lakeshore fringe, and disturbed wetland. These habitats occur in the Otay Lakes and along the Otay River, as well as in smaller drainages and ponds. These habitats are typically considered sensitive, and are protected under the wetland regulations of the USACE, CDFG, RWQCB and/or local jurisdictions. Due to no-net loss policies, these habitat/land cover types are likely to be highly conserved.

Disturbed Wetland. This community is dominated by exotic wetland species that have invaded previously or periodically disturbed sites, such that these invasive non-natives have displaced the native wetland flora. Characteristic species include giant reed (*Arundo donax*), bristly oxtongue (*Picris echioides*), cocklebur (*Xanthium strumarium* var. *canadense*), and tamarisk (*Tamarix* sp.). Approximately 943 acres of this community occur within the watershed.

Freshwater. Freshwater habitats consist of areas that are typically submerged under freshwater, totaling approximately 120 acres in the watershed. These areas include Upper and Lower Otay Lakes.

Non-vegetated Channel/Floodway/Lakeshore Fringe. Approximately 52 acres of these land cover types occur in the watershed. These areas are periodically inundated with freshwater, and therefore, they support few if any plants.

B.6.1.4 Meadow and Marsh

Meadow and marsh habitats within the watershed include southern coastal salt marsh, cismontane alkali marsh, coastal and valley freshwater marsh, and freshwater marsh. They occur in scattered drainages, as well as along the margins of Upper and Lower Otay Lakes and the Otay River. These habitats typically are considered sensitive, and are therefore, are protected under the wetland regulations of

USACE, CDFG, RWQCB and/or local jurisdictions. Due to no-net loss policies, these habitat/land cover types are likely to be highly conserved.

Southern Coastal Salt Marsh. Southern coastal salt marsh occurs in areas subjected to regular tidal inundation by salt water. Salt-tolerant, water-dependent plant species form a moderate to dense cover, and can reach a height of approximately three feet. Pacific cordgrass (*Spartina foliosa*) and perennial pickleweed (*Salicornia virginica*) are the dominant species of the salt marsh community (Holland, 1986). Alkali heath (*Frankenia grandifolia*) and saltgrass (*Distichlis spicata*) are also common salt marsh species. An elevational distribution of marsh plants typically occurs based upon their physiological tolerances (MacDonald, 1977). Saltmarsh in the watershed totals approximately 44 acres and is located near the outlet.

Cismontane Alkali Marsh. Cismontane alkali marshes occur in areas where high evaporation and low input of fresh water result in elevated salt levels. The high salinity limits the growth of all but the most salt-tolerant species. These habitats typically have lower flow and sparser cover than freshwater marshes. Characteristic species include yerba mansa (*Anemopsis californica*), cattail (*Typha* sp.) and rush (*Juncus* sp.). This habitat occurs in approximately 125 acres of the watershed.

Coastal and Valley Freshwater Marsh. Coastal and valley freshwater marsh is dominated by perennial, emergent monocots that reach a height of 12 to 15 feet. This vegetation type occurs along the coast and in coastal valleys near river mouths and around the margins of lakes and springs. These areas are permanently flooded by fresh water yet lack a significant current (Holland, 1986). Characteristic species include cattails (*Typha* sp.), spike sedge (*Eleocharis* sp.), rush (*Juncus* sp.), and umbrella sedge (*Cyperus* sp.). This habitat type occurs in approximately 91 acres of the watershed.

Freshwater Marsh. Freshwater marsh is dominated by perennial, emergent monocots 4 to 6 feet tall. Uniform stands of bulrushes (*Scirpus* sp.) or cattails (*Typha* sp.) often characterize this habitat. Freshwater marsh occurs in wetlands that are permanently flooded by standing fresh water (City of San Diego, 1993). Approximately 105 acres of freshwater marsh occurs in the watershed.

B.6.1.5 Riparian Scrub/Woodland/Forest

The riparian ecological community occurs along rivers, streams, and other watercourses, and typically is dominated by water-dependent, woody vegetation. Within the Otay River watershed, these habitat types include riparian and bottomland habitat, southern riparian scrub, southern willow scrub, tamarisk scrub, southern arroyo willow riparian forest, southern cottonwood-willow riparian forest, riparian forest, southern sycamore-alder riparian woodland, and southern coast live oak riparian forest. Within the watershed, these habitat types occur most extensively in the Otay River, but also occur in other scattered drainages. A rare habitat type, alkali riparian, occurs along Salt Creek. Riparian habitats typically are considered sensitive, and therefore, are protected under the wetland regulations of USACE, CDFG, RWQCB and/or local jurisdictions. Due to no-net loss policies, these habitat/land cover types are likely to be highly conserved.

Southern Riparian Forest. Southern riparian forests are composed of winter-deciduous trees that require water near the soil surface. Willow, cottonwood (*Populus* sp.), and western sycamore form a dense medium height forest in moist canyons and drainage bottoms. Associated understory species include mule fat, stinging nettle (*Urtica dioica* ssp. *holosericea*), and wild grape (*Vitis girdiana*) (Beauchamp, 1986). The canopies of individual tree species overlap so that a canopy cover exceeding 100 percent may occur in the upper tree stratum. Approximately 3 acres of southern riparian forest occur within the watershed.

Southern Arroyo Willow Riparian Forest. This community is dominated by mature individuals of arroyo willow (*Salix lasiolepis*) trees with smaller components of red willow (*Salix laevigata*), and sandbar willow (Salix hindsiana). The understory shrubs are usually immature willow trees and mulefat (*Bacchharis salicifolia*) and herbs can include nettle (*Urtica* sp.), yerba mansa (*Anemopsis californica*), and western ragweed (*Ambrosia psilostachys)*. Approximately 75 acres of southern riparian forest occur within the watershed.

Southern Cottonwood-willow Riparian Forest. This riparian community is dominated by tall, open, broad-leafed winter-deciduous species such as Fremont's cottonwood (*Populus fremontii*) and black willow (*Salix gooddingii*), with minor components of western sycamore (*Platanus racemosa*), black cottonwood (*P. trichocarpa*), and three other willow species (Holland, 1986). The understory is dominated by giant stinging nettle (*Urtica dioica* ssp. *holoserica*) along with herbs. It is present on sub-irrigated and frequently overflowed lands along rivers and streams. The dominant species require moist, bare mineral soil for germination and establishment. This is provided after flood waters recede, leading to uniform-aged stands in this seral type. The community is regionally distributed along perennially wet stream reaches of the transverse and peninsular ranges, from Santa Barbara County south to Baja California Norte and east to the edge of the deserts. Approximately 124 acres of southern riparian forest occur within the watershed.

Southern Coast Live Oak Riparian Forest. Southern coast live oak riparian forest is an open to locally dense, evergreen, riparian woodland that is dominated by coast live oak (*Quercus agrifolia*). This community occurs on fine-grained alluvial soils on the floodplains along large streams in the canyons and valleys of coastal southern California (Holland, 1986). Associated species include toyon (*Heteromeles arbutifolia*), Mexican elderberry (*Sambucus mexicana*), spreading snowberry (*Symphoricarpos mollis*), California rose (*Rosa californica*), California blackberry (*Rubus ursinus*), and poison oak (*Toxicodendron diversilobum*). Approximately 875 acres of southern coast live oak riparian forest occur in the watershed.

Southern Sycamore-Alder Riparian Woodland. Southern sycamore-alder riparian woodland is a tall, open, broad-leaved, winter-deciduous streamside woodland dominated by western sycamore and often alder (*Alnus rhombifolia*). These stands seldom form closed-canopy forests, and even may appear as trees scattered in a scrubby thicket. This type of woodland typically occurs in very rocky streambeds subject to seasonally high-intensity flooding, with alder increasing in abundance on more perennial streams and sycamore favoring more intermittent streams (Holland, 1986). Approximately 55 acres of this habitat type occur within the watershed.

Riparian and Bottomland Habitat. This category represents a variety of wetland/riparian habitats that have not been more precisely mapped. Approximately 2 acres of undifferentiated riparian and bottomland habitat occur within the watershed.

Riparian Scrub. Riparian scrub vegetation is described as early seral, broad-leafed deciduous riparian thicket usually dominated by any of the willow species (*Salix* spp.) together with other fast growing shrubs and vines including mulefat and mugwort (*Artemesia douglasiana*). The community grows in sand and gravel bars along streams and is regularly flooded or washed out limiting the typical height of this community to no greater than 20-feet high. Thickets can vary from open to impenetrable in densities. Approximately 2 acres of undifferentiated riparian scrub occur within the watershed.

Southern Willow Scrub. Southern willow scrub consists of dense, broadleaved, winter-deciduous stands of trees dominated by shrubby willows (*Salix* sp.) in association with mule fat (*Baccharis salicifolia*). This habitat occurs on loose, sandy or fine gravelly alluvium deposited near stream channels during flood flows. The herbaceous understory consists of curly dock (*Rumex crispus*),

cocklebur, and western ragweed (*Ambrosia psilostachya* var. *californica*). Southern willow scrub lacks a tree stratum, and the lower shrub stratum has high cover and density values. Frequent flooding maintains this early seral community, preventing succession to a riparian woodland or forest (Holland, 1986). Approximately 427 acres of this vegetation community occur in the watershed.

Southern Riparian Scrub. Southern riparian scrub is a generic term for several shrub-dominated communities that occur along drainages and/or riparian corridors, including southern willow scrub, mule fat scrub, and tamarisk scrub. Approximately 33 acres of undifferentiated southern riparian scrub occur in the watershed.

Tamarisk Scrub. Tamarisk scrub is a weedy stand of tamarisk species, all of which are non-native species that displace native vegetation subsequent to a major disturbance. This habitat occurs along intermittent streams in areas where high evaporation rates increase the salinity level of the soil. Tamarisk can obtain water from a groundwater source. Because of its deep root system and high transpiration rates, tamarisk can substantially lower the water table to below the root zone of native species, thereby competitively excluding them. As a prolific seeder, it is able to rapidly replace the native species that it displaces within a drainage (Holland, 1986). Approximately 307 acres of tamarisk scrub occur in the watershed. This exotic-dominated community dominates much of the upper Otay River Valley.

B.6.1.6 Woodlands

Woodlands within the watershed include coast live oak woodland, open coast live oak woodland, dense coast live oak woodland, englemann oak woodland, open Engelmann oak woodland, and undifferentiated woodland. Woodlands occur in the eastern portion of the watershed, and are most prevalent near its extreme eastern boundary. They are considered Tier I habitats by the MSCP, requiring a minimum 1:1 mitigation ratio.

Engelmann Oak Woodland. Engelmann Oak woodland is an open to dense woodland dominated by Engelmann oaks with few representatives of Coast Live Oak (*Quercus agrifolia*). Canopy cover is very similar to that observed in Open Englemann Oak Woodland, but stem densitieis are much smaller due to reduced representation of *Q. agrifolia*. This community occurs on slightly more xeric sites and intergrades with coastal sage scrub and chaparral. Annual grasses dominate the understory. Approximately 1 acre of this habitat type occurs within the watershed.

Open Engelmann Oak Woodland. Open Engelmann oak woodland occurs on relatively moist sites on fine-textured soils of gentle slopes and valley bottoms. This community type is dominated by Engelmann oaks (*Quercus engelmannii*), which are considered a sensitive species, in association with coast live oak. Annual grasses dominate the understory. This community intergrades with coastal sage scrub on drier rockier sites and with dense Engelmann oak woodland on the more mesic sites. Approximately 321 acres of this habitat type occur within the watershed.

Dense Coast Live Oak Woodland. Dense coast live oak woodland is essentially the same as the coast live oak woodland described above, but the oak trees form a denser canopy cover. Dense oak woodland dominated by coast live oak woodland typically occurs on north-facing slopes or in shaded ravines. The shrub layer is typically poorly developed, but may include toyon, currant (*Ribes* sp.), laurel sumac (*Malosma laurina*), and desert elderberry (*Sambucus mexicana*). The herbaceous component is continuous and often dominated by non-native, weedy species (City of San Diego, 1993). Approximately 1,456 acres of dense coast live oak woodland occur within the watershed.

Coast Live Oak Woodland. Coast live oak woodland is an open to dense evergreen woodland or forest community, dominated by coast live oak, which may reach a height of 35 to 80 feet. The shrub

layer consists of toyon, Mexican elderberry, spreading snowberry, fuchsia-flowered gooseberry (*Ribes speciosum*), and poison oak. A dense herbaceous understory is dominated by miner's lettuce (*Claytonia perfoliata* var. *perfoliata*) and chickweed (*Stellaria media*). This community occurs along the coastal foothills of the Peninsular Ranges, typically on north-facing slopes and shaded ravines (Holland, 1986). Approximately 197 acres of coast live oak woodland occur in the watershed.

Dense Coast Live Oak Woodland. Dense coast live oak woodland is essentially the same as the coast live oak woodland described above, but the oak trees form a very dense closed canopy cover. Dense oak woodland dominated by coast live oak woodland typically occurs on north-facing slopes or in shaded ravines. The shrub layer is typically poorly developed, but may include toyon, currant (*Ribes* sp.), laurel sumac (*Malosma laurina*), and desert elderberry (*Sambucus mexicana*). The herbaceous component is continuous and often dominated by non-native, weedy species (City of San Diego, 1993). Approximately 1,077 acres of dense coast live oak woodland occur within the watershed.

Open Coast Live Oak Woodland. Open coast live oak woodland is very similar to coast live oak woodland with less dense canopy cover. Approximately 49 acres of Open Coast Live Oak Woodland occur within the watershed.

Woodland. Approximately 5 acres of undifferentiated woodland occur within the watershed.

B.6.1.7 Montane Coniferous Forest

Montane coniferous forest in the watershed consists of southern interior cypress forest. This is a fairly dense, fire-maintained, low forest dominated by cypress trees (*Cupressus nevadensis*, *C. forbesii*, or *C. stephensonii*). Associated species include chamise (*Adenostoma fasciculatum*), Eastwood manzanita (*Arctostaphylos glandulosa* ssp. glandulosa), mountain-mahogany (*Cercocarpus betuloides*), and toyon. Stands of southern interior cypress forest are often even-aged due to "fire density" (Holland, 1986). Fire density occurs in an area dominated by species in which seedlings are adapted to sprout vigorously and densely following a fire, such that any seedlings that sprouted later would be unable to compete for space, light, or nutrients. This phenomenon results in vegetation communities that have limited age structure such as the case with southern interior cypress forest. Within the Otay River watershed, this habitat type occurs only on the slopes of Otay Mountain, where it is locally common. It occurs on slopes and ridges, and dominates steep drainages. Stands of tecate cypress on Otay Mountain vary from large numbers of presumably even-aged saplings growing up through the chaparral canopy to stands of mature individuals dominating a dense understory of chaparral shrubs (City of San Diego, 1993). This habitat type is considered Tier I by the MSCP, requiring a minimum 1:1 mitigation ratio. It occupies approximately 3,975 acres in the watershed.

Recent fires (1996 and 2003) have affected approximately half of this community. Research indicates that this community requires approximately 40 years between burns to remain viable (Esser, 1994). Therefore, careful management will be needed to ensure that recently burned areas have sufficient opportunity to produce a new crop before the next major fire.

B.6.1.8 Maritime Succulent Scrub

Maritime succulent scrub is a low, open scrub community that is dominated by a mixture of stem and leaf succulent species and drought deciduous species that also occur within sage scrub communities. This plant association occurs on thin rocky or sandy soils, on steep slopes of coastal headlands and bluffs. Maritime succulent scrub is restricted to within a few miles of the coast. The component species of this community are coast barrel cactus (*Ferocactus viridescens*), velvet cactus (*Bergerocactus emoryi*), prickly pear cactus (*Opuntia littoralis*), cliff spurge (*Euphorbia misera*), dudleya (*Dudleya*

spp.), desert thorn (*Lycium californicum*), and California encelia (*Encelia californica*) (Beauchamp, 1986). This community is considered Tier I by the MSCP, requiring a minimum 1:1 in-kind mitigation ratio. Within the watershed, this community occurs on approximately 173 acres between Interstate-805 and the Otay Lakes.

B.6.1.9 Coastal Sage Scrub

Coastal sage scrub is one of the two major shrub types that occur in California. This habitat type occupies xeric sites characterized by shallow soils. Sage scrub is dominated by subshrubs whose leaves abscise during summer drought and are replaced by a fewer number of smaller leaves. Sage scrub species have relatively shallow root systems and open canopies. This last trait allows for the occurrence of a substantial herbaceous component in coastal sage scrub. Four floristic associations are recognized within coastal sage scrub plant formation, and these occur in distinct geographical areas along the California coast with the Diegan association occupying the area from Orange County to northwestern coastal Baja, California (O'Leary, 1990). Diegan coastal sage scrub may be dominated by a variety of species, depending upon soil type, slope, and aspect. Typical coastal sage scrub species include: California sagebrush (*Artemisia californica*), flat-top buckwheat (*Eriogonum fasciculatum*), California encelia (*Encelia californica*), laurel sumac, black sage (*Salvia mellifera*), and lemonadeberry (*Rhus integrifolia*). Coastal sage scrub is considered a Tier II habitat under the MSCP, requiring mitigation at a minimum 1:1 ratio. It occurs throughout the watershed, primarily east of the Otay Lakes, and is by far the most common vegetation community in the watershed, totaling approximately 28,906 acres.

B.6.1.10 Coastal Sage Scrub/Chaparral

Coastal sage scrub/chaparral is a mix of woody chaparral species and drought-deciduous sage scrub species. It often represents a post-fire successional community. Because of this and due to the Otay fire of October 2003, this community could become more prominent in the near-term, with a Chaparral-dominant community succeeding in the long-term. Total vegetative cover includes roughly equal amounts of both scrub and chaparral species. Characteristic dominant species include chamise, California sagebrush, wild lilac (*Ceanothus* sp.), black sage, and poison oak (City of San Diego, 1993). Within the watershed, this community occurs on approximately 1,704 acres east of Otay Lakes, and is most extensive in the easternmost portions of the watershed.

B.6.1.11 Chaparral

Chaparral is the most prominent vegetation type within the regions of California that experience a Mediterranean climate, typically occurring on more mesic sites than the coastal sage scrub community. Chaparral communities are dominated by evergreen shrubs with small, hard leaves, which are thick and heavily cutinized. Chaparral stands form nearly continuous cover of closely spaced shrubs approximately 3 to 12 feet tall. Herbaceous vegetation is generally lacking within these stands, except after fires. Within the watershed, this community occurs east of the Otay Lakes and is represented by mafic northern mixed chaparral, scrub oak chaparral, northern mixed chaparral, granitic northern mixed chaparral, southern mixed chaparral, chamise chaparral, and undifferentiated chaparral. Mafic northern mixed chaparral is considered a Tier I habitat type by the MSCP, requiring a minimum 1:1 mitigation ratio; the other chaparral types are considered Tier III, and therefore, require mitigation at a minimum 0.5:1 ratio.

Mafic Northern Mixed Chaparral. Mafic Northern Mixed Chaparral is a community that occurs on coarse-grained igneous rock (also called gabbro soils) and on metavolcanic rocks, which are metamorphosed lavas and volcanic ash. Two soil types occur within the Otay River watershed that are described as gabbros (Las Posas and Boomer), and two additional soil types are described as

metavolcanic (San Miguel-Exchecquer and Exchequer). These soils are typically dominated by chamise (*Adenostoma fasciculatum*), with Ramona lilac (*Ceanothus tomentosus*), manzanita species (*Arctostapylos* sp.), or mission manzanita (*Xylococcus bicolor*) and Cleveland sage (*Salvia clevelandii*). This vegetation type is typically differentiated from other chaparrals by solid patches of soil-specific endemic species, including Parry's tetracoccus (*Tetracoccus diocus*), southern mountain misery (*Chamaebatia australis*), San Miguel savory (*Satureja chandleri*), and beargrass species (*Nolina* spp.). This community occupies approximately 151 acres in the watershed.

Scrub Oak Chaparral. Scrub oak chaparral is a dense, evergreen chaparral that reaches a canopy height of up to 20 feet. This is dominated almost exclusively by Nuttall's scrub oak (*Quercus dumosa*) in coastal sandstone situations, and scrub oak (*Quercus berberidifolia*) in in-land situations. Toyon and lemonadeberry occur as minor components. Scrub oak chaparral occurs in more mesic areas than many other chaparrals, such as north-facing slopes, and recovers more rapidly from fires than other chaparrals due to resprouting capabilities of scrub oak (Holland, 1986; Keeley and Keeley, 1988). Scrub oak chaparral dominated by Nuttall's scrub oak is sensitive because of the presence of this plant species. Scrub oak chaparral occurs on approximately 54 acres in the watershed.

Northern Mixed Chaparral. Northern mixed chaparral is composed of broad-, hard-leaved shrubs, approximately 6 to 15 feet tall, forming dense, often nearly impenetrable vegetation. There is usually little or no understory vegetation. Typical dominant species include Nuttall's scrub oak, chamise, manzanita (*Arctostaphylos* sp.), and wild lilac (Holland, 1986). This vegetation community occupies approximately 2,266 acres in the watershed.

Granitic Northern Mixed Chaparral. Granitic northern mixed chaparral is similar to northern mixed chaparral as described above, but it occurs on granitic soils and is found on rocky, granite-derived soils. This vegetation community occurs on approximately 1,325 acres in the watershed.

Southern Mixed Chaparral. Southern mixed chaparral is composed of broad-, hard-leaved shrubs that grow to about six to ten feet tall and form dense, often nearly impenetrable stands. The plants of this association are typically deep-rooted and grow 10 to 20 feet tall. Canopy coverage often exceeds 100 percent (Keeley and Keeley, 1988). This habitat occurs on dry, rocky, often steep, north-facing slopes with little soil. As conditions become more mesic, shrubs that resprout from underground root crowns become dominant. Depending upon relative proximity to the coast, southern mixed chaparral is dominated by chamise, mission manzanita (*Xylococcus bicolor*), coast white lilac (*Ceanothus verrucosus*), Ramona lilac (*Ceanothus tomentosus*), white-stem wild-lilac (*Ceanothus leucodermis*), thickleaf wild-lilac (*Ceanothus crassifolius*), big-berry manzanita (*Arctostaphylos glauca*), and scrub oak. Approximately 2,819 acres of southern mixed chaparral occur in the watershed.

Chamise Chaparral. The most widely distributed chaparral shrub is chamise. This species is found from Baja to northern California in pure stands or in mixed stands. Chamise's ubiquitous distribution may be the result of it being the only chaparral species that regenerates from fire from both an underground root crown and the production of seeds traits (Rundel, 1986; Parker, 1984). It often dominates at low elevations and on xeric south-facing slopes with 60 to 90 percent canopy cover. Along its lower elevation limit, chamise intergrades with coastal sage scrub (Rundel, 1986). Mission manzanita and black sage are minor associates within this community. Approximately 2,725 acres of chamise chaparral occur in the watershed.

Chaparral. Approximately 11,578 acres of undifferentiated chaparral occur in the watershed. Chaparral by itself is not a defined vegetation class by Holland (1986). This classification system is hierarchical, providing flexibility in the level of vegetation detail which can be mapped when dominant species are observed. As stated previously, the vegetation communities were originally mapped by

Ogden Environmental in preparation of the MSCP and was completed by interpreting aerial photographs (minimum of 1 inch = 24,000 feet) with minimal field checking and some digital project-level information (SANDAG, 1995). Because of the limitations of these methods, it is reasonable to assume that this category was used when subtle changes in vegetation or changes in key dominant species could not be determined. However, the most common chaparral vegetation class in San Diego County is Southern Mixed Chaparral, described previously. The most common species in chaparral classes include chamise, lilac (*Ceanothus* spp), manzanita (*Arctostaphylos* spp.), oak (*Quercus* spp.), and sage (*Salvia* spp.).

B.6.1.12 Grassland

Most grasslands in southern California are now dominated by non-native annual grasses. The quality and habitat of grasslands vary greatly throughout the watershed. Some grassland areas are fairly intact and dominated by native grasses, while many others are highly disturbed or in some state of recovery. Grasslands occur in scattered locations throughout the watershed, most extensively along the Otay River Valley and north of Lower Otay Lake. Grassland types in the watershed include native grassland, valley needlegrass grassland, valley and foothill grassland, and non-native grassland. Native grassland (including valley needlegrass grassland) is considered a highly sensitive Tier I habitat under the MSCP, requiring mitigation at a minimum 1:1 mitigation ratio, while non-native grassland is considered a Tier III habitat requiring mitigation at a minimum 0.5:1 mitigation ratio.

Native Grassland. Native grassland is a community dominated by perennial bunchgrasses such as purple needle grass (*Achnatherum pulchra*) with annual and perennial forbs such as common golden stars (*Bloomeria crocea* ssp. *crocea*) and California blue-eyed grass (*Sisyrinchium bellum*). Native grasslands are also known to contain highly sensitive annual plant species. Native grasslands generally occur on fine-textured soils that generally exclude the annual, exotic grasses. Native grasslands comprise approximately 158 acres of the study area.

Valley Needlegrass Grassland. Valley needlegrass grassland is a mid-height (to two feet) grassland dominated by perennial, tussock-forming needlegrass (*Stipa pulchra*). Native and introduced annuals occur between the perennials, often actually exceeding the bunchgrass in cover (Holland, 1986). Shrubs are infrequent, probably due to the unstable clay soils (City of San Diego, 1993). This vegetation community occurs on approximately 256 acres of the watershed.

Valley and Foothill Grassland. This vegetation category may include both native and non-native grasslands that have not been more specifically mapped. Undifferentiated valley and foothill grassland (the majority of which is undoubtedly non-native) occurs on approximately 2,259 acres in the watershed.

Non-native Grassland. Non-native grassland is a dense to sparse cover of annual grasses, often associated with numerous species of showy-flowered native annual forbs. This association occurs on gradual slopes with deep, fine-textured, loam or clay soils. Characteristic species include oats (*Avena* sp.), red brome (*Bromus rubens*), ripgut (*B. diandrus*), ryegrass (*Lolium* sp.), and mustard (*Brassica* sp.). Most of the introduced annual species that compromise the majority of species and biomass within the non-native grassland originated in the Mediterranean region, in an area with a long history of agriculture and a climate similar to California. These two factors, in addition to intensive grazing, agricultural practices, and severe droughts, contributed to the successful invasion and establishment of these species and the replacement of native grasslands with annual-dominated, non-native grassland (Jackson, 1985). Non-native grassland occurs on approximately 6,176 acres of the watershed.

B.6.1.13 Agricultural Land

Agricultural land within the watershed includes orchards and vineyards; intensive agriculture; and extensive agriculture. This land cover category primarily occurs on Otay Ranch west of Lower Otay Lake and along Highway 94. Because these areas almost exclusively support non-native species, no mitigation is required for impacts.

Extensive Agriculture. This type of agriculture involves cultivated field or row crops, as well as pasturelands. Most of these areas were once either native grasslands or Diegan coastal sage scrub. Pasturelands in particular may retain some habitat values, especially for raptor foraging. With the removal of cattle, they represent opportunities for upland habitat restoration. Approximately 3,248 acres of extensive agriculture occur within the watershed.

Intensive Agriculture. This type of agriculture includes such uses as dairies, nurseries, and chicken ranches. Approximately 46 acres of intensive agriculture occur within the watershed.

Orchards and Vineyards. Both of these land cover types typically involve linear cultivation of non-native species, with orchards consisting of trees and vineyards consisting of grape vines. Orchards and vineyards occur on approximately 147 acres within the watershed.

B.6.1.14 Developed/Disturbed Land/Eucalyptus

These habitat types do not support native vegetation, and mitigation typically is not required for impacts. They occur most extensively in the western portion of the watershed (i.e., west of the Otay Lakes).

Eucalyptus Woodland. Eucalyptus woodland is dominated by eucalyptus (*Eucalyptus* sp.), an introduced species, that produces a large amount of leaf and bark litter. The chemical and physical characteristics of this litter limits the ability of other species to grow in the understory and floristic diversity decreases. It is also one of the most flammable species on the planet. In most instances, eucalyptus are planted for a variety of cultural reasons. If sufficient moisture is available, eucalyptus become naturalized and are able to reproduce and expand their range, which has happened in many riparian areas. Approximately 102 acres of eucalyptus woodland occur in the watershed.

Arundo. This community is made up of monotypic stands of the non-native invasive species of giant cane (*Arundo donax*). This species is native to warmer tropical and temperate regions of the Mediteranean Sea to Lower Himalayas. French immigrants brought *Arundo* to the U.S. for use as a windbreak and for erosion control in the 1800s. Floristically, *Arundo* is part of the riparian areas requiring extensive amounts of water. This species grows through rhizome extension and spreads vegetatively when rhizomes break off from the parent plant and float downstream, re-rooting at a new location. *Arundo* is highly invasive and quickly out-competes native riparian vegetation for resources and is a fire hazard and interrupts surface water flow and flood control by producing large amounts of explosive fuel (DioTomaso, 1998). Approximately 14 acres of monotypic *Arundo* stands occur within the watershed.

Non-Native Vegetation. For the purposes of this mapping effort, this community represents areas dominated by one or several other non-native invasive riparian or upland species that were unable to be grouped into Eucalyptus Woodland or *Arundo* communities. Typical species included in this category are pepper trees (*Schinus* spp.), pampas grass (*Cortaderia selloana*), tree tobacco (*Nicotiana glauca),* and castor bean (*Ricinus communis*) among others. Approximately 144 acres of undifferented non-native vegetation occurs within the watershed.

Disturbed Habitat. Disturbed habitat is any land on which the native vegetation has been significantly altered by agriculture, construction, or other land-clearing activities, and the species composition and site conditions are characteristic of the disturbed phase of one of the plant associations in the study area. Such habitat typically is found in vacant lots, roadsides, construction staging areas, or abandoned fields (City of San Diego, 1993). Areas that are highly disturbed are dominated by non-native weedy species that are adapted to a regime of frequent disturbance. Typical species include red brome, mustard, tocalote (*Centaurea melitensis*), and Russian thistle (*Salsola australis*). Disturbed habitat occurs on approximately 3,001 acres in the watershed.

Urban and Developed. Urband and developed areas do not support native vegetation and may be additionally characterized by the presence of man-made structures such as buildings or roads. Development extends over approximately 15,486 acres of the watershed.

B.6.1.15 Non-native and Invasive Plant Species

Of the habitat/land cover types described above, eleven are dominated by species or activities that are competitive with, or harmful to, the native flora and fauna of the watershed and the surrounding region. These include disturbed wetland, Tamarisk scrub, non-native grassland, extensive agriculture, intensive agriculture, orchards and vineyards, eucalyptus woodland, Arundo, non-native vegetation, disturbed habitat, and developed land. These categories total approximately 29,614 acres (32 percent) of the Otay River Watershed. Non-native species are those that evolved elsewhere and have been transported purposefully or accidentally by humans following European settlement (LaRoe et al., 1995). Non-native, invasive species compete with native species for sun, water, and nutrients often displacing individual plant species or entire plant communities. Non-native species were first transported to the United States by immigrants between the 1700s and the 1800s for various reasons, such as gardening, windbreaks, erosion control, spiritual, and medicinal practices (DiTomaso, 1996). Non-native, invasive species have also been distributed "naturally" via wind or by animals from infested open space or from development areas. Developed areas are typically landscaped with ornamental species that are both non-native and invasive. In addition, these landscaped areas are often heavily irrigated and fertilized, both of which promotes the proliferation of weedy species. Currently, control of non-native invasive species that have spread from other open space area or "escaped" from developed areas cost local, state, and federal governments millions of dollars a year (LaRoe et al., 1995).

As discussed in Section B.3.1, the Corps has evaluated riparian ecosystem integrity in the Otay River watershed by assessing a suite of hydrologic, biogeochemical, and biologic indicators of ecosystem functions (Smith, 2004) (Figures B.3-11 to B.3-13). The scores for the Habitat Index are calculated, in part, by the diversity within vegetation communities, percent cover of non-native species, and the capacity of the habitat to support aquatic-dependent animals. Management of invasive species would help to protect the long-term integrity of the aquatic resources by protecting biological diversity of vegetation communities and the animals that rely on native plants for food, cover, and breeding sites. Without management, watershed habitat could exhibit long-term degradation due to invasion by non-native species and the conversion of diverse habitat communities to monocultures of, for example, giant reed (*Arundo donax*), salt cedar (*Tamarix* sp.), or castorbean (*Ricinus communis*), which are already prominent threats in the Otay River watershed.

B.6.2 Wildlife Movement

B.6.2.1 Overview

Wildlife corridors link together areas of suitable habitat that are otherwise separated by rugged terrain, changes in vegetation, or human disturbance. The fragmentation of open space areas by urbanization

creates "islands" of wildlife habitat. In the absence of habitat linkages that allow movement to adjoining open space areas, various studies have concluded that some wildlife species, especially the larger and more mobile mammals, will not likely persist over time in fragmented or isolated habitat areas because they prohibit the infusion of new individuals and genetic material (MacArthur and Wilson, 1967; Soulé, 1987; Harris and Gallagher, 1989; Bennet, 1990). Other studies show that the absence of top predators upsets the ecological balance, causing an increase in meso-predators and a corresponding decrease in bird abundance and diversity (Crooks and Soulé, 1999).

Corridors can act as links between different populations of a species. A group of smaller populations (termed "demes") linked together via a system of corridors is termed a "metapopulation." The long-term health of each deme within the metapopulation is dependent upon its size and the frequency of interchange of individuals (immigration vs. emigration). The smaller the deme, the more important immigration becomes, because prolonged inbreeding with the same individuals can reduce genetic variability. Immigrant individuals that move into the deme from adjoining demes mate with individuals and supply that deme with new genes and gene combinations that increase overall genetic diversity. An increase in a population's genetic variability is generally associated with an increase in a population's health.

Corridors have the potential to mitigate the effects of habitat fragmentation by: (1) allowing animals to move between remaining habitat patches, which allows depleted populations to be replenished and promotes genetic diversity; (2) providing escape routes from fire, predators, and human disturbances, thus reducing the risk that catastrophic events (such as fires or disease) will result in population or local species extinction; and (3) serving as travel routes for individual animals as they move within their home ranges in search of food, water, mates, and other needs (Noss, 1983; Fahrig and Merriam, 1985; Simberloff and Cox, 1987).

A number of terms have been used in various wildlife movement studies, such as "travel route," "wildlife corridor," "wildlife linkage," and "wildlife crossing" to refer to areas in which wildlife move from one area to another. However, generally each of these is a piece of habitat or a structure (e.g., a bridge under-crossing or a large culvert), usually linear in nature that connects two or more habitat patches that would otherwise be fragmented or isolated from one another. Wildlife corridors are usually bounded by urban land areas or other areas unsuitable for wildlife. The corridor generally contains suitable cover, food, and/or water to support species and facilitate movement while in the corridor. Corridor size, location (e.g., ridge or canyon), vegetation composition, and the type of structures such as culverts are not universally applicable for all terrestrial wildlife. Therefore, the effectiveness of a corridor is dependent on the species in which it was designed. Large mammals such as mountain lions require much larger culverts than do medium-sized mammals such as fox. In addition, the sensitivity of wildlife to human disturbances such as light and noise also varies. Larger, landscape-level corridors (often referred to as "habitat linkages" or "landscape linkages") can provide both transitory and resident habitat for a variety of species.

As defined above, wildlife corridors may not exist for large open space areas, such as what currently occurs in the eastern portion of the Otay River watershed, where there are few man-made or naturally occurring physical constraints to wildlife movement. Given an open space area that is both large enough to maintain viable populations of species and provide a variety of travel routes (canyons, ridgelines, trails, riverbeds, and others), wildlife will use these "local" routes while searching for food, water, shelter, and mates, and will not need to cross into other large open space areas. Based on their size, location, vegetative composition, and availability of food, some of these movement areas (e.g., large drainages and canyons) are used for longer lengths of time and serve as source areas for food, water, and cover, particularly for small- and medium-sized mammals. This is especially true if the travel route

is within a larger open space area. However, if open space areas become constrained and/or fragmented as a result of urban development or construction of physical obstacles such as roads and highways, remaining landscape features or travel routes that connect the larger open space areas can "become" corridors; as long as they retain enough of the necessary habitat characteristics, such as adequate space, cover, food, and water, and do not contain obstacles or distractions (man-made noise, lighting) that would generally hinder movement. In addition, the created corridor may function for some species and not another, depending on the characteristics described.

B.6.2.2 Wildlife Movement Within the Otay River Watershed and to Adjacent Watersheds

Two main landscape linkages facilitate regional wildlife movement between the Otay River watershed and beyond: (1) the Otay River Valley, linking the San Diego Bay to Otay Mountain; and (2) Otay Mountain, linking the Otay River watershed with the Tijuana River watershed (Penrod, 2001). Continued expansion of development, specifically of roads, presents the main threat to continued regional wildlife movement in the Otay River watershed. For example the linkage between the Otay and Tijuana River watershed is severely constrained by Otay Mesa Road. However, the coast-to-Otay Mountain linkage is well protected, as a series of wildlife movement corridors in public ownership, subject to open space management and wildlife corridor preservation.

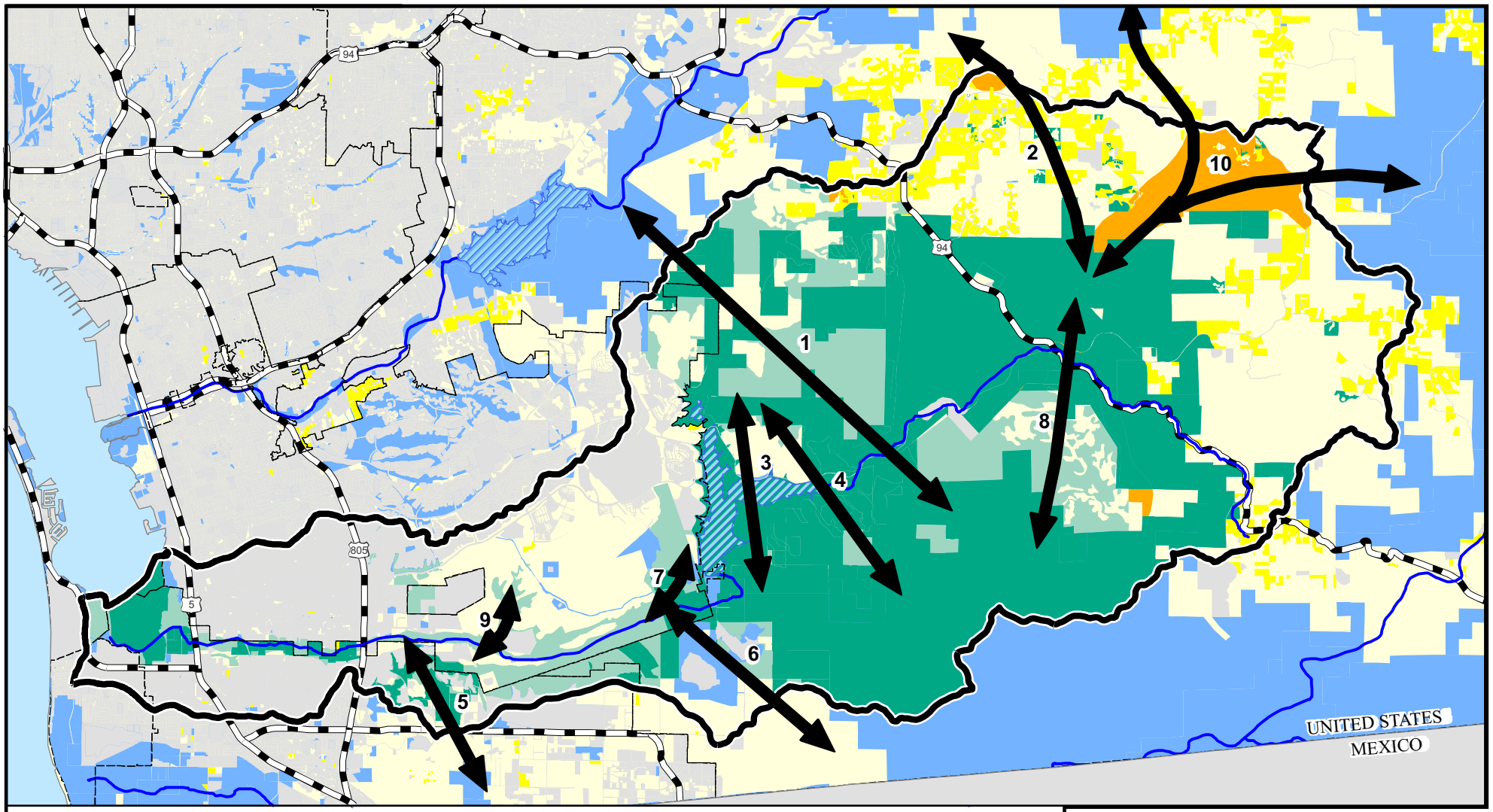
Because of the expansive open space within the Otay River watershed, many of the "corridors" described below are not constrained and by definition (provided above) are not yet corridors (Figure B.6-1). These are currently facilitating "localized" wildlife movement in the watershed versus acting as regional wildlife corridors. However, due to the potential for future development, many of these local movement areas have been identified by Conservation Biology Institute (CBI, 2003a and b) as potentially becoming corridors.

San Miguel Mountains/Proctor Valley/Otay Ranch. Prior to the October 2003 fires, San Miguel Mountain supported coastal sage scrub, chamise chaparral, southern mixed chaparral, native grasslands, vernal pools, and alkali meadow (City of Chula Vista and County of San Diego, 1993c). A significant portion of the Mountain is within the Otay Ranch resource area. At this time, the area functions as a wildlife linkage and is currently not constrained. The Otay Ranch RMP determined this area to be a wildlife linkage between San Miguel Mountain and the Sweetwater Reservoir and the Sweetwater River, located to the north and northeast, respectively. In addition, the area may facilitate movement from Proctor Valley to the south and Jamul Creek to the east, connecting the Jamul Mountains with the San Ysidro Mountains.

Sweetwater River/McGinty Mountain/Hollenbeck Canyon. The Sweetwater-Loveland Open Space and Habitat Management Plan provided a linkage from Sweetwater Reservoir through to the McGinty Mountains at the northeastern end of the Otay River watershed. The McGinty Mountain area encompasses large tracts of undeveloped land, including an existing Nature Conservancy Preserve and adjacent high quality native plant and wildlife habitat.

Jamul Mountains/Lower Otay Reservoir. Prior to the October 2003 fires, Jamul Mountain, a large topographic feature northeast of Lower Otay Reservoir, supported coastal sage scrub, chamise chaparral, and live oak woodland. The oak woodlands provide unconstrained wildlife movement across these lands, although future development plans are unclear at this time. Monitoring locations are recommended as part of the MSCP regional wildlife movement monitoring program (CBI, 2003a).

Jamul Mountains/San Ysidro Mountains. Much of this area is conserved as part of the MSCP, and wildlife movement across this region is facilitated by a multitude of canyons (e.g., Little Cedar and



Legend
Wildlife Corridors/Habitat Linkages
1. San Miguel Mountains/Proctor Valley/Otay Ranch
2. Sweetwater River/McGinty Mountain/Hollenbeck Canyon
3. Jamul Mountains/Lower Otay Reservoir
4. Jamul Mountains/San Ysidro Mountains
5. Spring Canyon/Dennery Canyon/West Otay Mesa
6. Johnson Canyon/O'Neal Canyon/Otay River Valley
7. Salt Creek/Otay Valley
8. Hollenbeck Canyon/Rancho Jamul
9. Poggi Canyon/Wolf Canyon/Otay River Valley
10. Hollenbeck Canyon/Lyons Valley/Lee Valley

Legend
Existing Development
Existing Spaced Residential Development
Vacant Private Lands
Vacant Public Lands

Preserve Status within Watershed
Acquired Preserve
MSCP Planned Preserve
County Pre-Approved Mitigation Area

Basemap Legend
Otay River Watershed Boundary
City Boundary
Rivers
Lakes

N

0 2.5 5
Scale in Miles

Source: TAIC, 2005

Otay River Watershed Management Plan

Figure B.6-1

Wildlife Corridors and Habitat Linkages

Aspen Environmental Group

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Cedar canyons) that are administered by the BLM. However, future development in the major amendment area on the East Otay Mesa are unclear, although open space preservation of the East Otay Mesa hills in the San Diego County Subarea may contribute to wildlife movement from the Tijuana River watershed to the Otay River watershed through this area.

Spring Canyon/Dennery Canyon /West Otay Mesa. Although Spring Canyon is located on top of the mesa south of the Otay River Valley, this isolated canyon drains into the Tijuana River Valley. The only connection between the Spring Canyon and Dennery Canyon open spaces to the Otay River Valley is through a culvert under Otay Mesa Road (CBI, 2003b), near Heritage Road. The culvert is known to be used by coyotes and gray foxes, but also seems to provide restricted crossing opportunities for bobcat and mountain lion. Mule deer were not found during transect surveys in this area. The Spring Canyon area is becoming more isolated by surrounding development and is losing its value as wildlife corridor.

Johnson Canyon/O'Neal Canyon/Otay River Valley. This area functions as a linkage between the Otay Lakes, the Otay River Valley, Otay Mountain, and adjoining open space (CBI, 2003a). Wildlife movement is adequately facilitated through the Otay River Valley and adjoining canyons connecting the mesa with the valley. Wildlife movement through O'Neil Canyon, which supports gnatcatcher-occupied coastal sage scrub, probably functions as a part of the regional wildlife corridor to Otay Mesa and beyond, as well as the local wildlife corridor to the Otay River Valley. Wildlife culverts and tunnels allow for movement through a constriction point under Alta Road, which appears to be used by wildlife (as evidenced by game trails and coyote scat). In addition, the MSCP planned preserve design took "unconstricted" wildlife movement in this area into consideration. A large part of this linkage will be preserved as mitigation for the Otay Ranch project and Caltrans' SR-125 project, and habitat management for the Johnson Canyon Preserve will facilitate wildlife movement (EDAW, 2003).

Salt Creek/Otay Valley. Historically, Salt Creek linked the Otay River Valley with the mesas and grasslands to the north (CBI, 2003a and b). According to the Baldwin Otay Ranch wildlife corridor studies prepared for the Otay Ranch Project Team, Salt Creek was considered to be a regional wildlife corridor for Quino checkerspot butterfly, cactus wren, and California gnatcatchers (Ogden, 1992). However, development of the EastLake communities has compromised its value by removing and fragmenting native habitats surrounding the creek to the north, west, and east (CBI, 2003a and b), including developing the Auld Golf Course, which straddles the creek near the headwaters (personal observations). Development in close proximity retards movement due to light, noise, and the foot traffic of humans, their vehicles, and their pets. In addition, culverted creek crossings and/or flood control/water quality basins have been installed at various locations, including Duncan Ranch Road, Proctor Valley Road, Otay Lakes Road, and Olympic Parkway. Roads are major barriers to wildlife movement and are the principal cause of habitat fragmentation (Lyren, 2001). These crossings, particularly were basins are also present, are unlikely suitable for mammal movement.

The MSCP preserve design did not indicate Salt Creek as a regional habitat linkage for large mammal movement; therefore, CBI did not recommend it for monitoring (CBI, 2003a and b). Nonetheless, restoration of habitat within and adjacent to Salt Creek and the use of fencing to limit access may provide core area and allow for important dispersal habitat for the Quino checkerspot butterfly, cactus wren, and California gnatcatchers (CBI, 2003a and b).

Hollenbeck Canyon/Rancho Jamul. The Hollenbeck Canyon Wildlife Area and Ranch Jamul Ecological Reserve open spaces managed by the CDFG comprise a large block of wildlife movement corridors and linkage in the county (CBI, 2003b), linking Otay Ranch to lands in the east. Both open space preserves are separated by SR-94; however, culverts appear to facilitate wildlife movement

underneath this highway in three to five locations. Wildlife movement target species across this swath of land include coyote, gray fox, bobcat, mule deer, and mountain lion. CDFG is currently preparing land management plans for these preserves, including provisions for wildlife movement as indicated by studies under way by the USGS.

Poggi Canyon/Wolf Canyon/Otay River Valley. Key biological resources within Poggi Canyon, Wolf Canyon, and Otay River Valley may also offer restricted linkages between the three as identified in the Otay Ranch RMP (City of Chula Vista and County of San Diego, 1993c). Poggi Canyon does not function as a terrestrial wildlife movement corridor due to constrictions from the Olympic Parkway, straightening and the installation of rock check-dams throughout. The canyon may continue to have value as a bird dispersal area (CBI, 2003a). Wolf Canyon is continuous with Otay River Valley via a narrow linkage west of Rock Mountain. This linkage may act primarily for bird dispersal, but may also facilitate small mammal movement. Wolf Canyon is worth considering in future analysis to identify potential management, restoration, or enhancement areas.

B.6.2.3 Summary of Wildlife Movement

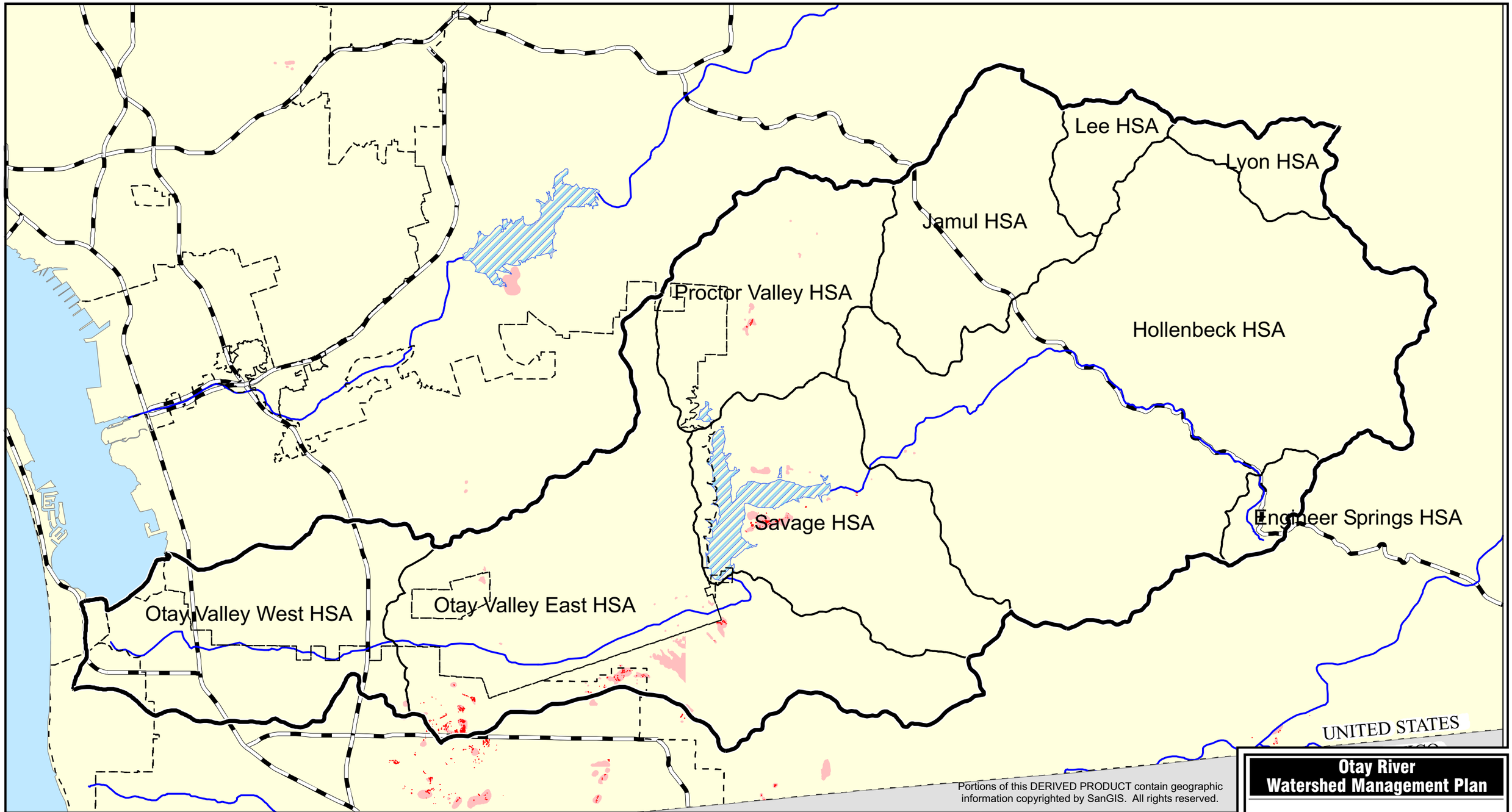
The nature of wildlife movement is species-specific; nevertheless, large open spaces will generally support a diverse wildlife community representing all types of movement. Each type of movement may also be represented at a variety of scales from non-migratory movement of amphibians, reptiles, and some birds, on a "local" level to many square mile home ranges of large mammals moving at a "regional" level. The presence of development surrounding the Otay River Valley presents a severe constraint to regional wildlife movement along the coastal terrain to Tijuana River and Mexico. In addition, wildlife movement to the north is also constrained along the coastal areas with Poggi and Wolf Canyons likely only facilitating bird dispersal. Conversely, because of the long-term planning efforts of the MSCP, land surrounding much of Otay Lakes and eastward maintain large open space preserves or other public lands that facilitate regional as well as local movement. As stated previously, healthy populations require the influx of new genetic material to protect against catastrophic events and to protect the biological integrity of the preserve. As the 2003 fires demonstrated, periodic, large-scale disturbances in southern California watershed do occur and need to be considered in watershed management planning. In the absence of wildlife movement, wetland functions and values are severely diminished, which would be in direct conflict with the goals of the ORWMP.

B.6.3 Sensitive Habitats and Species

B.6.3.1 Sensitive Habitats

Sensitive habitats are those that have been depleted, are naturally uncommon, and/or support sensitive species. Recognition of sensitivity is identified through a variety of mechanisms including regulatory protection (i.e., wetlands under the Corps permit process, the RWQCB's Section 401 Water Quality Certification, and/or the CDFG Streambed/Lake Alteration Agreement), the MSCP, local regulations (e.g., the County of San Diego's Biological Mitigation Ordinance), and the California Natural Diversity Database (CNDDB). Most of the habitats that occur within the watershed are considered sensitive by one or more of these agencies or sources, as described below.

Vernal Pools. Vernal pools have been mapped in the Otay River watershed (Figure B.6-2), although it is uncertain if this mapping is comprehensive, given their small size. Vernal pools are a highly specialized habitat supporting a unique flora and fauna, including several federally listed species. They have been reduced by an estimated 97 percent in San Diego County (Ogden, 1998). As a result, these



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Legend

- Vernal Pools
- Vernal Pool Complex (SANDAG)

Basemap Legend

- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes

N

0 2.5 5

Scale in Miles

Vernal Pool Source: FWS 2003, SANDAG 1995
Vernal Pool Complex Source: SANDAG 1995

Otay River Watershed Management Plan

Figure B.6-2

Vernal Pools and Complexes

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pools are considered sensitive by the USFWS, CDFG, RWQCB and the applicable local jurisdictions. They were actively regulated by the Corps, but a January 9, 2001 U.S. Supreme Court[5] ruling severely restricted the circumstances under which the Corps can regulate them.

Riparian and Wetland Habitats. Riparian and wetland habitats (including, to varying degrees, those listed under the headings of Ocean, Open Water, Meadow and Marsh, and Riparian Scrub/Woodland/ Forest) are considered sensitive by the USACE, USFWS, CDFG, RWQCB, and applicable local jurisdictions. Riparian communities are situated along stream courses and adjacent streambanks. Wetland habitat is defined by certain hydrologic, vegetation, and soil criteria. These are areas supporting vegetation specifically adapted to wet, anaerobic conditions. Important wetland functions that benefit surrounding areas include flood conveyance, flood storage, water quality improvement, and reduced erosion through sediment control. In addition, wetlands provide surface water for insects, fish, amphibians, reptiles, mammals, and birds, spawning grounds for aquatic fauna, habitat for rare and endangered species, and corridors for wildlife movement. Wetland habitat is naturally limited and remaining acreages provide important island habitats for migratory birds. Oberbauer (1991) reports a reduction of 91 percent of freshwater marsh and a reduction of 68 percent of coastal salt marsh in San Diego County since the pre-European era. Estimates of riparian habitat reduction in southern California floodplain areas run as high as 97 percent (Bowler, 1990). Oberbauer (1991) reported a reduction of riparian woodland in San Diego County of approximately 61 percent.

Oak Woodlands. Oak woodlands are considered sensitive by CDFG and the applicable local jurisdictions because of their scarcity, high wildlife value, and ability to provide watershed protection. The major factors contributing to the decline of oak woodlands in southern California include livestock grazing, recreational use, and urban and rural development. Scheidlinger and Zedler (1980) reported a 13 percent decline in oak cover during the interval covering 1928-1970 for southern San Diego County. Another alarming trend is the lack of recruitment of new individuals into existing oak populations. The decline in oak populations may accelerate as the large, old trees that make up the majority of these populations start to die off. Engelmann oak woodland is considered particularly sensitive, because its dominant species, Engelmann oak, is considered sensitive.

Southern Interior Cypress Forest. Southern interior cypress forest is considered a sensitive natural community by the CNDDB and the applicable local jurisdictions. This habitat has limited distribution, occurring only in four isolated groves in the Peninsular Ranges of southwestern California, with isolated groves also extending about 150 miles into Baja California, Mexico (Armstrong, 1978). Tecate cypress, which is the dominant canopy member in this habitat, is considered sensitive by the California Native Plant Society.

Maritime Succulent Scrub. Maritime succulent scrub has a restricted range and is known from only a few localized sites near the coast in southern California. Several sensitive species are associated with maritime succulent scrub habitat, including Shaw's agave and San Diego barrel cactus. As a result, it is considered sensitive by CDFG and the applicable local jurisdictions.

Coastal Sage Scrub. Coastal sage scrub is considered a sensitive habitat by the USFWS, CDFG, and the applicable local jurisdictions, because it supports a number of State and federally endangered, threatened, and rare vascular plants as well as several bird and reptile species that are federally listed or are candidate species for federal listing. Coastal sage scrub is thought to be one of the most endangered vegetation types in California (Atwood, 1993). According to Oberbauer (1991), the historical reduction

[5] Solid Waste Agency of Northern Cook County versus United States Army Corps of Engineers, No. 99-1178. U.S. Supreme Court, January 9, 2001. Also referred to as the "*SWANCC* decision."

of sage scrub in San Diego County is on the order of approximately 72 percent, and additional losses have continued since that time.

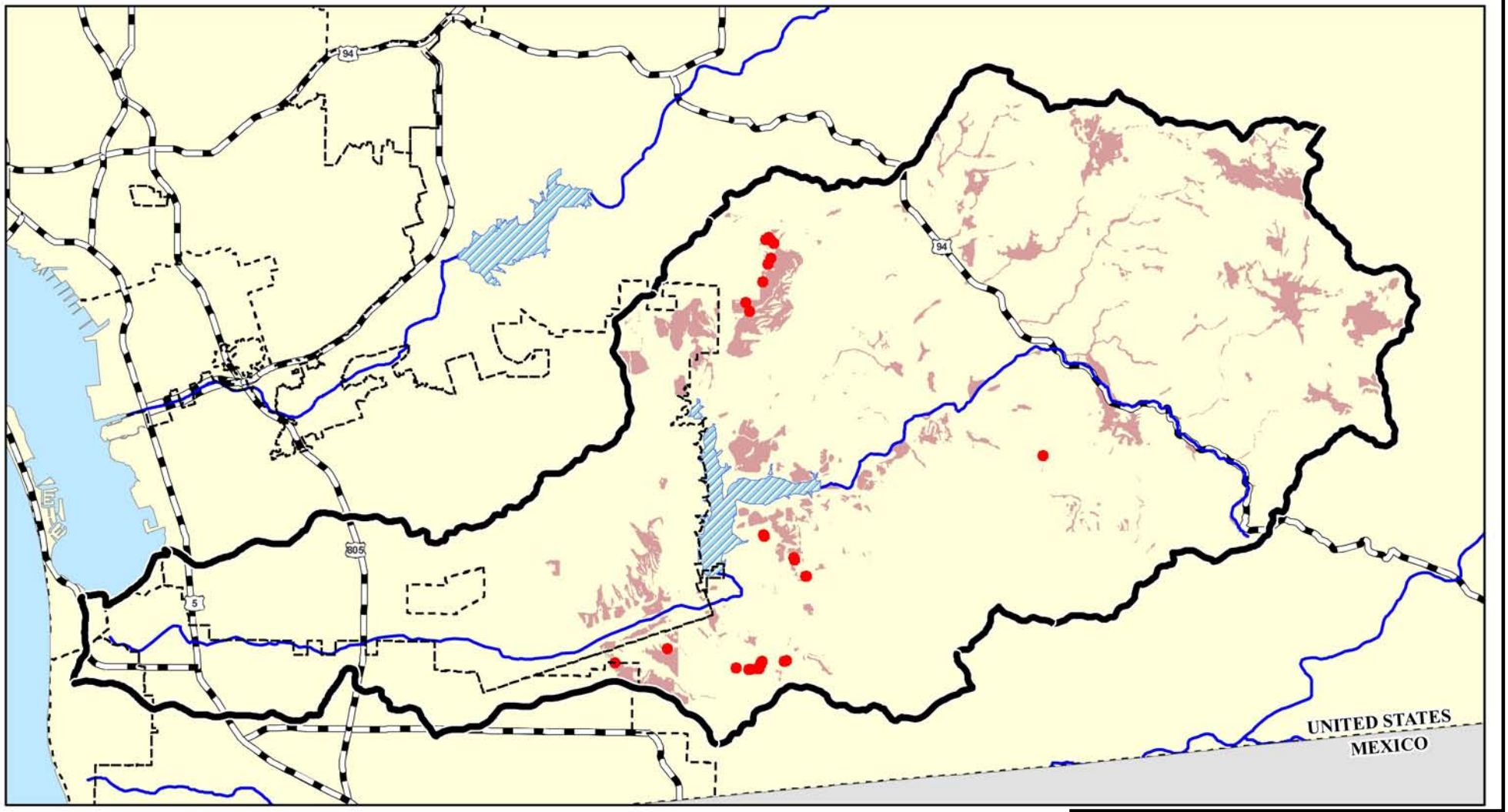
Chaparral. Due to increasing pressures from urban expansion, and the potential for presence of several sensitive plant species (e.g., wart-stemmed ceanothus, summer holly), this community is regarded as sensitive by the CNDDB and the applicable local jurisdictions, particularly where it supports sensitive plant or animal species or where it serves as a habitat linkage or wildlife movement corridor. Mafic northern mixed chaparral and scrub oak chaparral are considered especially sensitive.

Grasslands. Grasslands are considered sensitive by the CDFG and the applicable local jurisdictions. Native grasslands are one of the most heavily impacted plant communities within California. Many of the pristine native grasslands within the State have been converted to non-native grasslands, dominated by annual grasses from the Mediterranean. They are considered sensitive because of their limited distribution, potential for supporting sensitive plant species, use as raptor foraging habitat, and habitat loss. Oberbauer and Vanderwier (1991) estimated that almost 95 percent of the original acreage of native grassland in the County of San Diego had been lost as of 1988. Although they have a substantial component of exotic species, non-native grasslands also are considered sensitive because they have the potential to support raptor foraging and sensitive plant species, and to serve as habitat linkages.

B.6.3.2 Sensitive Species

Sensitive species are those considered unusual or limited in that the species are: (1) only found in the San Diego region; (2) local representatives of a species or association of species not otherwise found in the region; or (3) severely depleted within their ranges or within the region.

Sensitive Plant Species. High-interest plants include those listed by the USFWS, CDFG, County of San Diego, City of San Diego, City of Chula Vista, City of Imperial Beach, and California Native Plant Society (CNPS 2004). Table B.6-2 identifies sensitive plant species known or considered likely to occur within the watershed. In addition, a GIS-based species distribution model was developed to map potential locations of sensitive flora and fauna with specific physical and biological requirements (Oberbauer, 1991). Observational data were also obtained from the SANDAG Regional Species Database (2003). The species distribution model uses six coarse-grained factors to assess whether the species would be predicted to occur within each cell (in a raster-based GIS layer with 100 x 100 foot cell size). The factors included habitat type (i.e., vegetation communities such as coastal sage scrub, riparian scrub, etc.), ecoregion (contiguous areas of similar biogeographic conditions), elevation, topography, soil parent material, and soil structure. San Diego County DPLU biologists, with input from local biologists familiar with the species, identified the fundamental biological and physical factors that would best predict the presence of each species. For each cell, when the conditions for all the factors identified for a given species are met, then that cell is included in the model output for that species. A map displaying all the cells where all conditions were met for a species can be considered a predicted species distribution for that species in the study area. No relative habitat ranking is included as part of the species distribution model. Two examples of the model predicting existing distribution of sensitive plants are shown in Figure B.6-3, Orcutt's Brodiaea, and Figure B.6-4, San Diego Button Celery. Past species observations are also noted in these figures. This tool will be used in the watershed management planning effort to design a comprehensive preserve system that protects high-priority species for the long-term. Furthermore, it will assist the identification of data gaps, prioritization of preserve areas, and prioritization of land acquisition and management strategies for both aquatic and upland species.



Legend

- Predicted Distribution
- Known Location
- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes

N

0 2.5 5
Scale in Miles

Source: Species Distribution Model and SANDAG Regional Species Database.

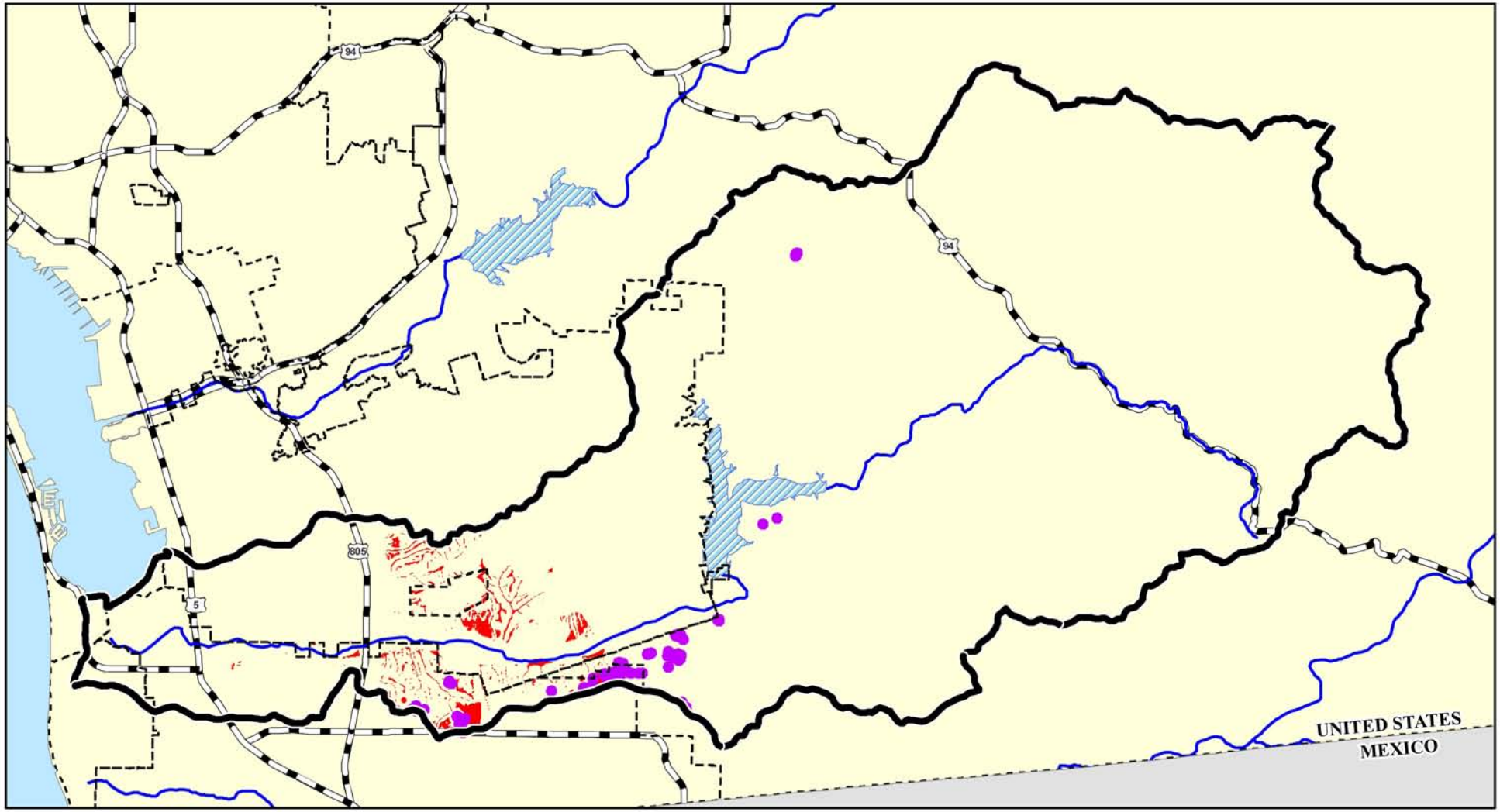
Source: TAIC, 2004

Otay River Watershed Management Plan

Figure B.6-3

Modeled Distribution and Observations of Orcutts Brodiaea

Aspen Environmental Group



Legend

- Predicted Distribution
- Known Location

Basemap Legend

- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes

N

0 2.5 5
Scale in Miles

Source: Species Distribution Model and SANDAG Regional Species Database.

Source: TAIC, 2004

Otay River Watershed Management Plan

Figure B.6-4

Modeled Distribution and Observations of San Diego Button Celery

Aspen Environmental Group

Table B.6-2 Otay River Watershed Sensitive Plant Species

Common Name	Scientific Name	FE	FT	SE	ST	SR	FSC	CSC	NE	A	B	C	D	MSCP	CNPS
San Diego thorn-mint	*Acanthomintha ilicifolia*	X		X					X	X				X	1B
San Diego County needlegrass	*Achnatherum diegoense*							X					X		4
San Diego adolphia	*Adolphia californica*							X			X				2
San Diego bur sage	*Ambrosia chenopodiifolia*							X			X				2
San Diego ambrosia	*Ambrosia pumila*	X						X	X	X				X	1B
Otay manzanita	*Arctostaphylos otayensis*							X		X				X	1B
Palmer's sage	*Artemesia palmeri*							X			X				4
South coast salt scale	*Atriplex pacifica*							X	X	X				X	1B
Orcutt's brodiaea	*Brodiaea orcuttii*							X	X	X				X	1B
Dunn's mariposa lily	*Calochortus dunnii*					X			X	X				X	1B
Slender-pod jewel flower	*Caulanthus stenocarpus*					X								X	
Lakeside ceanothus	*Ceanothus cyaneus*							X	X	X				X	1B
Otay lilac	*Ceanothus otayensis*							X							1B
Southern mountain misery	*Chamaebatia australis*							X					X		4
Prostrate spineflower	*Chorizanthe procumbens*							X					X		
Campo clarkia	*Clarkia delicata*							X			X				1B
Summer holly	*Comarostaphylis diversifolia* ssp. *Diversifolia*							X							1B
Salt marsh bird's-beak	*Cordylanthus maritimus* ssp. *Maritimus*	X		X					X	X				X	1B
Orcutt's bird's-beak	*Cordylanthus orcuttianus*							X			X			X	2
Tecate cypress	*Cupressus forbesii*							X		X				X	1B
Otay tarplant	*Hemizonia conjugens*		X	X					X	X				X	1B
Western dichondra	*Dichondra occidentalis*							X					X		4
Variegated dudleya	*Dudleya variegata*							X	X	X				X	1B
Palmer's goldenbush	*Ericameria palmeri* ssp. *Palmeri*							X	X		X			X	2
San Diego button-celery	*Eryngium aristulatum* var. *parishii*	X		X						X				X	1B
San Diego barrel cactus	*Ferocactus viridescens*							X			X			X	2
Mexican flannelbush	*Fremontodendron mexicanum*	X				X				X					1B
Palmer's grapplinghook	*Harpagonella palmeri*							X			X				4
Graceful tarplant	*Holocarpha virgata* ssp. *elongate*							X					X		4
Decumbent goldenbush	*Isocoma menziesii* var. *decumbens*							X		X					1B

Common Name	Scientific Name	FE	FT	SE	ST	SR	FSC	CSC	NE	A	B	C	D	MSCP	CNPS
San Diego marsh elder	*Iva hayesiana*							X			X				2
Southwestern spiny rush	*Juncus acutus* ssp. *Leopoldii*							X					X		4
Gander's pitcher sage	*Lepechinia ganderi*							X	X					X	1B
Felt-leaved monardella	*Monardella hypoleuca* ssp. *Lanata*							X	X	X				X	1B
Willowy monardella	*Monardella linoides* ssp. *Viminea*	X		X					X	X				X	1B
San Diego goldenstar	*Muilla clevelandii*							X		X				X	1B
Little mousetail	*Myosurus minimus* var. *apus*						X	X		X					3
Spreading navarretia	*Navarretia fossalis*		X					X		X					1B
California adder's tongue fern	*Ophioglossum californicum*							X					X		4
Snake cholla	*Opuntia californica* var. *californica*							X	X	X				X	
California Orcutt grass	*Orcuttia californica*	X		X										X	1B
Otay Mesa mint	*Pogogyne nudiuscula*	X		X						X				X	1B
Engelmann oak	*Quercus engelmannii*							X					X		4
Coulter's matiliaja poppy	*Romneya coulteri*							X					X		4
Small-leaved rose	*Rosa minutifolia*			X							X			X	2
Munz sage	*Salvia munzii*							X			X				2
San Miguel savory	*Satureja chandleri*							X						X	1B
Ashy spike-moss	*Selaginella cinerascens*												X		
Narrow-leaved nightshade	*Solanum tenuilobatum*													X	
Mint-leaved vervain	*Verbena menthifolia*								X					X	4
San Diego sunflower	*Viguiera laciniata*							X					X		4

Abbreviations: FE—Federal Endangered
FT = Federal Threatened
SE = State Endangered
SR = State Rare
FSC = Federal Species of Concern
CSC = California Species of Concern
NE = MSCP Narrow Endemic Species
A, B, C, D = County Sensitive Plant List
MSCP = MSCP Covered Species
CNPS = California Native Plant Society List

Sensitive Animal Species. Sensitive wildlife species include those species listed as endangered or threatened under the federal ESA or California Endangered Species Act (CESA), candidates for listing by the USFWS or CDFG, and species of special concern to the USFWS or CDFG. Additional sensitive species are identified under the MSCP and the California Natural Diversity Database (CNDDB). Table B.6.3, identifies sensitive animal species known or considered likely to occur in the watershed, each of which is considered a sensitive animal by the County. Wildlife taxonomy follows Stebbins (2003) for amphibians and reptiles, the American Ornithologists' Union (1998) for birds, and Jameson and Peters (1988) for mammals. As with sensitive plants described above, a GIS-based species distribution model was employed for sensitive animals, which overlays the biological and physical requirements of individual species. Past observation data were obtained from the SANDAG Species Regional Database (2003). A map displaying all the cells where all conditions were met for a species can be considered a predicted species distribution for that species in the study area. As discussed, no relative habitat ranking

is included as part of the species distribution model. Nevertheless, this tool will assist in the watershed management planning effort to design a comprehensive preserve system that protects high-priority species for the long-term. Furthermore, it will assist the identification of data gaps, prioritization of preserve areas, and prioritization of land acquisition and management strategies for both aquatic and upland species. Examples of modeled species distributions and past observations for least Bell's vireo, southwestern arroyo toad, San Diego fairy shrimp, and coastal California gnatcatcher are provided in Figures B.6-5, B.6-6, B.6-7, and Figure B.6-8, respectively. A comprehensive list of sensitive species expected to occur in the watershed is provided in Table B.6-3.

Table B.6-3 Otay River Watershed Sensitive Animal Species

Common Name	Scientific Name	FE	FT	SE	ST	FSC	CSC	NE	MSCP
Invertebrates									
San Diego fairy shrimp	*Branchinecta sandiegonensis*	X						X	X
Quino checkerspot butterfly	*Euphydryas editha quino*	X						X	*
Salt marsh skipper	*Panoquinoa errans*								X
Riverside fairy shrimp	*Streptocephalus woottoni*	X						X	X
Herpetofauna									
Arroyo toad	*Bufo californicus*	X					X	X	X
Coastal rosy boa	*Charina trivirgata roseofusca*					X			
Orange-throated whiptail	*Cnemidophorus hyperythrus*						X		X
Coastal whiptail	*Cnemidophorus tigris*								
Northern red-diamond rattlesnake	*Crotalus exsul*						X		
Southwestern pond turtle	*Emys marmorata pallida*					X	X	X	X
Coronado skink	*Eumeces skiltonianus interparietalis*						X		
San Diego horned lizard	*Phrynosoma coronatum blainvillei*						X		X
Western spadefoot toad	*Spea hammondii*					X	X		
Two-striped garter snake	*Thamnophis hammondii*						X		
Mammals									
Mountain lion	*Felis concolor*								X
San Diego black-tailed jackrabbit	*Lepus californicus bennettii*								
San Diego desert woodrat	*Neotoma lepida intermedia*								
Southern mule deer	*Odocoileus hemionus*								X
American badger	*Taxidea taxus*						X		X
Birds									
Cooper's hawk	*Accipiter cooperii*						X		X
Tricolored blackbird	*Agelaius tricolor*					X			X
Rufous-crowned sparrow	*Aimophila ruficeps canescens*								X
Grasshopper sparrow	*Ammodramus savannarum*								
Bell's sage sparrow	*Amphispiza belli belli*					X			
Golden eagle	*Aquila chrysaetos*						X	X	X
Great blue heron	*Ardea herodias*								
Burrowing owl	*Athene cunicularia*					X	X	X	X
Canada goose	*Branta Canadensis*								X
Red-shouldered hawk	*Buteo lineatus*								
Ferruginous hawk	*Buteo regalis*					X			X
Swainson's hawk	*Buteo swainsoni*				X	X	X		X
Green-backed heron	*Butorides striatus*								
Coastal cactus wren	*Campylorhynchus brunneicapillus couesi*							X	X
Western snowy plover	*Charadrius alexandrinus nivosus*		X				X		X

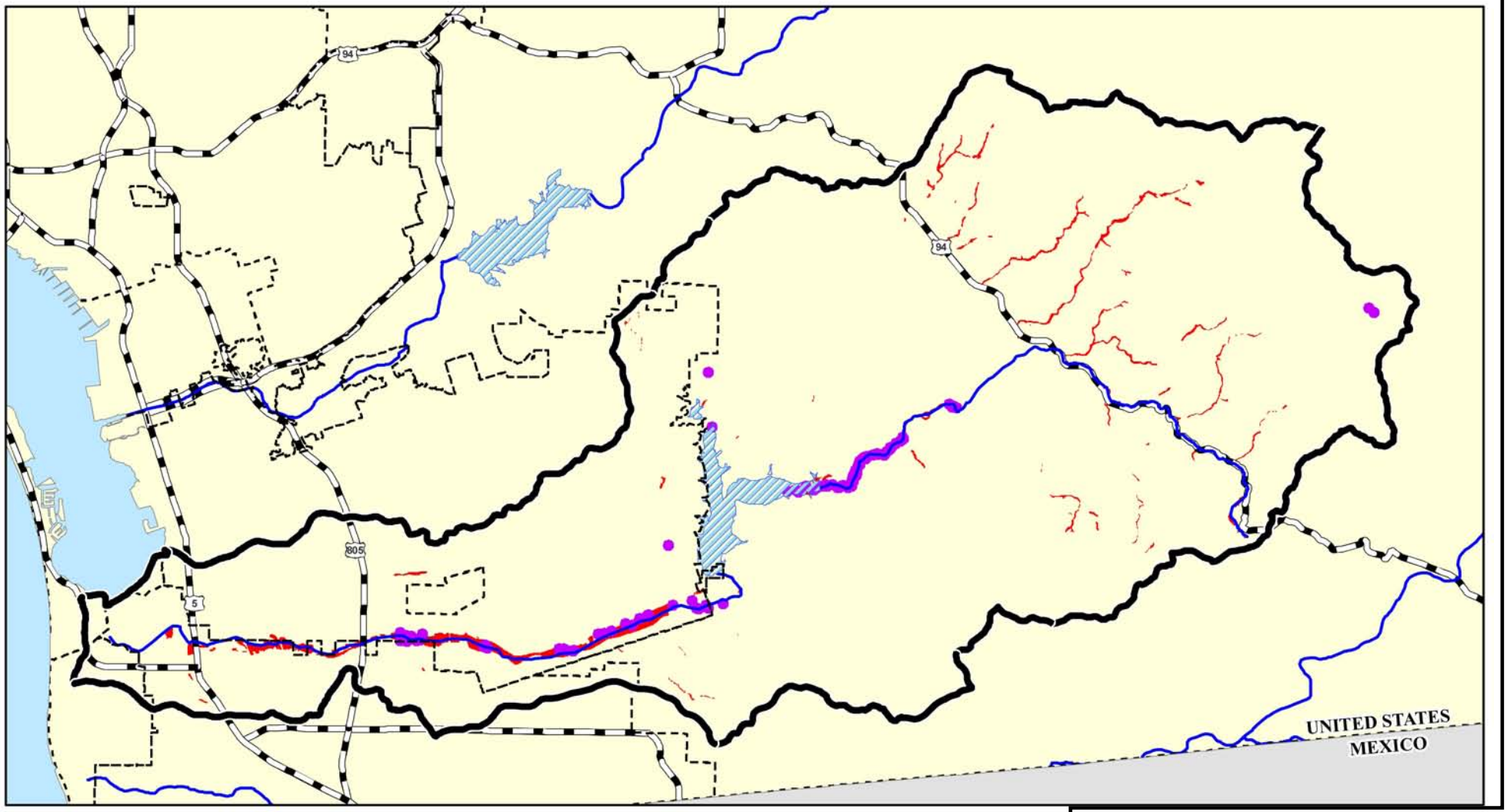
Common Name	Scientific Name	FE	FT	SE	ST	FSC	CSC	NE	MSCP
Northern harrier	*Circus cyaneus*								X
Yellow warbler	*Dendroica petechia*						X		
Reddish egret	*Egretta rufescens*								X
Black-shouldered kite	*Elanus caeruleus*					X			
Southwestern willow flycatcher	*Empidonax traillii extimus*	X		X				X	X
California horned lark	*Eremophila alpestris actia*								
Prairie falcon	*Falco mexicanus*						X		
American peregrine falcon	*Falco peregrinus anatum*			X		X		X	X
Bald eagle	*Haliaeetus leucocephalus*		X	X					X
Yellow-breasted chat	*Icteria virens*						X		
Loggerhead shrike	*Lanius ludovicianus*					X			
Long-billed curlew	*Numenius americanus*					X			X
Belding's savannah sparrow	*Passerculus sandwichensis beldingi*			X				X	X
Large-billed savannah sparrow	*Passerculus sandwichensis rostratus*								X
California brown pelican	*Pelecanus occidentalis californicus*	X		X					X
White-faced ibis	*Plegadis chihi*					X	X		X
California gnatcatcher	*Polioptila californica californica*		X				X		X
Light-footed clapper rail	*Rallus longirostris levipes*	X		X				X	X
Western bluebird	*Sialia mexicana*								X
California least tern	*Sterna antillarum browni*	X		X				X	X
Elegant tern	*Sterna elegans*					X	X		X
Common barn owl	*Tyto alba*								
Least Bell's vireo	*Vireo bellii pusillus*	X		X				X	X

* Quino checkerspot butterfly is considered a Covered Species under the City of Chula Vista MSCP; and the County of San Diego is seeking an amendment to provide coverage for this species.

Abbreviations:
FE = Federal Endangered
FT = Federal Threatened
SE = State Endangered
ST = State Threatened
FSC = Federal Species of Concern
CSC = California Species of Concern
NE = MSCP Narrow Endemic Species
MSCP = MSCP Covered Species

B.6.4 Programs and Plans Protecting or Enhancing Upland and Aquatic Biological Resources

Numerous programs and plans have been established to protect, enhance, and/or restore valuable upland and aquatic biological resources within the Otay River watershed. The most important of these is the MSCP, which guided the development of Subarea Plans for the City of Chula Vista, City of San Diego, and the County of San Diego. Within each Subarea Plan, core biological resource areas and wildlife movement corridors have been identified for acquisition, preservation, and/or restoration. In addition to these plans and preserves, the USFWS currently owns, leases, and/or plans to acquire land for three refuge "units" under the San Diego Bay NWR program. The USFWS has completed a Draft CCP and EIS (July 2005) that analyzes restoration alternatives for the Sweetwater Marsh and South San Diego Bay Units of the San Diego Bay NWR and is initiating a second CCP for the remaining NWR units. Similarly, the CDFG owns and actively manages two ecological reserves and one wildlife area within the watershed. The CDFG has funded detailed biological assessments, continues to acquire adjacent parcels, and is preparing a Land Management Plan for two of the three reserves. Open space protection has also been established by the BLM including the Otay Wilderness Area, and by the U.S. Forest Service, where the southwestern portion of the Cleveland National Forest extends slightly into the watershed.



Legend

- Predicted Distribution
- Least Bell's Vireo Point

Basemap Legend

- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes

N

0 2.5 5
Scale in Miles

Source: TAIC, 2004

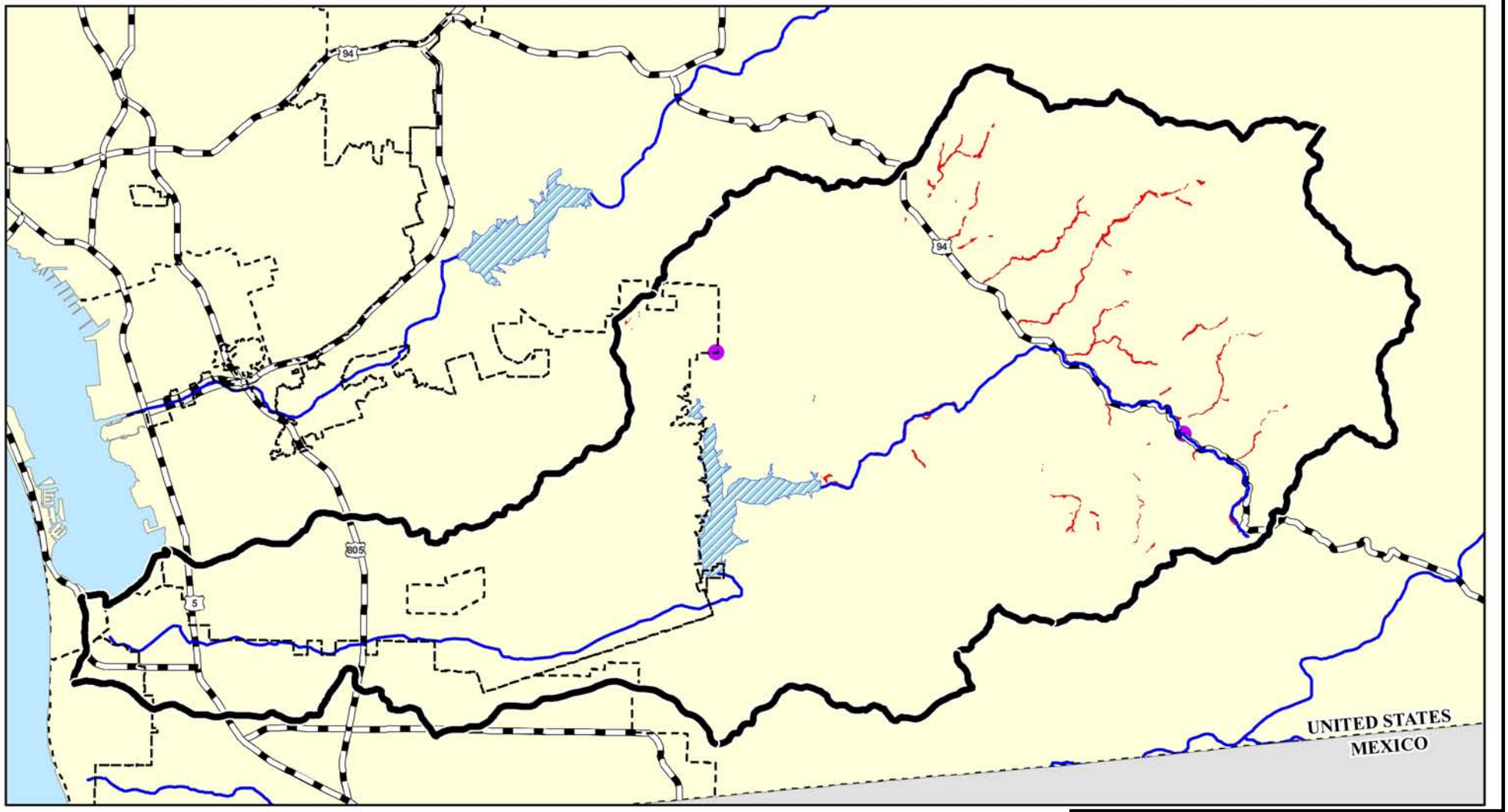
Source: Species Distribution Model and SANDAG Regional Species Database.

Otay River Watershed Management Plan

Figure B.6-5

Modeled Distribution and Observations of Least Bell's Vireo

Aspen Environmental Group



Legend

- Predicted Distribution
- Known Location

Source: Species Distribution Model and SANDAG Regional Species Database.

Basemap Legend

- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes

N

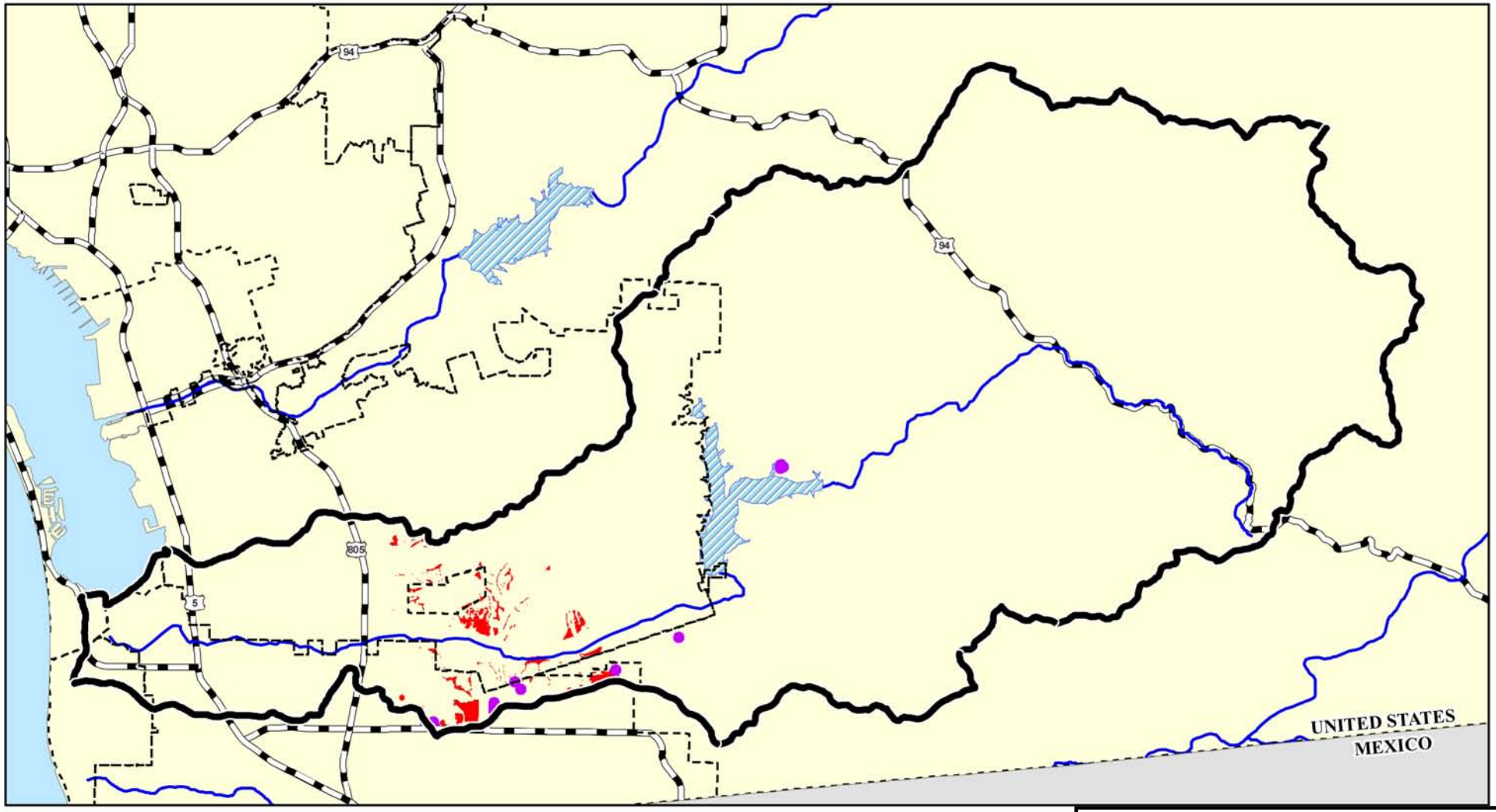
0 2.5 5
Scale in Miles

Otay River Watershed Management Plan

Figure B.6-6

Modeled Distribution and Observations of Arroyo Toad

Aspen Environmental Group



Legend

Predicted Distribution

Known Location

Basemap Legend

Otay River Watershed Boundary

City Boundary

Rivers

Lakes

N

0 2.5 5

Scale in Miles

Source: TAIC, 2004

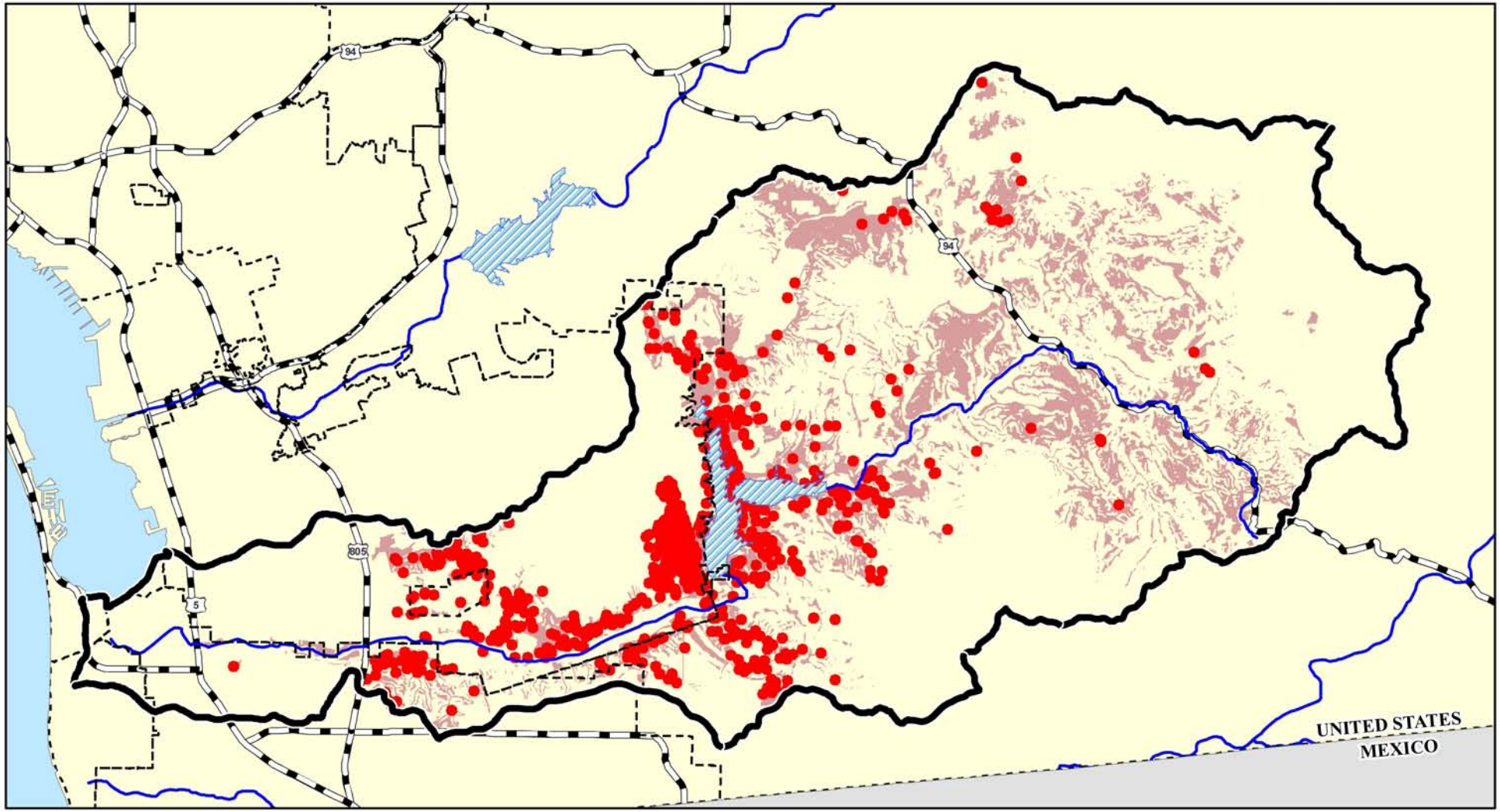
Source: Species Distribution Model and SANDAG Regional Species Database.

Otay River Watershed Management Plan

Figure B.6-7

Modeled Distribution and Observations of San Diego Fairy Shrimp

Aspen Environmental Group



Legend

- Predicted Distribution
- Known Location

Basemap Legend

- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes

N

0 2.5 5

Scale in Miles

Source: TAIC, 2004

Source: Species Distribution Model and SANDAG Regio Species Database.

Otay River Watershed Management Plan

Figure B.6-8

Modeled Distribution and Observations of Coastal California Gnatcatcher

Aspen Environmental Group

Each of these groups shares the goal of long-term conservation of multiple species and the preservation of natural vegetation communities. However, some allow for active versus passive recreational use (e.g., mountain biking vs. hiking), some are actively restoring habitats, and others are currently preserving natural open space without implementing management activities. Furthermore, each plan or program is currently at a different stage of implementation. It is essential to have a clear understanding of the activities currently on-going in the watershed in order to maximize these efforts and identify possible gaps. It is also essential that the Otay River Watershed Management Plan integrate or expand upon existing management programs in order for it to be effective in developing implementation strategies that do not compete with these uses. Therefore, in order to integrate and essentially coordinate these efforts into the ORWMP, each plan was reviewed and open-space- and/or plan-managers were contacted about management strategies being implemented. The following section includes a summary of the identified programs and plans established to protect or enhance biological resources in the watershed and a discussion of activities that are on-going or expected to be implemented. Figure B.6-9 shows the various types of planned and existing preserve and open space areas identified within the watershed. Table B.6-4 lists the acquired and planned preserve areas within the MSCP Subarea Planning areas, as well as the existing public and private preserves and protected open-space areas identified in the Otay River watershed, including BLM, CDFG, and USFWS lands. The existing and planned management activities and permitted uses are also presented in the table. The purpose of the table is to give a brief overview of how much land has been acquired to date and what management measures are being implemented.

B.6.4.1 MSCP

The MSCP (August 1998) was prepared for the subregion (southwestern San Diego County), an area encompassing twelve jurisdictions and 582,243 acres. The MSCP identified Core Biological Resource areas and habitat linkages for wildlife movement between these core habitat areas. The goal of the regional planning effort is to conserve a connected system of biologically viable habitat lands and preclude the need for future listings of species as threatened or endangered. The MSCP Subregional Plan is implemented through local Subarea Plans. The portion of the MSCP Planned Preserve area, which has not been acquired through subarea planning efforts, is shown on Figure B.6-9.

The MSCP Subregional Plan and the associated Subarea Plans for each jurisdiction established comprehensive measures to ensure the long-term conservation of a range of rare and endangered species and their habitats, including many species in the Otay River watershed. The MSCP Subregional Plan addresses the potential impacts of urban growth, loss of natural habitat, and species endangerment, and creates a plan to mitigate for the potential loss of Covered Species and their habitat due to the direct, indirect, and cumulative impacts of future development of both public and private lands within the MSCP area.

Figure B.6-10 shows the County of San Diego, City of Chula Vista, and the City of San Diego Subarea Plan areas within this watershed. Other cities indicated have not completed Subarea Plans or are outside of the watershed. Each Subarea Plan document implements the MSCP Subregional Preserve within each jurisdiction. As part of this program, each Subarea Plan has been prepared pursuant to the general outline developed by the USFWS and the CDFG to meet the requirements of the California Natural Communities Conservation Program (NCCP). Each plan fulfills the mandatory requirements of developing a Habitat Conservation Plan (HCP) pursuant to Section 10(a)(1)(B) of the federal ESA and a California NCCP pursuant to Section 2081 of the California Fish and Game Code. Therefore, the combined MSCP and City Subarea Plans allow for a streamlined permit process with the USFWS and CDFG for the Covered Species when impacts occur outside of the preserve area.

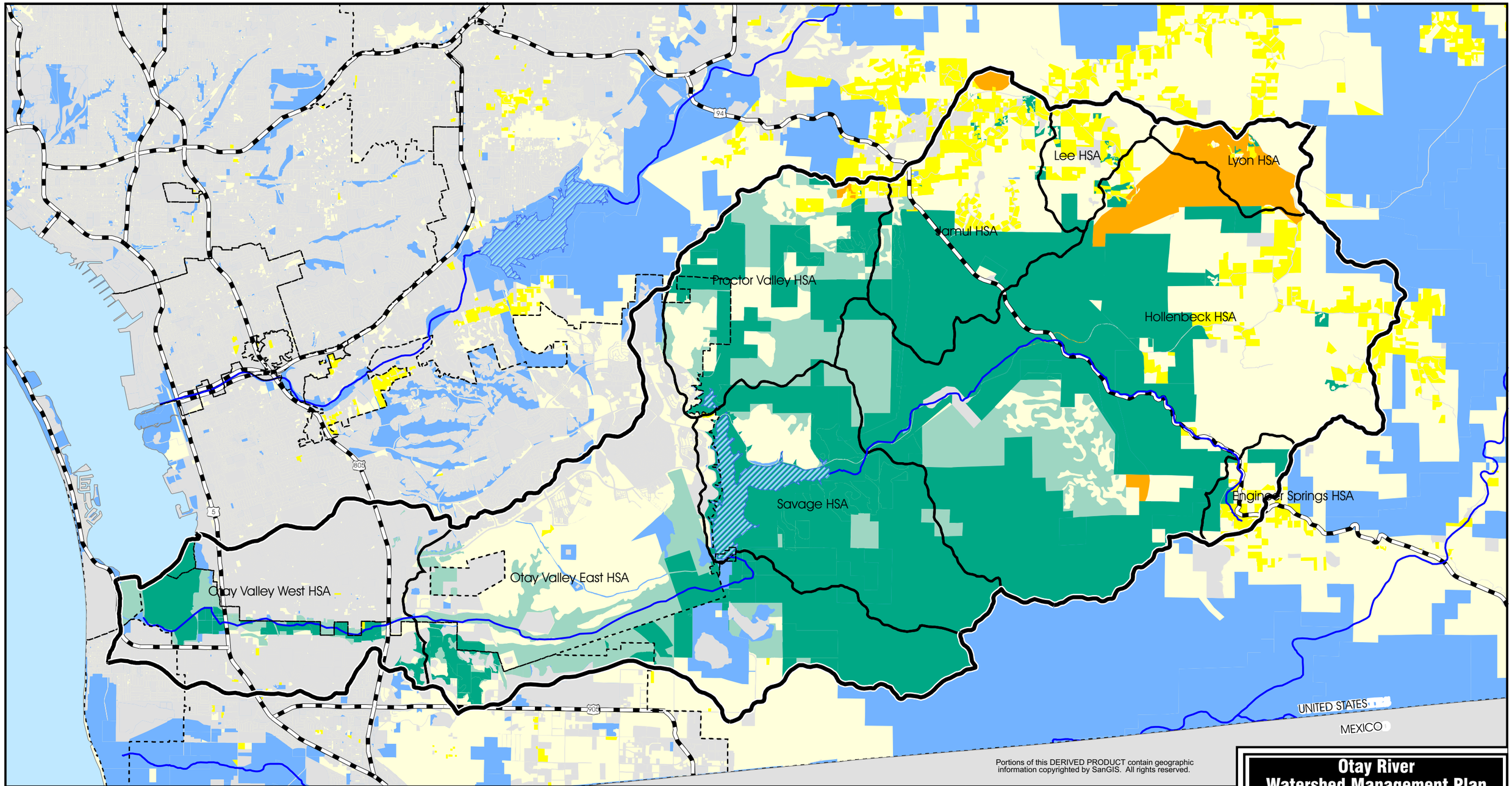
San Diego County MSCP Subarea Plan

Almost half of the MSCP Subregional Plan study area is under the jurisdiction of the County of San Diego. Because areas under the jurisdiction of cities and towns are more developed than the unincorporated areas in the County, the County Subarea contains disproportionately more undeveloped habitats as shown on Figure B.6-11. Approximately 63 percent of MSCP core areas and 81 percent of the linkages are under County jurisdiction. Furthermore, the County Subarea connects the remaining habitat in the western part of the MSCP area to the large federal land holdings (Cleveland National Forest) outside of the MSCP area to the east. Conservation within the County Subarea is crucial to the success of the MSCP. Conservation is achieved by protecting habitat and linkages, both within the MSCP area and to habitat outside the MSCP area. About 73 percent (approximately 184,000 acres) of the County Subarea provides habitat for native plants and wildlife. The remaining 27 percent (approximately 68,000) is disturbed, developed, or agricultural land that is considered to have little to no habitat value.

The County Subarea Plan was developed using the Board of Supervisors' deal/negotiation points as negotiated with the Wildlife Agencies. The following principles, based on the California and federal ESAs, the Natural Community Conservation Planning Act, State and federal policy, and the deal/negotiation points prepared by the Board of Supervisors, were used as the guiding principles for the County Subarea Plan.

The guiding principles were to develop a subarea plan that:

- Does not preclude public safety, fire protection and Border Patrol activities;
- Uses the existing California Environmental Quality Act and other processes, to the maximum extent possible, to implement the subarea plan and avoid creating redundant processes;
- Is consistent with the MSCP and its species coverages (85 species);
- Ensures that projects, which are consistent with the subarea plan and wetlands laws (Clean Water Act and Fish and Game Code Section 1600 et seq.), have obtained approvals from the County, and for which mitigation has been assured, will not be subject to additional Wildlife Agency review;
- Minimizes and mitigates impacts to covered species using the standards in the California and federal ESAa and the NCCP Act;
- Protects private property rights consistent with the U.S. Constitution;
- Avoids duplicate mitigation requirements based on County ordinances and the subarea plan;
- Incorporates regional, state, and federal funding for preserve management and land acquisition;
- Incorporates landowners into the process of determining which lands will be permanently set aside as preserves;
- Uses public lands to the maximum extent practicable to achieve anticipated conservation levels;
- Uses the Environmental Impact Report for the MSCP as a Master Environmental Impact Report to the maximum extent possible for future projects developed consistent with the subarea plan, with regard to biological impacts and mitigation;
- Is consistent with the NCCP Conservation Guidelines;
- Provides for public use (hiking, horse trails, etc.) in appropriate locations within preserves
- Provides for adaptive development of the final preserve design;



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Legend
- Existing Development
- Existing Spaced Residential Development
- Vacant Private Lands
- Vacant Public Lands

Preserve Status within Watershed
- Acquired Preserve
- MSCP Planned Preserve
- County Pre-Approved Mitigation Area

Basemap Legend
- Otay River Watershed Boundary
- Hydrologic Subbasin
- City Boundary
- Major Rivers
- Lakes

0 2.5 5
Scale in Miles

N

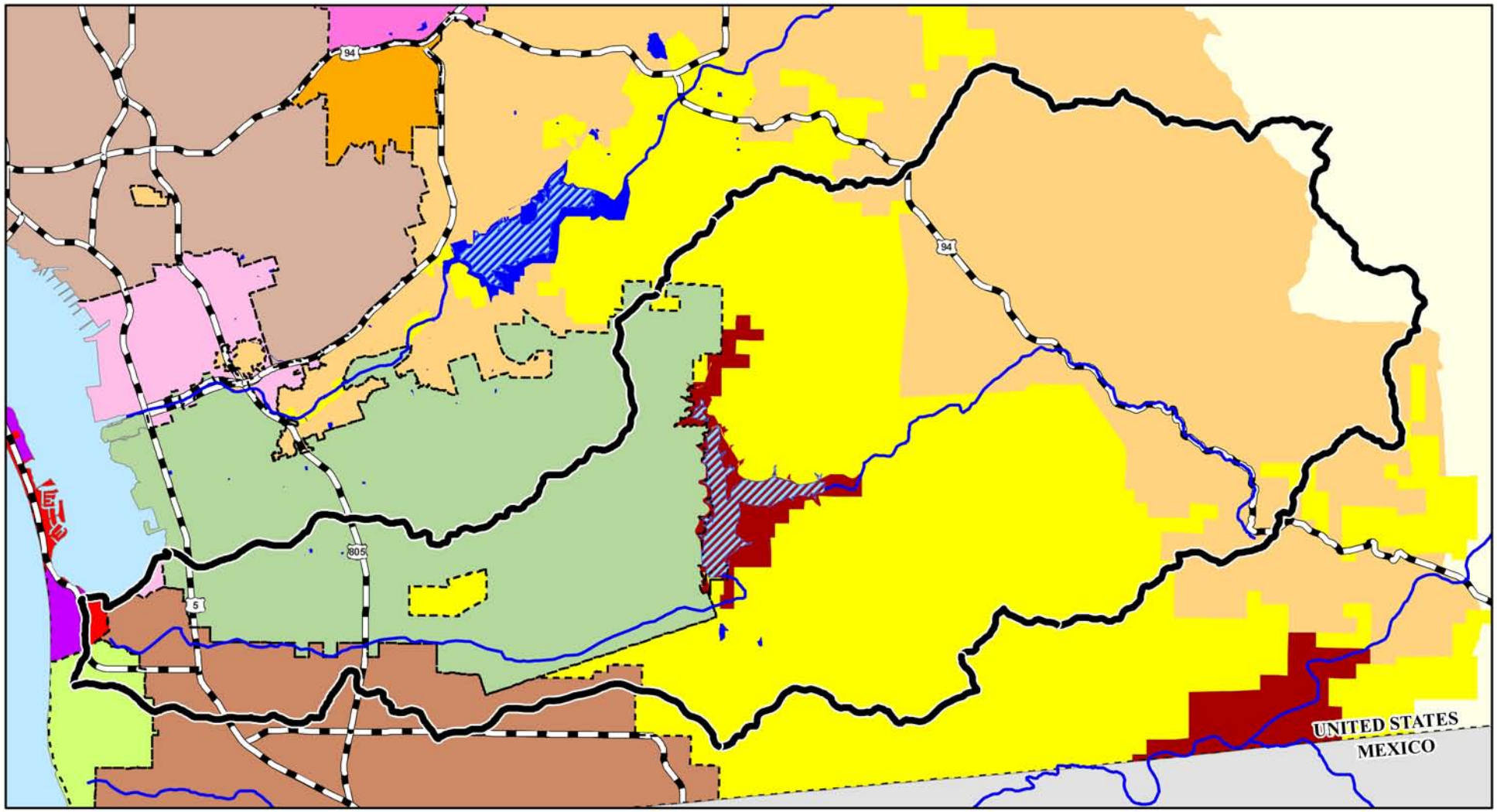
Source: TAIC, 2005

Otay River Watershed Management Plan

Figure B.6-9

Habitat Preserve Status

Aspen Environmental Group



Legend

- Outside MSCP
- COUNTY OF SAN DIEGO SOUTH METRO-LAKESIDE-JAMUL SEGMENT
- COUNTY OF SAN DIEGO SOUTH COUNTY SEGMENT
- CITY OF SAN DIEGO SOUTHERN AREA
- CITY OF SAN DIEGO CORNERSTONE LAND
- CHULA VISTA
- CORONADO
- IMPERIAL BEACH
- NATIONAL CITY
- WATER DISTRICTS
- CITY OF SAN DIEGO URBAN AREA
- LA MESA
- LEMON GROVE
- MILITARY

Basemap Legend

- Otay River Watershed Boundary
- Rivers
- Lakes
- City Boundary

N

0 1.25 2.5 5

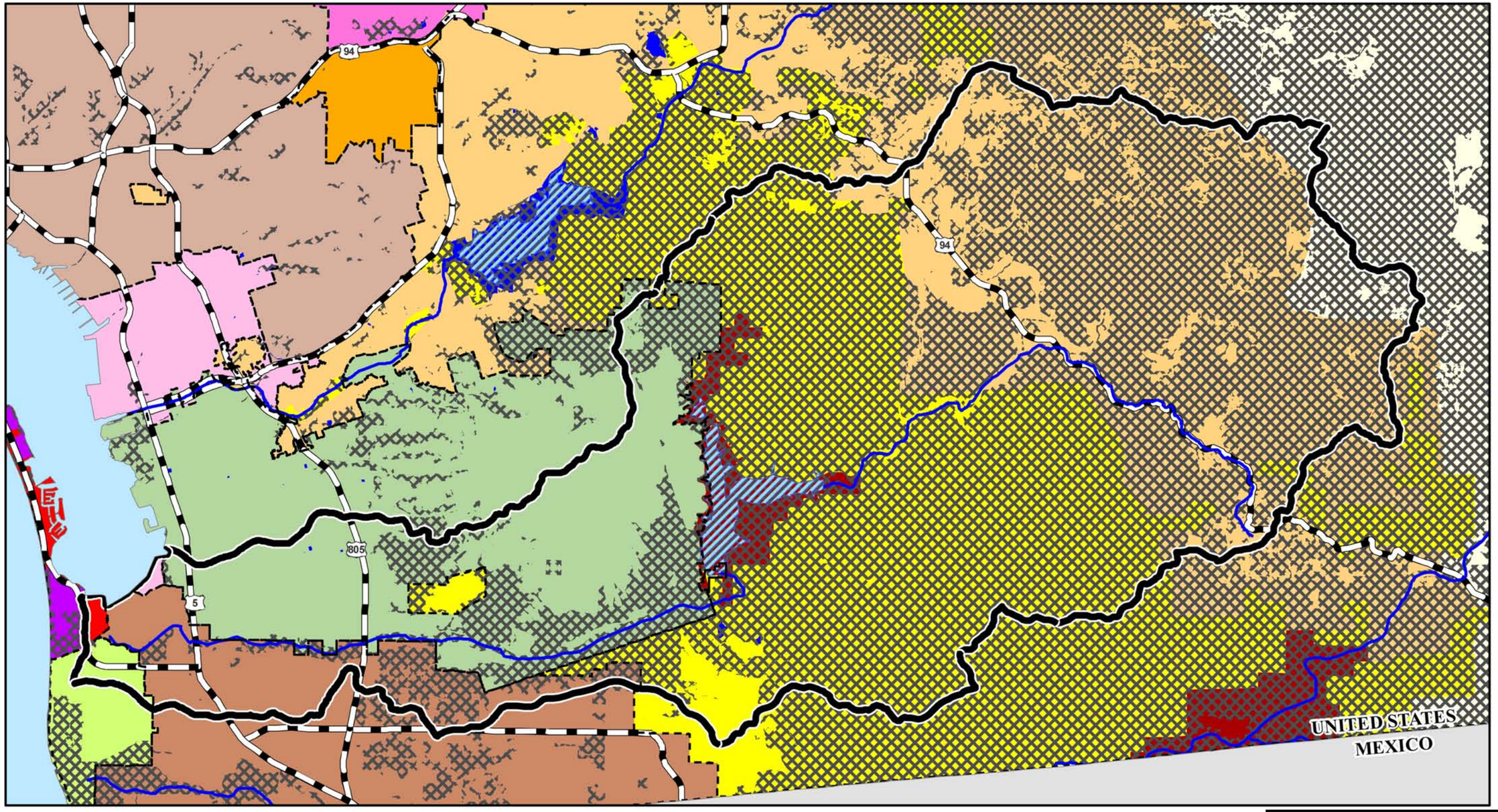
Scale in Miles

Source: TAIC, 2004

Otay River Watershed Management Plan

Figure B.6-10
MSCP Subareas

Aspen Environmental Group



Legend

- Outside MSCP
- COUNTY OF SAN DIEGO SOUTH METRO-LAKESIDE-JAMUL SEGMENT
- COUNTY OF SAN DIEGO SOUTH COUNTY SEGMENT
- CITY OF SAN DIEGO SOUTHERN AREA
- CITY OF SAN DIEGO CORNERSTONE LAND
- CHULA VISTA
- CORONADO
- IMPERIAL BEACH
- NATIONAL CITY
- WATER DISTRICTS
- CITY OF SAN DIEGO URBAN AREA
- LA MESA
- LEMON GROVE
- MILITARY
- Natural Vegetation

Source: TAIC, 2004

Basemap Legend

- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes

N

0 1.25 2.5
Scale in Miles

Otay River Watershed Management Plan

Figure B.6-11
MSCP Subareas with Natural Vegetation

Aspen Environmental Group

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Table B.6-4 Planned and Acquired Preserve Areas

Preserve or Open Space Name	Location in the Watershed	Size (ac.)	Ownership/ Responsible Party	Habitat Types	Management Activities	Target Species	Schedule of Activities	Funding Sources	Permitted Land Uses	Contact
PLANNED PRESERVE AREAS										
MSCP/MHPA										
Overview	Nearly all of the Otay River Watershed and South San Diego County	Total Area of Planned Acquisition Boundary is currently under evaluation and will be provided as data are collected. Acquired land within the MSCP/MHPA and beyond was estimated at 34,635.83 acres as of July 2004.	Joint venture among the County of San Diego, City of San Diego, City of Chula Vista, other jurisdictions, and State and federal agencies	Coastal sage scrub, maritime succulent scrub, chaparral, oak woodland, tecate cypress forest, southern coastal salt marsh, freshwater and alkali marsh, riparian forest, oak riparian forest, riparian woodland, riparian and tamarisk scrub, open water, disturbed wetlands	Proposed management activities include: land acquisition, upland and wetland restoration, recreation and education, and long-term management	Threatened and endangered species under the federal ESA, CESA, and locally rare or sensitive species as listed in the final plan.				
MSCP County of San Diego Subarea	Generally east of Otay Lakes	55,071 uplands and 1,118 wetlands	Multiple owners including San Diego County, City of San Diego, City of Chula Vista, Private in-holdings	Coastal sage scrub, maritime succulent scrub, chaparral, oak woodland, tecate cypress forest, southern coastal salt marsh, freshwater and alkali marsh, riparian forest, oak riparian forest, riparian woodland, riparian and tamarisk scrub, open water, disturbed wetlands	No management activities currently underway at this time	San Diego thorn mint, Orcutt's bird beak, Orcutt's brodiaea, prostrate navarritia, snake cholla, California Orcutt grass, coast barrel cactus, Otay tarplant, Otay mesa mint, San Diego goldenstar, Riverside fairy shrimp, San Diego horned lizard, orange throated whiptail, Wright's checkerspot, Northern harrier, Coopers hawk, golden eagle, peregrine falcon, California Gnatcatcher, burrowing owl, cactus wren, least Bell's vireo, variegated dudleya, Light-footed clapper rail, Belding's savanah sparrow, snowy plover, long-billed curlew, large-billed savanah sparrow	Plan formulation for restoration, exotic removal and monitoring underway at this time.	Coastal Conservancy grants, private funding, community facility district.	Variety of active and passive uses.	Angela O'Shay (858) 694-2963.
MSCP City of Chula Vista Subarea	Generally west of Otay Lakes	5,259 Uplands and 816 Wetlands (see break-down of parcels below)	City of Chula Vista	Coastal sage scrub, maritime succulent scrub, chaparral, oak woodland, tecate cypress forest, southern coastal salt marsh, freshwater and alkali marsh, riparian forest, oak riparian forest, riparian woodland, riparian and tamarisk scrub, open water, disturbed wetlands						
MSCP City of San Diego	Generally North and South of Chula Vista along the Otay River, Otay Lakes	3,309 uplands and 1,300 wetlands	City of San Diego/Private parties	Coastal sage scrub, maritime succulent scrub, wetlands, vernal pools, riparian woodlands, riparian scrub, grasslands, coastal wetlands, beach communities	Goals within the MSCP include maintaining the Otay River Valley as a contiguous open space and protecting sensitive habitats from degradation. Removing exotic species from the Otay River, to enhance Least Bell's Vireo habitat, when possible convert agricultural land to native habitat, remove trash and prevent illegal camps from disrupting wildlife. Maintain research and	San Diego thorn mint, Orcutt's bird beak, Orcutt's brodiaea, prostrate navarritia, snake cholla, California Orcutt grass, coast barrel cactus, Otay tarplant, Otay mesa mint, San Diego goldenstar, Riverside fairy shrimp, San Diego horned lizard, orange throated whiptail, Wright's checkerspot, Northern harrier, Coopers hawk, golden eagle, peregrine falcon, California Gnatcatcher, burrowing owl, cactus wren, least Bell's vireo, variegated dudleya, Light-footed clapper rail, Belding's savanah sparrow, snowy plover, long-billed curlew, large-billed savanah sparrow	Active management is ongoing with exotic species and trash removal, land acquisition and restoration activities identified in the MSCP.	Primary funding is through the City's general fund and grants. Future options include parcel tax/benefit assessment, community facilities district/"Mello-Roos," general obligation bonds - Ad Valorem tax and a sales tax. Local funding sources will be voter approved. If public funding sources do not become available, the City will not increase private development contributions beyond what is committed to in the MSCP Plan and Implementing Agreement.	Active and passive activities vary by site. ORV use by US Border Patrol permitted in Otay Valley. Limited development in non-preserve areas.	Randy Rodriguez (619) 533-4524.

Preserve or Open Space Name	Location in the Watershed	Size (ac.)	Ownership/ Responsible Party	Habitat Types	Management Activities	Target Species	Schedule of Activities	Funding Sources	Permitted Land Uses	Contact
					monitoring activities on natural communities, manage brush management areas, land acquisition and restoration activities.					
Key Components of the City of Chula Vista and the County of San Diego MSCP preserve areas										
Otay Valley Regional Park - this overlaps with the MHPA under the MSCP for the Cities and County and includes the Western Otay Valley Regional Park, described below.	San Diego Bay/Salt Ponds to and Around the Lower and Upper Otay Lakes	Planned to extend 13 miles. Acreage of owned lands and of proposed acquisition lands is currently under evaluation.	Private, City of San Diego, City of Chula Vista, County of San Diego	Riparian, Wetlands, fresh-water ponds, annual grassland, abandoned agriculture.	Public: Decision Making, Land acquisition; Citizens: Exotic Species Removal, Trash Removal, Trail Maintenance.	*Arundo donax*, *Tamarix* sp.	A Draft Habitat Restoration Plan was submitted to the County in December 2004. This plan provides an approach for eradicating several non-native plant species and revegetating with native species with in the OVRP. This plan focuses on the western third of the OVRP (i.e., from its western edge about 0.5 mile west of I-5 eastward to Heritage Road), with an understanding that the rest of the OVRP would be enhanced/restored in the future as logistical considerations are addressed.	Prop 13 Grant	Passive and Active Recreation.	Robert Rushlow at the County of San Diego Public Works (858) 694-2062
Western Otay Valley Regional Park - Natural Resource Preserve		2,030	Public Ownership							
Otay Ranch Preserve	Southwestern portion of the watershed, southwest of the Lower Otay Reservoir	11,375 (Acreage within the Otay Watershed for each jurisdiction is currently under evaluation)	Lands to be transferred to the County and Chula Vista to be included in the MSCP. A portion of this land has already been transferred	CSS, Chap, VP, GL, WRS, FWM, Oak Woodland, Tecate Cypress forest,	PLANNED Exotic species removal, trash removal, trail maintenance, habitat restoration (wetland mitigation bank, riparian and grasslands), education/scientific research.		This property has not been officially transferred to the City of Chula Vista or the County of San Diego.	Private: Mitigation for Otay Ranch Development.		
ACQUIRED PRESERVE AREAS										
BLM										
Otay Mountain Wilderness - BLM's South Coast Resource Management Plan Area (Otay Mtn Area: BLM Parcel #s299-011 & 299-181, 3 additional parcels were indicated for acquisition. According to BLM, parcels have been recently acquired that are not on this map)	Eastern Portion of Watershed	Under evaluation. Data to be obtained from analysis of GIS layer	Bureau of Land Management	Under evaluation. Data to be obtained from analysis of GIS layer	Management prescriptions: not open to oil or mining, acquisition, off-road vehicles are limited to two existing roads (Otay Truck Trail and Minnewawa Truck Trail). Active grazing allotment, presently in a none-use status. Road maintenance is done by Border Patrol, BLM will do some fire suppression, but very restricted. No new utilities, roads, trails. Land use must be compatible with the ESA and the 1964 Wilderness Act. 43cfr 8500 Wilderness Management	Tecate cypress forest, Mexican flannel bush, and other rare plants. Other federally threatened and endangered species under the ESA.	A management plan has not been completed, but is expected sometime in the next 5 years. BLM is a signatory to the MSCP and continues to acquire lands within the boundary. Goal is to purchase lands contiguous to existing lands and/or corridors between.	federal appropriated funds	Limited off-road vehicle use on the two Truck trails and minimal permitted grazing.	Janaye Byergo (858) 451-1767

Preserve or Open Space Name	Location in the Watershed	Size (ac.)	Ownership/ Responsible Party	Habitat Types	Management Activities	Target Species	Schedule of Activities	Funding Sources	Permitted Land Uses	Contact
Jamul Mtn Area: BLM Parcel #s 290-201 & 290-291)	North-central portion of the watershed	Under evaluation. Data to be obtained from analysis of GIS layer.	Bureau of Land Management	Under evaluation. Data to be obtained from analysis of GIS layer.	Parcel 290-201 is a BLM Public Land Parcel. Parcel 290-291 was designated for "Protective Disposal", but because the area is within the MSCP, BLM is going to retain it. Both are within the Otay Grazing Allotment. Lands will be managed for the protection and enhancement of sensitive species habitat and open space values.		A management plan has not been completed, but is expected sometime in the next 5 years. BLM is a signatory to the MSCP and continues to acquire lands within the boundary. Goal is to purchase lands contiguous to existing lands and/or corridors between.	federal appropriated funds		
Dulzura (Grazing Allotment Name) Parcel #300-021		Under evaluation. Data to be obtained from analysis of GIS layer.	Bureau of Land Management	Under evaluation. Data to be obtained from analysis of GIS layer.	BLM Public Land Parcel, Within the Dulzura Grazing Allotment.. Lands will be managed for the protection and enhancement of sensitive species habitat and open space values.		A management plan has not been completed, but is expected sometime in the next 5 years. BLM is a signatory to the MSCP and continues to acquire lands within the boundary. Goal is to purchase lands contiguous to existing lands and/or corridors between.	federal appropriated funds		
Lyons Peak (Grazing Allotment Name) BLM Parcel # 291-091		Under evaluation. Data to be obtained from analysis of GIS layer.	Bureau of Land Management	Under evaluation. Data to be obtained from analysis of GIS layer.	BLM Public Land Parcel. Lands will be managed for the protection and enhancement of sensitive species habitat and open space values.		A management plan has not been completed, but is expected sometime in the next 5 years. BLM is a signatory to the MSCP and continues to acquire lands within the boundary. Goal is to purchase lands contiguous to existing lands and/or corridors between.	federal appropriated funds		
Lawson Peak BLM Parcel #283-351 (this may not be within the Otay Watershed)	Northwestern Corner of the watershed.	Under evaluation. Data to be obtained from analysis of GIS layer.	Bureau of Land Management	Under evaluation. Data to be obtained from analysis of GIS layer.	This property was designated for "Protective Disposal", but because the area is within the MSCP, BLM is going to retain it. According to the Map 2-1 of the South Coast Resource Management Plan (June 1994), the area is "BLM Public Lands (Including Split-Estate Lands). Lands will be managed for the protection and enhancement of sensitive species habitat and open space values.		A management plan has not been completed, but is expected sometime in the next 5 years. BLM is a signatory to the MSCP and continues to acquire lands within the boundary. Goal is to purchase lands contiguous to existing lands and/or corridors between.	federal appropriated funds		
USFWS National Wildlife Refuges										
South San Diego Bay Unit of the San Diego Bay National Wildlife Refuge	Western extent of the watershed, southern portion of San Diego Bay	Proposed Acquisition/ Management Boundary = 3,454 acres.	Out of the 3,454 acres within the Proposed Acquisition/Management Boundary the USFWS owns 90 acres and leases 2,324 acres from the State Lands	Lower Otay River: eastern part of property is poor quality SWS. Mouth of the Otay River experiences tidal influence supporting salt marsh in the channel. Uplands surrounding the entire refuge are ruderal.	1. Completion of a Comprehensive Conservation Plan (CCP) expected to be out for public review in September 2004. This is an EIS consisting of an Alternatives Analysis of	Freshwater, saltmarsh, mudflats, intertidal aquatic: light-footed clapper rail, Western snowy plover, CA least tern, CA brown pelican, and other waterfowl, seabirds, shorebirds, and fish. Salt Works sensitive species: royal term, elegant tern, gull billed tern, foresters tern, caspian tern, black skinner tern.	Annual mowing of ruderal habitat areas. EIS due for public review in September 2004.	Public	Solar Salt Works - the activity has been going on in the watershed for over 100 years. No trails are actively managed by the USFWS; however, a paved bike trail is maintained by the City of SD along their easement for Saturn Blvd (this	Vicky Touchstone (760) 431-9440 ext 349

Preserve or Open Space Name	Location in the Watershed	Size (ac.)	Ownership/ Responsible Party	Habitat Types	Management Activities	Target Species	Schedule of Activities	Funding Sources	Permitted Land Uses	Contact
			Commission. An additional 1,130 acres is privately owned.		restoration proposals. One proposal is to restore the floodplain by removing fill material from approximately 140 acres fallow agriculture fields and use the fill material in the salt ponds area to bring the elevation up to restore cordgrass habitat. 2. On-going invasive species removal for Arundo, Tamarisk, Castor bean and annual mowing of the floodplain (abandoned agriculture = ruderal habitat), trash removal, education/ scientific research.				street is never expected to be constructed). Extensive network of utility lines (sewer, power, phone etc. in the floodplain).	
San Diego Bay National Wildlife Refuge (no longer referred to as the Otay-Sweetwater Unit)	Western extent of watershed, north of Otay Canyon	A total of 46,000 are currently planned (acquisition boundary) and not all of this will be acquired because some is developed, some is in conservatorship, and other areas are too expensive. 70% of the Otay unit occurs within the Otay watershed 8,063 acres that they actively manage.	U.S. Department of Interior, U.S. Fish and Wildlife Service	CSS, Chap	Exotic species removal (activity in 2002 and 2003, Arundo and Tamarisk along Sweetwater River), trash removal and debris removal (old water storage tanks, heavy equipment - ongoing). Currently there are no restoration activities. The USFWS are in the planning process of developing a Comprehensive Conservation Plan (CCP for this and the VP unit). It may take up to two years to complete the process. There is another property that they do not own, but due to a lawsuit the USFWS manages it with the help of an endowment. This is referred to as the TriMark property, an isolated parcel totaling 67 acres near the San Diego Bay National Wildlife Refuge. The TriMark property is within the acquisition boundary.	Least Bell's vireo, California gnatcatcher, Quino checkerspot butterfly, San Diego horned lizard, vernal pools, Otay tarplant. Set up as a T&E spp. Southwest arroyo toad, SWWF, vernal pool flora and fauna	TBD via the CCP for the existing San Diego Bay National Wildlife Refuge. Restoration for Otay tarplant on a 67 acre TirMark parcel is currently on going.	Public	Recreational hiking and bird watching. Some equestrian and mountain biking use, but neither have been determined as a "compatible use". The CCP will determine this and/or how to manage the activities.	Don Brubaker 619-669-7295

Preserve or Open Space Name	Location in the Watershed	Size (ac.)	Ownership/ Responsible Party	Habitat Types	Management Activities	Target Species	Schedule of Activities	Funding Sources	Permitted Land Uses	Contact
San Diego Bay National Wildlife Refuge Vernal Pools Unit	Western extent of watershed, north of Otay Canyon	A total of 46,000 are currently planned (acquisition boundary), 80% of the 2,130-acre vernal pool unit occur within the Otay watershed. According to USFWS there are no owned vernal pool parcels within the Otay Watershed.	U.S. Department of Interior, U.S. Fish and Wildlife Service	CSS, Chap, VP, Grasslands	Exotic species removal, trash removal, vernal pool protection, in the beginning of October a new biologist is starting so restoration activities.	Sensitive vernal pool plants (e.g., Otay mesa mint, San Diego button celery), San Diego and Riverside fairy shrimp	TBD	Public	none	Don Brubaker 619-669-7295
CDFG Lands										
Rancho Jamul Ecological Reserve	Northeastern part of watershed, west of SR-94	Approximately 4,350 (approx. 3,700 original piece purchased from Daily Family. Purchased in 2004 approx. 650 acres of Dulzura Creek. This second parcel extends from Thousands trails around the campground and follows the creek to lower Otay Reservoir.) A third parcel is being purchased in Proctor Valley that will be managed by the USFWS refuge department, but will be apart of this ownership.	CDFG	CSS, small areas of Chap, annual grassland, small areas of freshwater marsh, and riparian. None of the facilities on-site burned in the 2003 fire, but most of the preserve burned including all of the CSS.	Exotic species removal, trash removal, trail maintenance, habitat restoration (wetland mitigation bank (see below), riparian and grasslands), education/scientific research, and fuel modification for fire protection. Preparing a Management Plan that will need to go through the CEQA process. I is expected to be completed in 18 months. It will allow for recreational activities, fuel modification and fire suppression, as well as biological preservation and restoration, and will focus also on maintaining wildlife movement between the two CDFG properties (Rancho Jamul and Hollenbeck Canyon). The property consists of a few warehouses and residences (ranch style home and trailers). One CDFG Warden lives on the property and the facilities are also used to house and maintain San Diego Bay National Wildlife Refuge fire-crew equipment.	California gnatcatcher, least bell's vireo, grasshopper sparrow, Quino checkerspot butterfly, mountain lion, mule deer, Otay tarplant, raptor foraging (large grassland component on original parcel), and wildlife movement.	A detailed Biological Inventory has been completed by USGS in 2003 (TAIC/EDAW should have a copy). This includes a detailed veg map completed by SDSU. This Inventory does not cover the new parcel. A Land Management Plan is in preparation and should be completed in approximately 18 months (end of 2006) by EDAW/TAIC Consultant Team).	Public funding for acquisition. Federal appropriations for management. Two endowment funds from the mitigation bank, the first from Wildlands Inc. leasing the property on a monthly basis and the second from selling mitigation credits which can only be used for maintaining the riparian/wetland areas and only after the bank is closed and all credits have been sold.	Passive recreation such as hiking. Active recreation including equestrian, mountain biking, and a small scale hunting program (upland game including doves, quail, and pheasants, but most of these activities have been moved to Hollenbeck Canyon Wildlife Area)	David Lawhead (858) 467-4211
Rancho Jamul Mitigation Bank	Northeastern part of watershed, east of Otay Lakes Road, west of SR-94 within the CDFG Rancho Jamul Ecological Reserve	110 (included in the 4,350 acre Rancho Jamul Ecological Reserve)	Ownership = CDFG. Managers = Wildlands, Inc.	Freshwater marsh, mulefat scrub, southern willow scrub, southern cottonwood-willow riparian forest, sycamore alluvial woodland, southern coast live oak riparian forest, ephemeral and intermittent	55.12 acres of wetland and riparian restoration implemented along Dulzura and Jamul Creeks in Phase 1; Phase 2 in planning phase. Ongoing monitoring of Least Bell's Vireo population and point counts	Least Bell's Vireo, Yellow Breasted Chat	Annual monitoring until final approval from resource agencies.	Private; Restoration and management funded through wetland and riparian mitigation credit sales; RJMB is a formal agency-approved mitigation bank.	Habitat restoration and conservation	Mark Tucker, Southern California Regional Manager/ Senior Ecologist, office: (619) 497-2506, cell: (619) 929-6855

Preserve or Open Space Name	Location in the Watershed	Size (ac.)	Ownership/ Responsible Party	Habitat Types	Management Activities	Target Species	Schedule of Activities	Funding Sources	Permitted Land Uses	Contact
				stream	to document the development and trends of the riparian bird community, exotic plant control and eradication program (primarily Arundo, Tamarisk, and Ailanthus), and cow bird trapping as-needed; 8.9 acres of phase 1 Dulzura Creek restoration replanted in Fall 2004.					
Hollenbeck Canyon Wildlife Area	Northeastern part of watershed, east of SR-94	5500 (including 2,000 acres of new acquisition called Honey Springs Ranch). A third parcel equaling approximately 500 acres, currently owned by the County, will likely be swapped to CDFG to be added the Hollenbeck Canyon Wildlife Area. This third parcel is in Dulzura Canyon and it is adjacent to the BLM Otay Wilderness Area. None of the three parcels were burnt in the fire, October 2003.	CDFG	Riparian woodlands, CSS, annual grassland (some abandoned agriculture fields)	Exotic species removal, trash removal, trail maintenance, habitat restoration (grasslands), education/scientific research. A biological Inventory was completed for the original 3,200 acres (the first acquisition), but report is not quite completed. A new veg map will be prepared for the new Honey Springs Ranch parcel. The Land Management Plan is not expected to allow for expanding hunting areas, but active growing of food crops to bring in hunting opportunities in the existing area may occur. The Land Management Plan will focus on maintaining raptor foraging and breeding sites and wildlife movement between Hollenbeck and Rancho Jamul Reserves.	California gnatcatcher, grasshopper sparrow, raptors, mountain lion, mule deer, quino checkerspot butterfly, Englemann Oaks, SD thorn mint.	Currently preparing a Land Management Plan scheduled to be completed in the next 18 months, December 2006. Scheduling supplemental surveys for the new Honey Springs Ranch Parcel, primarily on rare plants. The Land Management Plan for Hollenbeck Canyon will differ Slightly from the Rancho Jamul Land Management Plan even though the two CDFG areas are continuous. This is because different activities are allowed under "wildlife areas" vs. "ecological reserves".	Public	Passive and active recreation, equestrian, mountain biking on trails, hunting (wildlife area that allows upland game hunting of quail and dove primarily/ active irrigation for Doves to attract hunters), a small area for training hunting dogs, fallow ag fields are mowed in strips in late summer to make more attractive for doves. Trails will be mapped in the management plan. The huney property has homes and things that need to be determined what to do with, many may need to be torn down.	David Lawhead (858) 467-4211
Otay Mountain Ecological Reserve	North-facing slopes draining towards Otay Reservoir - surrounded by BLM land	Teri Stewart to get acreage - approximately 480 acres purchased in 1995 or 1996, but just purchased another approximately 500 acres	CDFG	CSS, burned repeatedly - 1996, 2003, tecate cypress forest, chamise chaparral	Not a lot of work, some biological monitoring, attempt to do some veg transects to monitor CSS recovery, mountain lion there, dudley varagata	California gnatcatcher - trying to get them back - they have an old veg map done for the previous owner	Environmental management plan, but because human activity is minimal the management plan is not on the horizon		Access is limited because you have to go through the city of SD property and through a locked gate - activity is mostly illegal migrants or border patrol, one main dirt road - in theory it could be hunted, but it was purchased for its overall conservation value	Markus Spiegelberg Center for Natural Lands Mgmt. (619) 295-4953

Preserve or Open Space Name	Location in the Watershed	Size (ac.)	Ownership/ Responsible Party	Habitat Types	Management Activities	Target Species	Schedule of Activities	Funding Sources	Permitted Land Uses	Contact
US Forest Service										
Cleveland National Forest	USFS land is located in two areas on the northeast section of the watershed. The first site is Lyons Peak is a small inholding adjacent to BLM and Private lands. The second area is located near Barber Mtn.	Lyons Peak (40 acre) site is currently used for communications and contains several private communication links (issued Special Use Permits from the USFS). The Barber Mtn. Site is a small section of the Cleveland Forest that is extends into the watershed.	USFS, and Private Communication firms operating under SUP.	Lyons Peak: Chaparral, CSS, riparian areas, paved and developed for communication.	Unknown for Lyons Peak (Area fenced and utilized as communication site). Forest working on Fuel Management Plans, fuel reduction, tree thinning, trash removal. USFS working on BE/BA for fuel breaks surrounding private homes adjacent to forest lands. Minimal activities in this area.	California Gnatcatcher, mule deer, quino checkerspot, Moreno current, Monardella, Gander's ragwort.	Lyons Peak: Use of site for communications towers. Future road upgrade for Barber Mountain for fire suppression activities.	Federal	Lyons Peak fenced due to communication towers. Hiking occurs in surrounding habitat. Barber Mountain activities: Hiking, hunting, limited access in watershed.	Information from USFS Ranger Russ Lajoie and Kirsten Winter (619) 445-6235.
ACQUIRED PRESERVES AND MITIGATION SITES										
Environmental Trust (TET)										
Newport 5 Preserve	West Otay Mesa area. APN 631-041-10	4.81 acres	Environmental Trust (TET) – Filed Bankruptcy on March 23, 2005 and is looking for a new land manager. The property may be left to the State.	Diegan CSS, Maritime succulent scrub	Monitoring conducted ca. four times per year. Trash removal, sensitive bird surveys, exotic species removal, and yearly report submitted to City on management activities.	California Gnatcatcher	As a result of funding shortfalls, TET has been unable to visit the site since November 2003 and is unable to manage the property at this time.	Endowment from mitigation purchase. Current funding inadequate to protect and monitor resources.	Access restricted to management activities. Area fenced.	TET. Leslie Beck (619) 461-8333
Robinhood Ridge	Located on southern Mesa above Otay River Valley near Coors amphitheater APN 645-020-15	63.5 acres	Environmental Trust (TET) – Filed Bankruptcy on March 23, 2005 and is looking for a new land manager. The property may be left to the State	CSS, NNG, Open water, tamarisk scrub, disturbed habitat.	Some initial restoration from sewer line easement. Monitoring conducted ca. four times per year. Trash removal, sensitive bird surveys, exotic species removal, and yearly report submitted to City on management activities.	California gnatcatcher, San Diego jackrabbit, SD barrel cactus, SD County needle grass, Otay tarplant.	As a result of funding shortfalls, TET has been unable to visit the site since November 2003 and is unable to manage the property at this time.	Endowment from mitigation purchase. Current funding inadequate to protect and monitor resources.	Access restricted to management activities. Area fenced to stop OHV use.	TET. Leslie Beck (619) 461-8333
Upham Vernal Pools	Located adjacent to lower Otay County Park. APN 644-100-05	24.8 acres (3.86 acres managed by TET for Vernal Pools)	Chester Upham but managed by Environmental Trust (TET) – Filed Bankruptcy on March 23, 2005 and is looking for a new land manager. The property may be left to the State	Vernal Pools (J26 Series)	3.86 acres conserved as preserve. Area managed under Otay Vernal Pool Management Plan, TET, and CDFG. TET removes trash, monitor for trespass, exotic removal, fence maintenance, conduct yearly species surveys and report writing.	Otay Mesa mint, San Diego button-celery, prostrate navarretia, little mousetail, San Diego goldenstar, San Diego barrel cactus, variegated dudleya ,Otay tarplant, and a possible San Diego fairy shrimp (Branchinecta sandiegonensis) population. Also coastal sage scrub with coastal California gnatcatchers.	As a result of funding shortfalls, TET has been unable to visit the site since November 2003 and is unable to manage the property at this time.	Endowment from mitigation purchase. Current funding inadequate to protect and monitor resources.	Access restricted to management activities. Area fenced. Area opened to scientific research.	TET. Leslie Beck (619) 461-8333
O'Neal Canyon Preserve	Consists of several parcels most within the O'Neal Canyon	Several individual parcels total 562 acres. 400 TET easements and 162 TET owned.	Parcels with TET easements are owned by Rocque de la Fuente's various business entities These include: International Industrial Park Inc., KYDDLF & RDLFG FT NO 1 LLC and Rancho Vista del Mar. TET manages these parcels, but they	Diegan coastal sage scrub, maritime succulent scrub, southern willow riparian scrub, California native grassland, Engelmann oak woodland, Tecate cypress woodland (interior closed-cone coniferous forest), southern mixed chaparral, chamise chaparral, cismontane alkali wetlands, and freshwater marsh.	A number of management plans have been submitted and direct TET activities which are: maintenance visits for trespass control, removal of exotic species, and trash removal; monitoring visits for a spring bird survey and bird species diversity, vegetative cover and photo documentation; submission	Coastal California gnatcatcher, San Diego black-tailed jackrabbit, Bell's sage sparrow, San Diego barrel cactus, Dunn's Mariposa lily, San Diego goldenstar, variegated dudleya, Engelmann oak, Nuttal's oak, Gander's pitcher sage, Mexican flannelbush, Tecate cypress, narrow-leaved nightshade, San Miguel savory, Otay manzanita, Munz's sage, and ashy spike-moss. Quino Checkerspot butterfly has been sighted at different locations in	As a result of funding shortfalls, TET has been unable to visit the site since November 2003 and is unable to manage the property at this time. The easternmost areas of this preserve were burned in the October 2003 fire.	Endowment from mitigation purchase for each property. Current funding inadequate to protect and monitor resources.	Limited access. Easements state that preservation is for protection of open space with only scientific and limited educational or recreational uses.	TET. Leslie Beck (619) 461-8333

Preserve or Open Space Name	Location in the Watershed	Size (ac.)	Ownership/ Responsible Party	Habitat Types	Management Activities	Target Species	Schedule of Activities	Funding Sources	Permitted Land Uses	Contact
			filed bankruptcy on March 23, 2005 and is looking for a new land manager. The property may be left to the State		of an annual report.	O'Neal Canyon but TET does not have formal survey reports.				
Environmental Trust Lands managed by Center for Natural Lands Management	Same as Env. Trust.	Same as Env. Trust.	Center for Natural Lands Management.	Same as Env. Trust.	Complete biological inventory of all species present, GIS vegetation mapping, exotic species removal, monitoring of sensitive species, habitat evaluation, long term ecosystem monitoring.	Same as Env. Trust.	Center for Natural Lands Management would develop additional Natural Resource Monitoring Plans if the land was acquired.	Mitigation funding.	Passive recreation such as hiking, birding and botanizing. Possible mountain biking in select areas of large reserves if biological conditions warrant such activities.	
Miscellaneous Preserve and Mitigation Lands										
Johnson Canyon (SR-125)	Southwestern portion of the watershed, on mesa south of Otay Valley	150	Currently owned by Caltrans and California Transportation Ventures (mitigation property for SR-125); ownership to be transferred to the City of Chula Vista to be included in the MSCP preserve boundary	CSS, Chap, VP, GL, WRS, FWM	Exotic species removal, trash removal, habitat restoration (vernal pools and Quino checkerspot butterfly).	Quino checkerspot butterfly, California gnatcatcher, cactus wren, fairy shrimp, San Diego button celery, Otay mesa mint, spreading navarretia	Annually in perpetuity	Private and Public: Mitigation for State Route 125	Habitat Conservation	Information primarily from site biologist, David Lawhead (858) 467-4211.
Dennery VP Reserve	Southwestern portion of the watershed, southwest of the Lower Otay Reservoir, north of Otay Mesa Road	45	City of San Diego	CSS, VP, Chap	Exotic species removal, trash removal, habitat restoration (vernal pools).	Cactus wren, California gnatcatcher, Otay tarplant, vernal pool plants, San Diego and Riverside fairy shrimp; wildlife movement	Annually in perpetuity	Private and Public (NCCP funds): Mitigation for Pardee development	Habitat Conservation	

CSS = Coastal sage scrub
VP = Vernal pool
FWM = Freshwater marsh
Chap = Chaparral
WRS = Willow riparian scrub
GL = Grassland

- Meets the biological goals and provides preserve access for emergency services, border patrol, and other public safety needs;
- Provides for the development of future infrastructure across and adjacent to preserved lands;
- Allows for the permitted extraction of sand and gravel resources with appropriate mitigation; and
- Encourages mitigation within identified areas, thereby keeping lands outside of the preserves for future development.

The County Subarea is divided into three segments, the Lake Hodges Segment, the Metro-Lakeside-Jamul Segment, and the South County Segment. The majority of the Otay River watershed planning area is covered by the South County and the Metro-Lakeside-Jamul Segments of the County MSCP Subarea Plan. The County MSCP Subarea Plan estimates that approximately 101,268 acres of habitat (55 percent), including 4,142 acres of wetland habitat (58 percent) will be conserved within the County. The County Subarea Plan preserve areas include 55,071 acres of upland and 1,118 acres of wetland habitats in the Otay River watershed. This estimated preserve acreage includes approximately 75 percent of the area within the County of San Diego Pre-Approved Mitigation Area, located in the northeastern corner of the Otay River watershed (Figure B.6-9). Under the Biological Mitigation Ordinance, a mitigation ratio for impacts that occur within this area has been pre-negotiated with the regulatory agencies. This is an incentive-based system that gives property owners "credit" for avoidance and high mitigation requirements for impacts.

Many of the County's land holdings are within the OVRP. The County is currently preparing a habitat restoration and exotic/non-native plant removal plan for the OVRP (County of San Diego Department of Parks and Recreation, 2005) (see Section B.6.4.2 for a description of the existing OVRP Concept Plan, the WORVP NRMP, and the OVRP Trail Guidelines).

City of Chula Vista MSCP Subarea Plan

The City of Chula Vista is located in the southwestern portion of the County of San Diego and includes 33,045 acres within its incorporated boundaries Figure B.6-10. Chula Vista is a growing municipality, with much of the new development occurring in the eastern portion of the City. Recent annexations have expanded the City boundary to the east and northeast, and the adopted General Plan for Chula Vista extends beyond the current jurisdictional boundaries, particularly to the east. There are approximately 8,386 acres of natural habitats in the Chula Vista MSCP Subarea Plan study area including 1,080 acres of wetland habitats. The Chula Vista MSCP Subarea Plan estimates that approximately 4,557 acres of natural habitat in the Subarea (54 percent) will be preserved in perpetuity including 1,005 acres of wetlands (93 percent), although the policy for no net loss of wetlands will result in 100 percent conservation of wetland functions and values. The Chula Vista MSCP Subarea Plan preserve areas include 5,259 acres of upland and 816 acres of wetland habitats in the Otay River watershed. These acreages will continue to change in the immediate future due to the transfer of lands from the Otay Ranch development and other acquisitions.

The City of Chula Vista's Subarea Plan utilizes its Wetlands Protection Program (Section 5.2.4) and existing federal and California law and regulatory programs to regulate uses within aquatic resources. The federal Clean Water Act, the California Porter-Cologne Water Quality Control Act, and the California Fish and Game Code provide protection to wetland habitats and species through federal and State regulatory permitting and agreements. Where applicable, project proponents must submit an application for, and receive federal Section 404 and State Section 1600 et seq. permits prior to impacting most wetlands. These proponents must also apply to the RWQCB for a Section 401 Water Quality Certification prior to any discharges, including discharges from land that may affect any waters

of the State. Additional WDRs may be imposed on specific projects by the RWCQB; these requirements implement Basin Plans that designate beneficial uses and water quality criteria for water-bodies, including wetlands.

Projects that are regulated by federal agencies will continue to be subject to Section 7 Consultations under the federal ESA. Those projects that are subject to a Section 7 Consultation will be evaluated to ensure that the project is consistent with this Subarea Plan and wetlands mitigation program. The level of conservation afforded by the provisions of this Subarea Plan to Covered Species has been established through extensive consultation with, and review by, the Wildlife Agencies. Therefore, projects undergoing Section 7 Consultations that are consistent with the provisions of this Subarea Plan are expected to receive Take Authorization for Covered Species through the Take Authorization permit issued to the City.

The City of Chula Vista is not currently actively managing preserve lands within their jurisdiction. Rather, lands dedicated within Salt Creek, for example, are managed by the POM for the City of Chula Vista and the County of San Diego. Pending IODs will also be dedicated to the POM.

City of San Diego MSCP Subarea Plan

The City of San Diego Subarea encompasses 206,124 acres within the MSCP Subregional Plan study area. The Subarea is characterized by urban land uses with approximately three-quarters either built out or retained as open space/park system. The 1997 population within the subarea was approximately 1.3 million. The City of San Diego MHPA represents a "hard line" preserve, in which boundaries have been specifically determined. It is considered an urban preserve, which is constrained by existing or approved development, and is comprised of linkages connecting several large areas of habitat.

The MHPA contains approximately 56,831 acres of upland and wetland habitats and includes approximately 47,910 acres within City jurisdiction, and additional City-owned lands (8,921 acres) in the unincorporated areas around San Vicente Reservoir, Otay Lakes, and Marron Valley. Approximately 52,012 acres (61 percent) of undeveloped land, including 10,620 acres of wetland habitats, is conserved under the City of San Diego MSCP. The City's plan preserve areas include 3,309 acres of upland and 1,300 acres of wetland habitats in the Otay River watershed.

Habitat loss or "take" within the MHPA will be avoided or minimized to less than 25 percent on parcels within the MHPA (most MHPA areas allow significantly less take [e.g., 5 to 20 percent]). Take of habitat for covered species outside of the MHPA will not be restricted by the City's MSCP Subarea Plan except as necessary for narrow endemic species. The estimate of take assumes that wetland impacts inside and outside the MHPA will be avoided or mitigated under federal and State regulations to achieve a "no-net-loss of function and value." This estimate of loss of upland habitats represents a worst-case analysis; actual loss outside the MHPA may be lower due to avoidance of habitat impacts on steep slopes.

The City of San Diego currently owns preserve lands surrounding the Otay Reservoirs (owned and managed by the City of San Diego Water Department) and within the lower Otay River valley, the latter of which are managed under the OVRP. Figure B.3-2 shows the City's ownership as of 2003 and Figure B.3.17 shows the existing boundary of the proposed park ownership and management area. The following section provides details regarding the existing OVRP Concept Plan, the WOVRP NRMP, and the OVRP Trail Guidelines.

The Otay Reservoirs are included within the City of San Diego's MSCP "Cornerstone Lands." These "Cornerstone Lands" total 10,400 acres and are considered essential building blocks for creating a viable habitat preserve system. The Cornerstone Lands have been largely maintained by the City of San

Diego Water Department in an undisturbed natural condition to serve as watershed for Lake Hodges, San Vicente, and Otay Reservoirs. Conservation of City of San Diego lands around Otay Reservoirs will form the cornerstone lands for a natural open space corridor in the South Bay area. The Otay Reservoir component of the Cornerstone Lands comprises 1,800 acres.

Under the City's MSCP, the following are normal activities within reservoir watersheds consistent with the MSCP Specific Management Policies and Directives for Cornerstone Lands:

1. Patrolling for debris and dump sites with removal to landfills or on site disposal/storage.
2. Patrolling for pollution/nuisance type activities and for public protection.
3. Brush management for fire protection of Water Department facilities, private property, road, trail and parking lot maintenance.
4. Water quality sampling and analyses for surface and well water.
5. Maintenance of weather monitoring stations.
6. Access for watershed surveys, management and monitoring.
7. Field reviews for construction plan checks of other agencies and developers on properties adjacent to City property.
8. Maintenance around reservoir keepers' residences, water wells and waste disposal facilities.
9. Maintenance of leach fields servicing water treatment plants, public parks and recreational facilities.
10. Maintenance of public pedestrian access, hiking, and bicycling paths, horse trails, fishing, and hunting as permitted by the City.
11. Maintenance and operation of groundwater recharge, extraction, and conveyance facilities.
12. Maintenance and operation of flood control and surface water conservation facilities.
13. Maintenance and monitoring of siltation and erosion control facilities, water quality control basins, diversion ditches and other facilities.
14. Operation and maintenance of existing water and sewer pipeline and pump station facilities across reservoir properties.
15. Maintenance of utility access roads.
16. Access for land management of easements and leases of Water Department owned properties.
17. Vegetation control immediately around dams for dam safety.

The City's MSCP also provides land development policies in the Land Use Consideration (Section 1.4) that also implement watershed planning principles, including Compatible Land Uses (Section 1.4.1), Planning Policies and Design Guidelines (Section 1.4.2), and MHPA Land Use Adjacency Guidelines (Section 1.4.3).

B.6.4.2 OVRP

OVRPCP and On-going Activities

The OVRPCP forms the basis for future creation of the OVRP. It was developed as a result of a Joint Exercise of Powers Agreement for coordinated planning, acquisition, and design entered into by the County of San Diego and the cities of San Diego and Chula Vista in 1990, and was approved by those three entities and the 30-member Citizens Advisory Committee (CAC) in June 1997. The OVRP is planned to extend approximately 11 miles from the southeastern edge of the salt ponds at the edge of

San Diego Bay (approximately 0.5 mile west of I-5) through the Otay River Valley to land surrounding the Lower and Upper Otay Reservoirs (Figure B.3-17). It is intended to fulfill the following needs: provide a mix of active and passive recreational opportunities; protect environmentally sensitive areas; protect cultural and scenic resources; and encourage compatible agricultural uses within the Park.

Much of the land within the identified boundaries of the OVRP is currently under private ownership. The Concept Plan, therefore, provides policy direction to the jurisdictions for coordinated land acquisition and development for the Regional Park within the framework of private property rights. It does not preclude private development; does not change existing zoning, land use plans, or add new development regulations; and does not call for specific types of recreational development or give detailed design plans for specific areas. The planning boundary is intended to outline and generally identify areas that are needed to protect sensitive resources or areas that would be suitable for recreational use. The major areas identified within the boundary include open space/core preserve area, recreation area, trail corridor, staging area, viewpoint and overlook area, interpretive center, and park study area.

Most of the floodway and floodplain of the Otay River Valley, along with most slopes over 25 percent, are within the Open Space/Core Preserve Area, which is contiguous with the MHPA boundary identified by the MSCP. Therefore, the Concept Plan identified only appropriate recreational access points and recommended coordinating the Park's development with adjacent land uses to ensure compatible development, appropriate buffering and establishment of linkages with other regional resources. It also encourages development standards for new roads across the Otay River to minimize impacts to habitat and wildlife movement. It acknowledges that development of Park features and facilities must be consistent with the MSCP, the Otay Ranch Resource Management Plan, and all applicable federal, State, and local policies. It also states that open space management practices should be coordinated with those of adjacent open space areas.

The County of San Diego, in cooperation with the City of San Diego and the City of Chula Vista have been developing a Restoration Plan for the Otay River Valley. As noted in Section B.3.3, the Draft Otay Valley Regional Park Habitat Restoration Plan (December 2004) provides a framework for eradicating numerous exotic plant species within the OVRP and revegetation with native wetland and upland species. These enhancement activities would complement the various restoration and trail maintenance activities within the OVRP coordinated by the CAC, including trash clean-up days focused on removing household, commercial, and industrial debris from the River; encouraging homeless living in unsanitary encampments to leave the area to protect sensitive habitat and create a safe environment for trail users; installing fencing and signs along trails, sidewalks and streets; and removing invasive weeds around the trails, overlook facilities and staging areas. The CAC has also been active in revegetation efforts, water quality monitoring, and mapping storm outfalls. These activities are planned to be the cornerstone of the Restoration Plan currently under development.

WOVRP NRMP

The purpose of the WOVRP NRMP, anticipated to be adopted by the Cities of San Diego and Chula Vista in 2006, is to provide guidance for the present and future development and maintenance of the portion of the OVRP west of Heritage Road (Heritage Road is shown as a red line in Figure B.3-17) (City of San Diego, 2002a). The WOVRP comprises approximately 2,030 acres of land along the Otay River. The guidelines of the NRMP are applicable to areas within the OVRP west of Heritage Road that are in public ownership at any given time. They include guidelines related to maintenance, usage and development; impact mitigation, restoration and enhancement; and interpretive and research opportunities.

One of the key objectives within the WOVRP is to provide for the maintenance and preservation of these resources. Enhancement and restoration opportunities also are identified, with removal of giant reed and tamarisk being assigned the highest priority. Mitigation options for impacts to habitat resulting from necessary construction or maintenance activities include creation of new habitat, restoration of degraded habitat, and/or enhancement of existing disturbed or degraded habitat, at a ratio to ensure no net loss of habitat value. The NRMP seeks to minimize the indirect impacts of development adjacent to the Park, including limiting water quality and erosion impacts from new development. The NRMP also recognizes the need for certain recreational activities, consistent with the protection of important resources. As noted in Section B.3.3., it is expected that the Draft Habitat Restoration Plan will be included as an appendix to this document.

OVRP Trail Guidelines

The OVRP Trail Guidelines, finalized in 2003 by the County of San Diego, City of Chula Vista, City of San Diego, and the OVRP Citizens Advisory Committee, establishes guidelines for development of a multi-use trail system from the San Diego Bay, along the Otay River (both sides), and around the perimeter of Otay Lakes Reservoirs that will: (1) provide connections to existing and proposed park and recreation facilities; (2) create links to adjacent trail systems; and (3) avoid adverse effects to environmentally and culturally sensitive areas (Figure B.3.17). This document is intended to help realize the goal of the 2001 OVRP Concept Plan to develop a continuous trail that highlights a wide variety of recreational (passive and active) and interpretive/educational experiences while protecting natural and cultural resources. This trail system is intended to be an integral part of a larger regional trail network for connection with the City of Chula Vista Greenbelt, Sweetwater River Park, Jamul/Dulzura Trail system, Eastlake community Trails, and Otay Ranch Neighborhood Trails. This document provides guidelines for development, management, and maintenance of the OVRP trail system, as applied to the five segments of the OVRP: (1) South San Diego Bay to I-5; (2) I-5 to I-805; (3) I-805 to Heritage Road; (4) Heritage Road to Lower Otay Lakes Reservoir; and (5) Otay Lake Reservoirs Vicinity. However, a trails alignment has only been prepared for the I-5 to I-805 segment, because it is the only one in which the majority of the land is publicly owned; the phasing of the other four segments has no specific timeline.

The plan also attempts to implement regional trails and their associated features and facilities above the 100-year floodway where appropriate. The latter would tend to minimize impacts to aquatic resources while also reducing the probability of facilities washout. This document also identifies potential funding sources for implementing activities.

As described above, the CAC is actively maintaining existing trails, helping to build new trails, and has been aiding the County and their consultants in developing the Draft Restoration Plan for the OVRP.

B.6.4.3 Otay Ranch RMP

The Otay Ranch consists of three distinct parcels (Otay Valley, Proctor Valley and San Ysidro) within the Otay River watershed, totaling 22,899 acres (Figure B.3-6). The Otay Ranch RMP is a comprehensive planning document that addresses the preservation, enhancement, and management of sensitive natural and cultural resources within a conservation area (Preserve) to be established on these parcels. The three key elements of the plan are (1) resource protection and management; (2) research; and (3) public education and appreciation. Phase 1 of the Otay Ranch RMP establishes a framework, while Phase 2 translates policies into specific action programs. The Phase 1 document was adopted by the County of San Diego Board of Supervisors and City of Chula Vista City Council on October 28, 1993, concurrent with enactment of the Otay Ranch GDP (Section 3.6); Phase 2 was completed on June

4, 1996. The open space system originally envisioned consisted of 11,375 acres of Preserve, in addition to "restricted development" areas and parks. Through negotiations and acquisitions of land for open space that were slated for development, the total amount of open space to be preserved now exceeds 12,500 acres.

The key objectives of the Otay Ranch RMP include protection, restoration, enhancement and management of sensitive resources. Furthermore, the RMP establishes a standard of no net loss of in-kind wetland quality or quantity. It requires that at least 90 percent of identified wetlands be included within the Preserve, and specifies minimum conservation percentages and buffer distances for certain habitat types. The entire 3,000-acre Otay Valley on Otay Ranch is included in the Preserve, with the only potential development consisting of up to 400 acres of active recreational use that could be included in the OVRP. Moreover, the RMP calls for restoration of wetland and riparian habitat to be concentrated in the Otay River Valley. To protect the Preserve, the Preserve Owner/Manager is authorized to prohibit uses within the Preserve that have a negative effect on sensitive resources and to review and comment on proposed uses on Otay Ranch adjacent to the Preserve. The RMP recognizes the importance of providing appropriate recreational access. the RMP is concerned with appropriate drainage design to provide for both adequate flood protection and sensitivity to biological resources.

The Otay Ranch RMP recognizes the importance of coordinating with other applicable parties, including the resource agencies, the applicable local jurisdictions, and the managing entity of OVRP. Specifically, the Phase 2 RMP includes a requirement that preservation and restoration activities must be consistent with the guidelines of any applicable regional open space/resource protection program.

The Otay Ranch RMP identifies a number of uses within that could be implemented in the preserve area, including demonstration agricultural activities, a nature interpretive center (potentially including a native plant nursery and/or botanic garden), up to 400 acres of active recreational use, a trail system, and infrastructure. These activities could result in varying degrees of direct and indirect impacts (e.g., noise, water quality, introduction of non-native species) to the Preserve. In addition to the potential to adversely affect existing resources, such impacts could limit the restoration potential of the Otay River. However, because conservation of resources is one of the primary aims of the RMP, it does include a number of measures to minimize the potential impacts of these uses, including locating several of the uses in previously disturbed areas, minimizing the amount of interface between uses and the RMP Preserve, limiting use (e.g., establishing limits on the number of trail users, limiting bicycle and equestrian access to certain trails), and providing for review by the Preserve Owner/Manager.

At present, land within Salt Creek and a portion of the Otay Ranch has been conveyed to the POM (Table B.6-4). A short-term management plan is in place, and a long-term management plan is in preparation.

B.6.4.4 San Diego Integrated Natural Resources Management Plan

The U.S. Navy and the San Diego Port District sponsored the preparation of the San Diego Integrated Natural Resources Management Plan (INRMP) (September 2000), also known as the Bay Ecosystem Plan. This plan's goal is to ensure the long-term health, recovery, and protection of San Diego Bay's ecosystem, in concert with the Bay's economic, Naval, recreational, navigational, and fisheries needs. While it is specific to San Diego Bay, it recommends Watershed Management Strategies for the Otay watershed, Sweetwater watershed, and several smaller watershed basins affecting the Bay (Figure B.3-5). The plan was developed with an understanding that the conditions of the watersheds contributing to the San Diego Bay also affect the health of the Bay itself. This "big-picture" approach replaces the traditional piece-meal or jurisdictional approach to managing the Bay's resources, which had long frustrated the sponsors and the regulators. Toward this systemic vision, it establishes baseline

conditions for the identification of sound management strategies in the Bay and portions of the contributing watersheds (the portions of the watersheds directly linked to the Bay's resources). It also facilitates a more comprehensive understanding of the cumulative effects resulting from specific actions. The more than 1,000 strategies identified are intended to better manage the Bay's resources and to realize the vision of a wilder Bay, with softer shorelines, and richer and more abundant native life.

The San Diego INRMP dispenses with political boundaries and focuses on the broader ecosystem (i.e., the San Diego Bay and, at a conceptual level, the watersheds contributing to it). Furthermore, it encourages a multi-use approach, balancing the Bay's natural resources with economical and recreational needs. Similar to the ORMWP's stakeholder-driven process (Working Group, Policy Committee, etc.), this plan seeks to establish a stakeholders' committee (Technical Oversight Committee) and focus subcommittees for ecosystem-based problem solving. Furthermore, the plan strives for coordination with other efforts, as well as conducting research and monitoring to support decision-making. It also recommends protecting and restoring ecosystem processes and several habitat types, such as eelgrass, intertidal flats, salt marsh, salt pond (the salt pond at the south end of San Diego Bay), and stream/river mouths for better corridor connectivity. Sensitive species support is recognized as an important function of the Bay. It recommends minimizing shoreline stabilization (74 percent of the shoreline is armored) and enhancement of existing stabilization to benefit fish and wildlife. To further these objectives, this plan calls for the preparation of a comprehensive Shoreline Stabilization and Restoration Plan. In addition, the San Diego INRMP recommends providing information to businesses and residents on "bayscaping," such as establishing native vegetation management corridors or buffer areas along the shoreline to enhance habitat values, conserve water, prevent pollution, and control exotic species infestation. For the Otay River watershed, there is a recommendation to enhance the interconnections between the South Bay salt ponds and the nearby salt marsh and mud flat habitats. The wetlands in the lower Otay River are also recommended enhancement areas. Moreover, there is a recommendation to restore the ecological functioning of the Otay River's 100-year floodplain (levee removal, etc.) and salt ponds within the USFWS San Diego Bay NWR. A description of the refuge activities are described in Section B.6.4.6.

B.6.4.5 Bureau of Land Management SCRMP

The BLM SCRMP, approved in May 1994, documents where and how the BLM plans to administer approximately 296,000 acres of public lands under its jurisdiction in the five-county South Coast Planning Area. The San Diego County Management Area encompasses approximately 65,000 acres of BLM land and an additional 74,000 acres where the BLM holds mineral rights, including lands in the vicinity of Otay Mountain (Figure B.3-7). The stated purpose of the RMP is "to provide overall direction for managing and allocating BLM public land resources and uses in the South Coast Planning Area over the next 15 years." Through this direction, the RMP provides a framework to maximize both resource values and multiple uses of BLM public lands.

The South Coast RMP attempts to strike a balance between the protection of sensitive resources and open space values with other potential uses (in the case of the RMP, recreation, grazing, and mineral development). In 1991, the BLM and other agencies signed a memorandum of understanding intended to promote interagency cooperation in development of plans to preserve biological resources. As a result, the BLM has been, and is anticipated to continue to be, an active participant in multi-agency planning initiatives for protecting natural diversity while promoting sound economic development. In the "Border Mountains" area, south of Interstate 8, a major objective is to consolidate public land ownership and improve management by using natural corridors, such as canyons, to connect the BLM parcels in the area, and by acquiring privately held in-holdings. The RMP also recognizes the importance of providing opportunities for low-impact recreation.

It has been determined that the BLM owns and manages five land areas, each comprised of one or more parcels within the Otay River watershed. The largest is shown on Figure B.3-7. The remaining four lands are described in Table B.6-4 and are primarily "grazing allotments" or other lands within the MSCP Planning area. BLM is managing these lands with an emphasis on the protection and enhancement of sensitive species habitat and open space values. All BLM lands south of Interstate 8 are managed as the Border Mountains Special Recreation Management Area, which provides opportunities for hiking, backpacking, equestrian use, camping, picnicking, nature study, and specific permitted hunting. Presently, motorized vehicle use is permitted, but is limited to existing routes, which includes the two truck trails crossing Otay Mountain. The BLM also administers several grazing allotments within the MHPA, not all being in active status. As part of fulfilling their MSCP obligation, BLM has acquired over 4,000 acres of private in-holdings within the MHPA to promote habitat conservation. BLM has initiated a Resource Management Plan Amendment which will address management of these acquired lands.

B.6.4.6 San Diego NWR Complex

San Diego Bay NWR, South San Diego Bay Unit: Land Protection Plan and Comprehensive Conservation Plan

The South San Diego Bay Unit for the San Diego Bay NWR is located at the south end of San Diego Bay and includes portions of the open bay, salt evaporation ponds, and the portion of the Otay River and associated floodplain west of Interstate 5. Of the 3,940-acre acquisition boundary, the USFWS currently has management authority over approximately 2,300 acres (Figure B.3-8 and Table B.6-4). The LPP, approved in January 1999, established the acquisition boundary and outlined the various habitat protection methods to be used by the USFWS, including leases and cooperative agreements, conservation easements and fee title acquisition from willing sellers. Designation of the acquisition boundary does not result in regulatory or environmental compliance requirements on unacquired lands within or near the boundary.

The USFWS initiated preparation of a CCP for the San Diego Bay NWR in 2000 and submitted the Draft CCP/EIS for public review in July 2005. A Final CCP/EIS is expected to be completed in early 2006. The CCP is intended to provide a management plan for the conservation of fish, wildlife, and plant resources and their related habitats, while also providing opportunities for compatible wildlife dependent recreational uses (Victoria Touchstone, pers. comm.). The CCP will guide refuge management for a period of 15 years. As part of the CCP process, wildlife dependent recreational uses, including fishing, hunting, wildlife observation and interpretation, and environmental education and interpretation, were evaluated to determine if they are compatible with the purposes for which the NWR was established and are consistent with public safety. In addition, the CCP evaluated several management alternatives, which varied in the level of wildlife and habitat management (including restoration) to be implemented.

Some of the goals of the CCP include protecting, managing, enhancing, and restoring native habitats; supporting the recovery and protection efforts for listed and sensitive species; and providing high quality foraging, resting, and breeding habitat for a variety of migratory bird species. Two of the four alternatives being analyzed in the CCP (including the alternative identified as the preferred alternative in the Draft CCP/EIS) involve restoration of 140 acres of fallow agricultural fields within the Otay River floodplain to intertidal salt marsh, freshwater wetlands, and upland habitat. Such restoration could not, however, be used as mitigation for impacts associated with any other projects. Another goal of the CCP is to provide opportunities for compatible wildlife-dependent recreation and interpretation that foster public appreciation of the unique natural and cultural heritage of South San Diego Bay. A

public trail is being considered in the vicinity of the Otay River floodplain to provide a connection between trails in the OVRP and the Bayshore Bikeway.

In addition to the detailed restoration planning efforts on-going, the San Diego Bay NWR conducts annual mowing of ruderal habitat within abandoned agricultural fields located in the Otay River floodplain and has conducted some invasive species removal of giant reed (*Arundo donax*) and salt cedar (*Tamarisk* spp) within and adjacent to the Otay River channel.

San Diego NWR, Otay-Sweetwater Unit: Land Protection Plan

The approved acquisition boundary of the Otay-Sweetwater Unit of the San Diego NWR encompasses approximately 52,080 acres of land. It stretches from Loveland Reservoir along the Sweetwater River to the Sweetwater Reservoir; extends northward between the communities of El Cajon and Crest; encompasses the San Miguel, Mother Miguel, and Jamul Mountains; extends along the northern flanks of the San Ysidro Mountains and portions of Otay Mesa and the Otay River Valley; and runs west of State Route 94 between Jamul and Rancho San Diego (Figure B.3-8). The LPP, approved in April 1997, provides a description of the biological values, protection and acquisition methods, and acquisition priority for individual tracts of land within the approved NWR boundary. As described above for the South San Diego Bay Unit, designation of the acquisition boundary does not result in regulatory or environmental compliance requirements on unacquired lands within or near the boundary. Most of the acquisitions thus far have been within the northern portion of the NWR boundary, outside of the Otay River watershed.The CCP for this NWR is expected to be initiated in early 2006.

The goals of the LPP include protection, restoration, enhancement, and management of sensitive resources. Specifically, the goals of the San Diego NWR address the protection, enhancement, and restoration of native habitats, including riparian woodland, vernal pools, and wetland habitats. The goals also recognize the importance of creating partnerships in coordinating land management activities of various entities. Additionally, the LPP recognizes the importance of providing for compatible educational and recreational activities.

On-going activities at the Otay-Sweetwater Unit LPP include land acquisition, habitat management (i.e., fencing, signage, exotic species removal), and pre-planning for the upcoming CCP.

San Diego NWR, Vernal Pools Stewardship Project: Land Protection Plan

The approved Vernal Pools Stewardship Project acquisition boundary of the San Diego NWR encompasses approximately 8,220 acres. It includes several disparate areas of San Diego County, with areas in the Otay River watershed limited to properties near Lower Otay Reservoir (509 acres) and on Otay Mesa (1,460 acres; Figure B.3-8). The Land Protection Plan, approved in April 1997, describes the various habitat protection methods for lands within the Vernal Pools Stewardship Project, and includes a priority listing of private lands to be considered for acquisition from willing sellers within the approved boundary. Designation of the acquisition boundary does not result in regulatory or environmental compliance requirements on unacquired lands within or near the boundary. The upcoming CCP planning process for the San Diego NWR will address the Vernal Pools Unit.

B.6.4.7 CDFG Lands

The CDFG currently manages three preserves within the Otay River watershed (Table B.6-4): the Rancho Jamul Ecological Reserve, Hollenbeck Canyon Wildlife Area, and Otay Mountain Ecological Reserve. In total, CDFG manages approximately 10,000 acres of land in the watershed. CDFG has conducted detailed biological inventories for most of the properties including detailed vegetation

mapping. Management Plans are currently being developed for both the Rancho Jamul and Hollenbeck properties, expected to be completed in the next 18 months (by December 2006). Management activities and permitted uses will differ from the two properties because one is designated as an Ecological Reserve and the other as a Wildlife Area. Within Ecological Reserves, more restrictions are proposed such as passive recreation (hiking and bird watching), with limited active recreation such as mountain biking and equestrian use. Wildlife Areas tend to allow slightly more active recreation, as well as limited hunting. However, hunting on these properties has been, and will continue to be, limited to upland game hunting, such as quail and doves on a seasonal basis and in restricted areas that are closely monitored.

Active restoration is occurring within the Rancho Jamul Mitigation Bank, part of the Rancho Jamul Ecological Reserve. Approximately 110 acres of land within Dulzura and Jamul Creeks is leased by Wildlands, Inc. Activities on-site include active restoration of riparian and emergent marsh habitat through the removal of invasive weed species and cow-bird trapping. See Table B.6-4 for further details.

B.6.4.8 U.S. Forest Service Lands

The U.S. Forest Service (USFS) Cleveland National Forest extends into the Otay River watershed in the northeastern corner near Barbar Mountain. These are indicated as Public Lands in the far northeast corner of the watershed on Figure B.6-9. In addition, the USFS has a 40-acre communications site on Lyons Peak. Currently, the USFS is preparing a Fuel Management Plan that will include strategies for fuel reduction techniques, such as tree trimming or thinning and trash removal. In addition, the USFS is preparing a Biological Assessment (BA) for impacts associated with fire breaks surrounding private homes. Minimal impacts are expected to occur as a result of these activities.

Although the USFS does not account for very much acreage within the Otay River watershed, it is critical to the overall functions and values of the existing and proposed preserve areas within the watershed. This is due in part to the proximity of the Cleveland National Forest and critical wildlife movement linkages (Figure B.6-1) through the County Pre-Approved Mitigation Area to the Forest. Therefore, close coordination with the USFS will be essential in developing the Otay River Watershed Management Plan.

B.7 DIFFERENTIAL SUB-BASIN SENSITIVITY TO CHANGES IN LAND USE

The Section B.1 to B.6 characterization provides an overview of the past, current, and anticipated conditions in the Otay River watershed. All of this information is important to consider when making decisions about appropriate implementation strategies for protecting, enhancing, and restoring natural resources while allowing reasonable development and other uses to continue within the watershed.

It is also important to consider, however, that there are differences in how the various portions of a watershed will respond to changes in land use or management approaches. Physical and biological conditions can vary significantly within watersheds, particularly in southern California. The Otay River watershed is no exception. One approach to subdividing Hydrologic Units (HUs) or entire watersheds was developed by the DWR in the 1960s and enumerated by the SWRCB in the early-1970s. It divides HUs into Hydrologic Areas (HAs), which are major tributaries and/or major groundwater basins within the HU; it further divides some HAs into Hydrologic Subareas (HSAs), which include water-bearing and nonwater-bearing formations. This system bases subdivisions on geologic, hydrologic, and topographic characteristics. As shown in Figure B.3-10, the Otay River watershed has been divided into 1 HA and 7 HSAs (Otay Valley, and the HSAs of Savage, Proctor Valley, Jamul, Lee, Lyons, Hollenbeck, and Engineer Springs). What follows is a characterization of 9 distinct Subbasins (the Otay

Valley HA has been divided into Upper Otay Valley and Lower Otay Valley based on differences in geology and land use) comprising the Otay River watershed. As a reminder, important hydrologic and physical features, such as the Otay River and the reservoirs, are shown in the USGS map of the watershed (Figure B.1-2). The Upper Otay Reservoir is included in the Proctor Valley Subbasin, while the Lower Otay Reservoir is included in the Savage Subbasin. In addition to runoff from the Savage Subbasin, the Lower Otay Reservoir receives runoff from all upstream areas within the watershed (Jamul, Hollenbeck, Lee, Lyons, and Engineer Springs Subbasins).

The characterization focuses on each Subbasin's geomorphic setting, geology, soils, and land use/vegetation, with a summary evaluation of how land use changes are anticipated to affect each Subbasin in terms of water runoff and stream erodibility. Information depicted in many of the figures included in this document as well as Figures B.7-1, B.7-2, and B.7-3 were evaluated to complete this characterization and assessment.

Increased runoff and erodibility have important implications regarding the stability of stream channels, the quantity and quality of water, habitat functions and values, and other beneficial uses, within the Subbasins and areas downstream, including the Otay Reservoirs. These characterizations will serve as key information in developing the most appropriate implementation and management strategies for these distinctive watershed management areas. Similarly, they will provide the foundation for developing tailored Planning Principles or suites of BMPs for the watershed's Subbasins, which is an important component of preparing the Otay River watershed SAMP. This SAMP product will also take into account how these changes could affect sensitive habitats, to develop approaches that avoid or minimize adverse effects to these valuable natural resources.

B.7.1 Otay Valley West Subbasin

Geomorphic Setting. The Otay Valley West Subbasin, representing watershed areas west of the La Nacion fault (just east of the I-805 Freeway), is comprised of gently westward-sloping marine terraces and the lower Otay River valley itself (approximately 2,000 to 4,000 feet), comprised of its active channel and alluvium deposits.

Geology. The marine terraces are formed in the Baypoint, Linda Vista, and San Diego Formations comprised primarily of marine, lagoonal, and non-marine sandstones. The alluvium of the Otay Valley channel area is dominated by sands and gravels derived historically from upper watershed areas.

Soils. The soils of the marine terraces are dominated by clays, with more loam textures in the eastern part of this Subbasin (nearer the Interstate-805 Freeway). Sands and gravels are found in the active stream channels such as lower Poggi Canyon. Soil hydrographic groups are predominantly D class, representing poorer infiltration. Soil erodibility, as recorded by the NRCS soil series, is marked as severe in this region.

Land Use/Vegetation. The Otay Valley West Subbasin is predominantly urbanized, with the City of Chula Vista occurring north of the main Otay River channel, and the southern portion of the City of San Diego occurring south of the Otay River channel. This Subbasin is the most developed/urbanized area of the entire Otay watershed. Past small drainage tributaries are mostly channelized into an engineered stormwater drainage system. The mouth of the Otay River system has been diked and rerouted around filled (past agricultural) areas and the South Bay Salt Works.

Sensitivity to Runoff/Erosion with Land Use Change. Because this Subbasin is already largely urbanized, its sensitivity to future land-use change is not great and is less than the other Subbasins in the Otay River watershed. On-going urban infill in Chula Vista or south San Diego may further increase runoff conditions; however, this would primarily occur within an already built-out footprint.

Restoration efforts at the mouth of the Otay River, through either removal/lowering of leveed channel reaches; or through salt pond restoration would likely have a net flood management benefit, because floodplain storage areas would increase. It would also result in habitat benefits.

B.7.2 Otay Valley East Subbasin

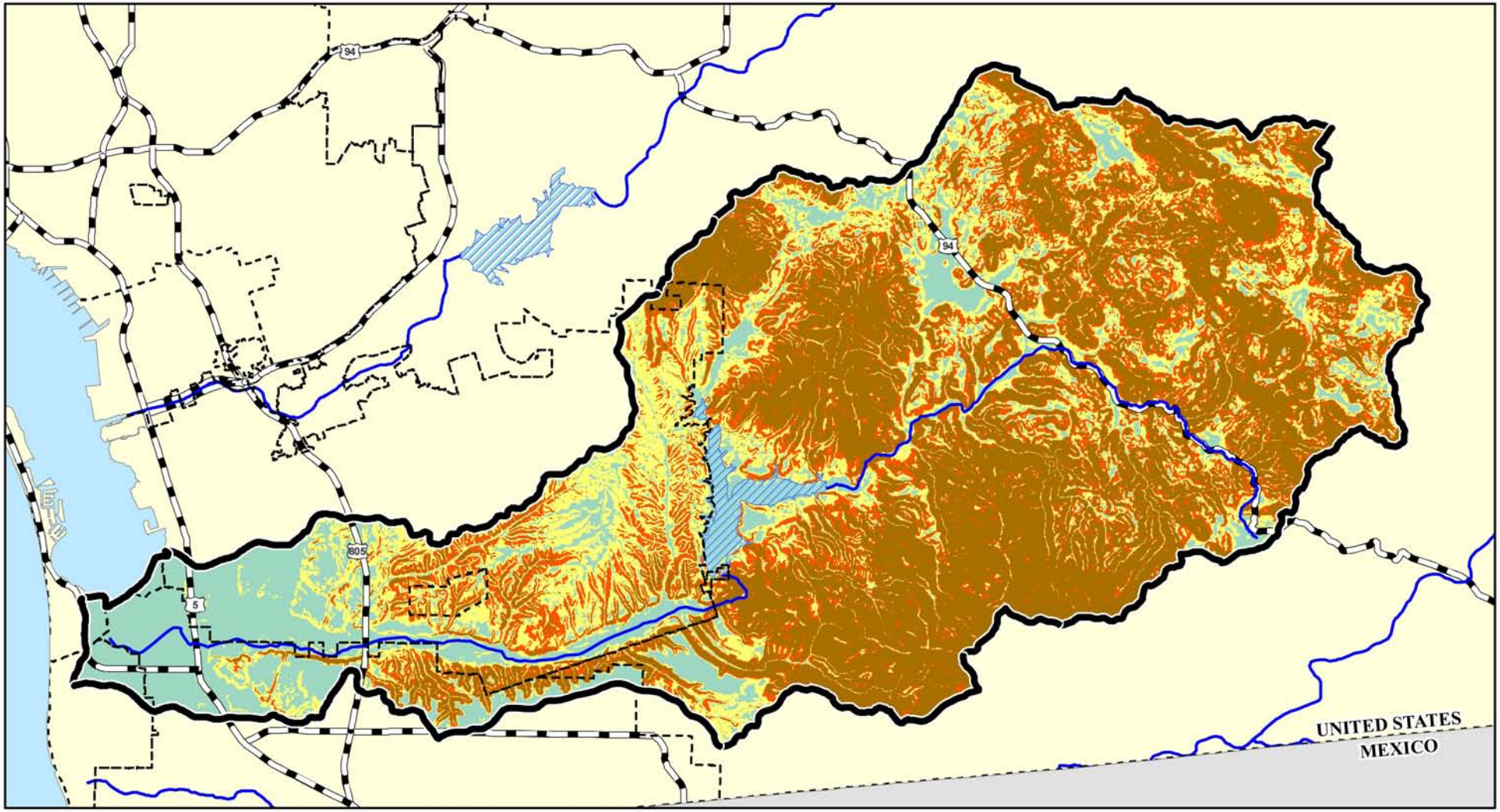
Geomorphic Setting. The Otay Valley East Subbasin occurs east of the La Nacion Fault (just east of the Interstate-805 Freeway) and continues east until the Lower Otay Reservoir. Physiographically, in the region north of the main Otay River, rolling hills typical of the mesa topography of coastal San Diego County are found, with stream channels cut into the plateaus and hills of the mesa surface. The Otay Mesa rests on a bluff south of the main Otay River channel. In the eastern portion of this sub-area, east of Salt Creek, the mesa topography drops into a broad lower valley, occupied by the Lower Otay Reservoir. This marks a geomorphic transition from the marine terraces and mesas of the lower Otay watershed to the broader valley bottoms and steep mountains of the central Otay watershed.

Geology. This Subbasin is predominantly comprised of the Otay Formation with its sandstones and claystones. Some of the claystones include Bentonite, which can be prone to landsliding where slopes are steep or unsupported. Santiago volcanic rock is found at the Rock Mountain site just north of the main Otay River channel and east of Wolf Creek, and fanglomerate rocks are found in lower Salt Creek to the margin with the lower Otay Reservoir.

Soils. Similar to the Otay Valley West Subbasin, this Subbasin is predominantly clay soils with some loam pockets. Soil hydrogroups are predominantly of the D class (poorer infiltrators) with alluvial channel areas and floodplains along some tributaries having better infiltrating A and B classes. Interestingly, in the Otay Valley East Subbasin, the soil erodibility index is characterized as slight/moderate, representing a reduced erosivity compared to the lands of the Otay Valley West zone. This is also a reduced erosivity compared to the several other sub-basins in the Otay River watershed, which are predominantly characterized as having severe erodibility.

Land Use/Vegetation. This Subbasin contains areas of residential development in the western portion. North of the Otay River in the eastern portion of the Subbasin, residential development is currently occurring within the Poggi Canyon and upper Salt Creek drainages. Wolf Canyon is currently undeveloped. South of the Otay River, most of this Subbasin is in planned MSCP preserves. Most of the undeveloped land in this Subbasin is grassland, some of which is grazed. The grassland grades into coastal sage scrub in the southeastern portion of the Subbasin. There are also pockets of maritime succulent scrub mixed with the coastal sage scrub.

Sensitivity to Runoff/Erosion with Land Use Change. In the areas of Poggi, Wolf, and Salt Creeks with intermediate or better infiltration conditions, potential development, which would increase impervious surfaces, would result in increased runoff and erosive conditions. This is currently observable in the rapidly urbanizing portions of Poggi Canyon, where: a previously ephemeral system has been perennialized; stormflow runoff peaks have increased (though somewhat controlled through detention basins); and post-construction related sediment yields are high during the build-out phase. An area of potential sensitivity that is not slated for development (but it will be indirectly affected by development) is found in lower Salt Creek. Because upper Salt Creek is urbanizing, increased runoff, sediment yield, and pollutants will be transported downstream through lower Salt Creek prior to the confluence with the main branch of the Otay River.



Legend

- 0 to 5 Percent
- 5 to 15 Percent
- 15 to 25 Percent
- Greater than 25 Percent

Basemap Legend

- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes

N

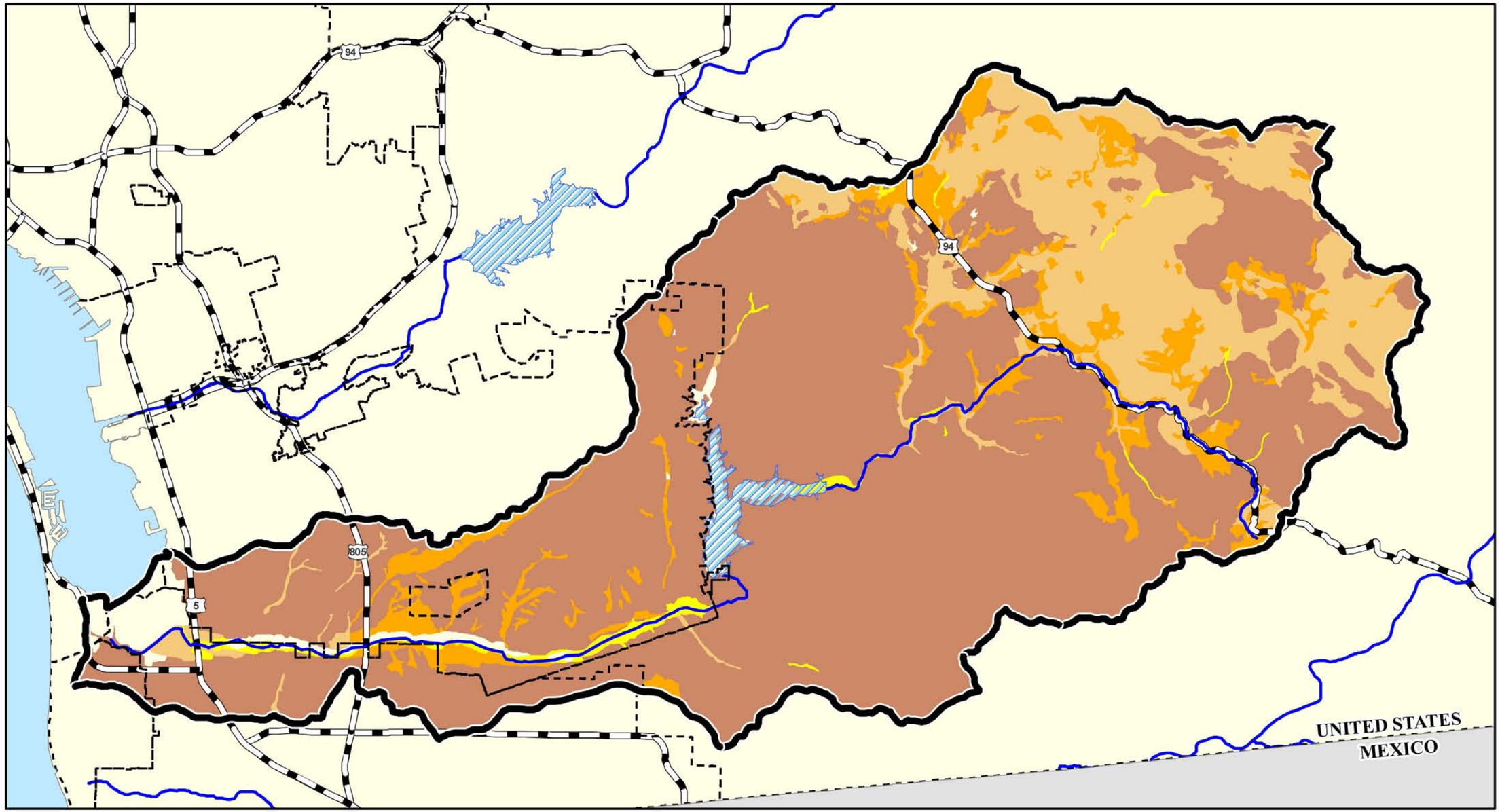
0 2.5 5
Scale in Miles

Otay River Watershed Management Plan

Figure B.7-1

Slope

Aspen Environmental Group



Legend

- Group A — Soils have a high infiltration rate when thoroughly wetted; chiefly deep, well-drained to excessively drained sand, gravel, or both. Rate of water transmission is high; thus runoff potential is low.
- Group B — Soils have a moderate infiltration rate when thoroughly wetted; chiefly soils that are moderately deep to deep, moderately well drained to well drained, and moderately coarse textured. Rate of water transmission is moderate.
- Group C — Soils have a slow infiltration rate when thoroughly wetted; chiefly soils that have a layer impeding downward movement of water, or moderately fine to fine textured soils that have a slow infiltration rate. Rate of water transmission is slow.
- Group D — Soils have a very slow infiltration rate when thoroughly wetted; chiefly clays that have a high shrink-swell potential, soils that have a high permanent water table, soils that have a claypan or clay layer at or near the surface, or soils that are shallow over nearly impervious material. Rate of water transmission is very slow.

Basemap Legend

- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes

0 2.5 5
Scale in Miles

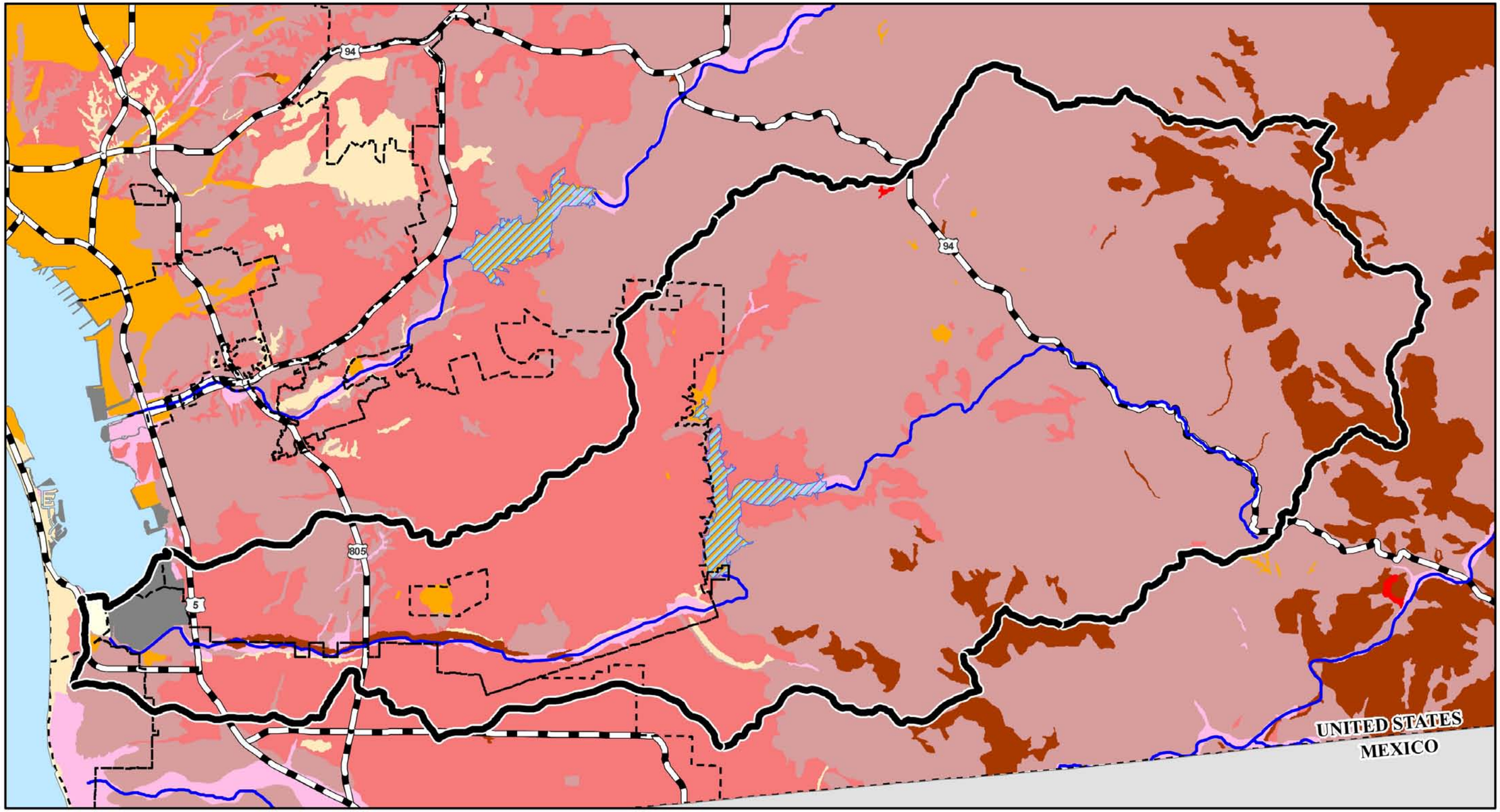
N

Source: TAIC, 2004

Otay River Watershed Management Plan

Figure B.7-2
Hydrologic Soil Groups

Aspen Environmental Group



Legend

- Clay
- Coarse Sand
- Loam
- Other
- Rock
- Sand
- Silt
- Unknown

Basemap Legend

- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes

0 2.5 5
Scale in Miles

N

Source: TAIC, 2004

Otay River Watershed Management Plan

Figure B.7-3
Soil Texture

Aspen Environmental Group

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B.7.3 Savage Subbasin

Geomorphic Setting. The Savage Subbasin comprises the southern flank of the Jamul mountains, the north-western side of the San Ysidro mountains, the areas immediately surrounding the Lower Otay Reservoir, and the lower Jamul stream valley. As such, Savage and Proctor Subbasins represent the mid-Otay River watershed and are discernable in geomorphology and geology from the lower watershed to the west, as well as the upper watershed to the east.

Geology. The Savage Subbasin is predominantly comprised of Santiago volcanic rocks and fanglomerate/sedimentary deposits which are derived locally from the volcanic material. These sediments (and some San Diego Fm. rocks) are observed on the relatively gently sloping bench found along the north side of the Lower Otay Reservoir.

Soils. Soils in the Savage Subbasin are generally loam with some more clay areas around the Reservoir and rock in the southeast. Soils are characterized as D class infiltrators (poor infiltrators), most likely due to shallow soil depths along the Jamul and San Ysidro steeper mountain fronts. This Subbasin is mapped as having severe erodibility.

Land Use/Vegetation. Most of this Subbasin has been acquired for preserves. Portions of it are planned for preserves. However, the area described above with the volcanic sedimentary geology is mapped as being planned for development. Vegetation in this Subbasin is dominated by coastal sage scrub and chaparral with pockets of grassland on flatter areas and in the valleys.

Sensitivity to Runoff/Erosion with Land Use Change. In terms of runoff/erosion generation, the regions of the Savage Subbasin in public or preserve designation are typically steep-sloped areas with sage/chaparral cover. While development will not occur in these steeper preserve areas, which would increase runoff/erosion, such regions do experience periodic fires. As observed since the fires in the Otay River watershed in 2003, the post-fire landscape with reduced vegetative cover and increased soil hydrophobicity (i.e., reduced infiltration of water) results in increased runoff and erosion. Regarding the potential for development in the Savage Subbasin, along the northern margin of the Lower Otay Reservoir, on the bench comprised of volcanic and undifferentiated volcanic sediments, development could lead to increases in runoff/erosion. However, as this area is designated as generally poor in infiltration, the relative impact of such impact may not be as severe as observed in regions with initially higher infiltrating soils (such as portions of Poggi Canyon, Wolf Canyon, or Salt Creek).

The Lower Otay Reservoir was identified as being threatened by water quality problems related to color and odor on the SWQCB's 303(d) Monitoring List in 2002 (SWRCB, 2003). Increased sediment and algae within the reservoir can affect the clarity and scent of the water, which in turn affect potable water treatment and aesthetic values. Though development directly adjacent to the reservoir could minimally increase runoff and erosion, development in regions farther upstream (Proctor, Jamul, Hollenbeck Subbasins) could cumulatively increase nutrient and sediment inputs to the reservoir, thus exacerbating color and odor problems. A substantial amount of residential development is planned for the Proctor Valley Subbasin, which drains to the Upper Otay Reservoir, and ultimately the Lower Otay Reservoir. Increased inputs of nutrients, sediment, and other urban contaminants resulting from this development could degrade the water quality of the Upper and Lower Otay Reservoirs. On the other hand, residential development in the upper reaches of the Dulzura Creek watershed (including Jamul, Lee, Lyons, Hollenbeck, Engineer Springs Subbasins) would potentially be located at a far enough distance from the reservoir to remove contaminants from the water column by natural filtration processes. In addition, implementation of appropriate best management practices (BMPs), as discussed in *Source Water Protection Guidelines for New Development* (City of San Diego Water Department,

2004) and *Storm Water Management BMPs for the Otay Watershed* (Appendix 4), could potentially minimize or eliminate nutrient and sediment inputs from increased development upstream of the reservoir.

B.7.4 Proctor Valley Subbasin

Geomorphic Setting. The Proctor Valley Subbasin encompasses the upper Proctor Creek drainage area. This sub-basin includes the steep southern slopes of San Miguel Mountain, and also the broader/gentler topography of the lower and upper Proctor valleys.

Geology. The Proctor Valley Subbasin shares similar geologic conditions as the Savage Subbasin to the south, with a large coverage of Santiago volcanics, volcanic sediments derived from the Santiago rocks, and also San Diego Fm. rocks.

Soils. Soils in the Proctor Valley Subbasin are mostly loam with expanses of clay in the southwest portion of the sub-basin. Similar to the Savage region, Proctor has mostly poor infiltrating soils (D class), although locally in the bottom of Proctor valley, better infiltration conditions exist in the soils derived on the alluvium and sedimentary rock material. Soil erosivity is characterized as severe.

Land Use/Vegetation. Most of this Subbasin is in existing or planned preserves. However, part of Upper Proctor Valley and an area upstream of the Upper Otay Reservoir are planned for low-density development. Vegetation in this Subbasin is dominated by coastal sage scrub and chaparral with pockets of grassland on flatter areas and in the valleys.

Sensitivity to Runoff/Erosion with Land Use Change. While several sections of the Proctor Valley Subbasin are designated for public acquisition or preserve, there are areas in the upper Proctor Valley and lower Proctor Valley (Figure B.3-9) that are designated for residential development. Some of these areas are located on better infiltrating class B and A soils (Figure B.7-2). A conversion of such areas to more urbanized and impervious surfaces might cause a disproportionate increase in runoff and erosion. Additionally, as some of these areas are in the upper portion of the Proctor Subbasin, increased imperviousness would reduce runoff lag times and increase peak flows downstream, potentially causing other related impacts of channel erosion. Accumulation of sediment transported from upstream channel erosion could degrade the water quality of the Upper and Lower Otay Reservoirs by reducing water clarity, dissolved oxygen content, leading to increased algal growth within the reservoirs. Increased algal growth could degrade the color and odor of the water, thus affecting water treatment and aesthetic values. Implementation of appropriate BMPs, as discussed in *Source Water Protection Guidelines for New Development* (City of San Diego Water Department, 2004) and *Storm Water Management BMPs for the Otay Watershed* (Appendix 4), could potentially minimize or eliminate nutrient and sediment inputs from increased development in this Subbasin. Proctor Valley Creek is on the SWRCB's 303(d) Monitoring List for potential trash impairment (SWRCB, 2003). Implementation of the above BMPs could also potentially reduce or eliminate this threat to water quality degradation.

B.7.5 Jamul Subbasin

Geomorphic Setting. The Jamul Subbasin comprises several tributary streams in the northern upper watershed with their steeper headwaters that coalesce into the main Jamul Creek in the valleys west of Highway 94. Stream gradients decreased from the headwaters to the lower valley sections, then steepen farther south into the Jamul Creek Canyon towards the confluence with Dulzura Creek.

Geology. The geology of this Subbasin is varied, as it is located in the zone of transition from Santiago volcanics to the southwest and granodiorite and tonalities to the northeast. Porous residuum is found along stream channels. Green Valley tonalite is found in the north of the Subbasin. Areas of cretaceous

granodiorite dominate the northeast, and Santiago volcanics comprise the southern portion. A pocket of Triassic gabbro is found in the southeast. River deposits are found along Jamul Creek.

Soils. Loamy soils are found throughout the Subbasin, with some small pockets of sand and clay. Most of this Subbasin is moderately well-drained, due to loamy soils, porous residuum, and fracturing in underlying bedrock. Jamul Butte and areas underlain by Santiago volcanics in the Subbasin are poorly drained with slow to very slow infiltration rates. Most of the Subbasin is severely erodible. Some areas underlain by Santiago volcanics have a slight to moderate erodibility hazard.

Land Use/Vegetation. The southwestern portion of the Subbasin is located in a preserve. The northeastern portion contains low-density development or open space zoned for low-density development. Developed areas are mostly landscaped. Grazed grassland is found along Highway 94. The rest of the Subbasin is a mixture of coastal sage scrub and chaparral with small pockets of grassland. Small pockets of woodland are found in this Subbasin as well.

Sensitivity to runoff/erosion with Land Use Change. Valleys and gentle slopes in the northeastern portion of this Subbasin are prone to greatly increased runoff and erosion with increased development. This is due to the fact that soils in these areas are well drained and also severely erodible. Furthermore, coastal sage scrub and chaparral in or adjacent to these areas translate to a fire regime that could threaten public safety in the event of development, while simultaneously increasing runoff. Because this area is at the upstream end of Jamul Creek, increased runoff and erosion here would affect the entire creek downstream, including the Lower Otay Reservoir. Natural filtration processes protected by preserve areas between planned development and the Lower Otay Reservoir would potentially prevent water quality degradation within the reservoir, except perhaps in the event of a fire. In addition, implementation of appropriate BMPs, as discussed in *Source Water Protection Guidelines for New Development* (City of San Diego Water Department, 2004) and *Storm Water Management BMPs for the Otay Watershed* (Appendix 4), could potentially minimize or eliminate nutrient and sediment inputs from increased development in this Subbasin.

B.7.6 Lee Subbasin

Geomorphic Setting. The Lee Subbasin represents an upper watershed tributary to Hollenbeck Canyon. Interestingly, the Lee sub-basin includes its own headwater areas above the floor of the Lee Valley. The Lee Valley itself can be considered a 'perched valley' that sits above a canyon exit that drains to Hollenbeck Canyon to the east then south.

Geology. Most of this Subbasin is underlain by Woodson Mountain granodiorite, with a large pocket of residuum in Lee Valley. Lee Valley lies along an inactive east-west fault line.

Soils. Soils in the Subbasin are mostly loams with some rock outcrops in the eastern portion. The soils in this Subbasin are mostly moderately well-drained due to the jointed regolith associated with the granodiorite formation. Pockets of soils overlying residuum in and around Lee Valley have slower infiltration rates and are more poorly drained. Erodibility hazard is severe in most of the Subbasin, with areas of moderate hazard in Lee Valley.

Land Use/Vegetation. Portions of this Subbasin contain spaced rural development. Much of the rest of the Subbasin is zoned for low-density development. Vegetation in the Subbasin is comprised of chaparral with a large area of grassland and ribbons of woodland along stream channels and in Lee Valley.

Sensitivity to Runoff/Erosion with Land Use Change. Slopes surrounding Lee Valley in the northern and southwestern portions of this Subbasin are prone to greatly increased runoff and erosion with

increased development. This is due to the fact that soils in these areas are well drained and also severely erodible. Furthermore, chaparral in or adjacent to these areas translate to a fire regime that could threaten public safety in the event of development, while simultaneously increasing runoff. Lee Valley itself is less prone to increased runoff and erosion, because soils are less well drained (Drainage Class C) and slopes are gentler. Because this Subbasin feeds into Hollenbeck Canyon, increased runoff and erosion here would affect the entire system downstream, including the Lower Otay Reservoir. Natural filtration processes protected by preserve areas between planned development and the Lower Otay Reservoir would potentially prevent water quality degradation within the reservoir, except perhaps in the event of a fire. In addition, implementation of appropriate BMPs, as discussed in *Source Water Protection Guidelines for New Development* (City of San Diego Water Department, 2004) and *Storm Water Management BMPs for the Otay Watershed* (Appendix 4), could potentially minimize or eliminate nutrient and sediment inputs from increased development in this Subbasin.

B.7.7 Lyons Subbasin

Geomorphic Setting. Similar to the Lee Valley Subbasin, the Lyons Valley Subbasin is a high watershed valley (i.e., perched) surrounded by steep headwater channels, that then drain east, then south, and enter a steep canyon descent into the main section of the Hollenbeck Subbasin.

Geology. Most of this Subbasin is underlain by Woodson Mountain granodiorite, with a large pocket of residuum in Lyons Valley. Lyons Valley lies along an inactive east-west fault line.

Soils. Soils in the Subbasin are mostly loams with some rock outcrops in the eastern portion. The soils in this Subbasin soils are mostly moderately well-drained due to the jointed regolith associated with the granodiorite formation and porous residuum. Erodibility hazard is severe in most of the Subbasin, with a large area of moderate hazard in Lyons Valley.

Land Use/Vegetation. Most of the Subbasin is currently undeveloped, with pockets of spaced rural development. The northwestern portion is zoned for low-density development, while the southwestern portion is set aside as a mitigation area. The Subbasin is dominated by chaparral, with pockets of grassland, and a large area of woodland along Lyons Valley.

Sensitivity to Runoff/Erosion with Land Use Change. Much of the Subbasin is prone to greatly increased runoff and erosion with increased development. This is due to the fact that soils in the Subbasin are mostly well drained and also severely erodible. Furthermore, chaparral in or adjacent to these areas translate to a fire regime that could threaten public safety in the event of development, while simultaneously increasing runoff. Lyons Valley itself is less prone to increased erosion, because slopes are gentler. In addition, woodland vegetation in Lyons Valley may burn less frequently and less intensely than surrounding chaparral. Because this Subbasin feeds into Hollenbeck Canyon, increased runoff and erosion here would affect the entire system downstream, including the Lower Otay Reservoir. Natural filtration processes protected by preserve areas between planned development and the Lower Otay Reservoir would potentially prevent water quality degradation within the reservoir, except perhaps in the event of a fire. In addition, implementation of appropriate BMPs, as discussed in *Source Water Protection Guidelines for New Development* (City of San Diego Water Department, 2004) and *Storm Water Management BMPs for the Otay Watershed* (Appendix 4), could potentially minimize or eliminate nutrient and sediment inputs from increased development in this Subbasin.

B.7.8 Engineer Springs Subbasin

Geomorphic Setting. Similar to the Lee and Lyons Subbasins, Engineer Springs Subbasin also represents a 'perched' valley towards the headwaters of the overall watershed. Engineer Springs is found in the southern headwaters of the Dulzura Creek drainage.

Geology. The Subbasin contains a deposit of residuum along Dulzura Creek. Bonsall tonalite underlies the area around this residuum and grades into the Santiago volcanics, which are found throughout the surrounding area. The Subbasin also contains a pocket of Triassic gabbro/diorite in its southwestern edge.

Soils. Soils in the Subbasin are mostly loams. Soils in the south-central part of the Subbasin are in Group B and C drainage groups (moderately well drained, less well drained) due to the porosity of the residuum and fracturing in the upper portion of the tonalite bedrock. Surrounding areas underlain by Santiago volcanics are poorly drained. Soils in the Subbasin are mostly severely erodible, with pockets of moderately erodible soils along Dulzura Creek and in the southwest of the subbasin.

Land Use/Vegetation. The Subbasin contains areas of low-density development and agriculture along Highway 94. Much of the remaining Subbasin is preserve land. Undeveloped land in the southeastern portion of the Subbasin is zoned for low-density development. The Subbasin is dominated by chaparral and coastal sage scrub vegetation with a large area of agriculture.

Sensitivity to Runoff/Erosion with Land Use Change. Gently sloping areas in the southern part of this Subbasin near to Highway 94 are prone to greatly increased runoff and erosion with increased development. This is due to the fact that soils in this part of the Subbasin are mostly well-drained and also severely erodible. Furthermore, chaparral in these areas translates to a fire regime that could threaten public safety in the event of development, while simultaneously increasing runoff. Because this Subbasin is at the upstream end of Dulzura Creek, increased runoff and erosion here would effect the entire system downstream, including the Lower Otay Reservoir. Natural filtration processes protected by preserve areas between planned development and the Lower Otay Reservoir would potentially prevent water quality degradation within the reservoir, except perhaps in the event of a fire. In addition, implementation of appropriate BMPs, as discussed in *Source Water Protection Guidelines for New Development* (City of San Diego Water Department, 2004) and *Storm Water Management BMPs for the Otay Watershed* (Appendix 4), could potentially minimize or eliminate nutrient and sediment inputs from increased development in this Subbasin.

B.7.9 Hollenbeck Subbasin

Geomorphic Setting. The main Hollenbeck Subbasin represents the transition from the highest peaks and upper perched valleys (Lee, Lyons, Engineer Springs) of the upper watershed down to the central watershed as represented by the principal drainage path of Dulzura Creek to its confluence with Jamul Creek. As such, the characteristic longitudinal profile of the streams of this Subbasin are not simply concave, but include an upper concave profile often draining into the upper valleys, than a more steeply defined profile heading typically west through steep channel canyons. In the vicinity of Highway 94, many of these canyons enter the broader valley bottom of the central watershed.

Geology. This Subbasin is underlain by Santiago volcanics in the southwest and Woodson Mountain granodiorite in northeast. Pockets of triassic gabbros and diorites are located along the transition zone between Santiago volcanics and the granodiorite deposits. River deposits are found along Dulzura creek. Deposits of older alluvium, triassic volcanics, and residuum are also found in this Subbasin. An Inactive southeast to northwest trending fault runs through part of the Subbasin south of Highway 94.

Soils. Loamy soils make up most of the Subbasin. Rock outcrops are found in the northeastern portion of the Subbasin, and some pockets of clay are found along Dulzura Creek and its tributaries.

Soils in the southwestern portion of the Subbasin are underlain by Santiago volcanics and are poorly drained. Some areas along stream channels in the southwestern portion of the Subbasin have somewhat higher infiltration rates, but are still Group C drainage soils. The northeastern portion of the Subbasin is mostly classed as moderately well-drained (Group B drainage), due to the fractured upper bedrock of the underlying granodiorite. Large pockets of more poorly drained soils are found in this part of the Subbasin as well, due partly to rock outcrops associated with Mother Grundy Peak. Most of the Subbasin is severely erodible, with small pockets of moderate erodibility along stream channels and in areas of gentler topography.

Land Use/Vegetation. Most of the Subbasin has been acquired for preserves or is planned for preserves. Small clusters of low-density development are found in the eastern portion of the Subbasin, and a large area is planned for similar development.

The Subbasin is dominated by chaparral and coastal sage scrub with pockets of grassland. Significant areas of montane coniferous forest (Tecate cypress) are found in the southern portion of the Subbasin on the slopes of the San Ysidro Mountains. A large patch of woodland is found in the southeastern portion of the Subbasin.

Sensitivity to Runoff/Erosion with Land Use Change. Well-drained areas in the northeastern portion of the Subbasin are prone to greatly increased runoff and erosion with increased development. In addition to being well-drained, these soils are also severely erodible. Furthermore, chaparral and costal sage scrub in these areas translates to a fire regime that could threaten public safety in the event of development, while simultaneously increasing runoff. Areas dominated by woodland may be less threatened by the effects of fire. This large Subbasin drains directly to the Lower Otay Reservoir; thus, increased sediment transport resulting from increased runoff or fire-related landscape changes could threaten water quality of the reservoir. However, natural filtration processes protected by preserve areas between planned development and the Lower Otay Reservoir would potentially prevent water quality degradation, except perhaps in the event of a fire. In addition, implementation of appropriate BMPs, as discussed in *Source Water Protection Guidelines for New Development* (City of San Diego Water Department, 2004) and *Storm Water Management BMPs for the Otay Watershed* (Appendix 4), could potentially minimize or eliminate nutrient and sediment inputs from increased development in this Subbasin. Dulzura Creek is on the SWRCB's 303(d) Monitoring List for potential impairment due to eutrophic conditions, hydromodification, and sediment/siltation (SWRCB, 2003). Implementation of the above BMPs could also potentially reduce or eliminate these threats to water quality degradation.

B.8 DATA GAPS IN PROTECTING, ENHANCING, RESTORING, AND MANAGING WATERSHED RESOURCES

There are several data needs that, if adequately addressed, will benefit the protection, enhancement, restoration, and management of this watershed's resources. Some of these needs are more immediate, while others can be addressed in the future, shortly before actual the initiation of enhancement or restoration activities. Others focus on long-term management issues.

- Update the vegetation communities GIS layer for watershed areas outside of the four large project level vegetation mapping areas and the Corps data source areas that were integrated in December 2005 (see Section B.6.1). The areas updated included the OVRP, East Otay Mesa, the Rancho Jamul Ecological Reserve, the Hollenbeck Canyon Wildlife Area, and aquatic areas mapped as part of the U.S. Army Corps of Engineers' planning-level delineation outside of the four project level vegetation mapping areas and the regional vegetation mapping. Vegetation communities that are located outside of these updated areas remain mapped at

a scale of 1 inch = 24,000 feet (mapping, which is 10 years old). The watershed has developed significantly since this GIS layer was created, and vegetation in these dynamic systems can change rapidly as shown in the updated map. It is important to have a fairly recent inventory of the types, associations, and quality of vegetation in this watershed to better plan those areas for protection, enhancement, and restoration (e.g., some areas might have been developed, while others are now nearer to urbanization). A number of smaller project-specific vegetation mapping efforts have also occurred within the watershed that should be integrated (e.g., Caltrans SR-125).

- Provide an inventory of existing wetland mitigation and restoration sites/activities.
- Provide an inventory of approved not graded, pending and future projects to get a better picture of development trends. This should be coupled with the project land use data, including "vacant" developable land.
- Follow-up on the various preserve areas to identify their specific locations and extents, entities responsible for them, management activities initiated, management activities planned, and status of preservation, enhancement, and restoration efforts. Consulting Team-member TAIC has developed an ArcView (GIS) tool to collect and record information on management status and activities.
- Increase understanding about how water quality and quantity (primarily pH and salt content) in different parts of the watershed will affect plant palletes and establishment. Habitat type conversion (e.g., ephemeral stream to perennial stream) due to the introduction or increases in urban runoff is a concern identified by the watershed stakeholders. In addition, high salt has been a problem in restorations along Salt Creek.
- Similarly, additional investigation will be required to ascertain how aquatic habitat will respond to changes in land use over time. An initial assessment was provided in Section B.7. More detailed assessment is occurring to develop the Otay River Watershed Special Area Management Plan Planning Principles Report.
- Determine how best to deal with tamarisk, which is a highly invasive, non-native plant species. Typically, the most effective approach to eradication of non-native plant species is to begin at its upstream extent and proceed downstream along affected drainage courses. Tamarisk propagates well by seed, so the best approach to removal of this plant could vary. An important issue is to evaluate the anticipated success of potential habitat restoration downstream of or in proximity to tamarisk-infested areas.
- Assess and prioritize other invasive, non-native plant species in this watershed, and evaluate the most effective approaches to eradicating them (e.g., *Arundo donax* [giant reed]).
- Assess and prioritize invasive, non-native faunal species (e.g., crayfish, bullfrogs, brown-headed cowbird) in this watershed, and evaluate the most effective approaches to eradicating them.
- Determine how enhanced and restored areas will be maintained over the long-term. Some mitigation project sites in the region are becoming invaded by invasive, non-native species after the typical 5-year maintenance and monitoring period required by the regulatory agencies. It will be important to determine how to manage these areas over time to protect on-site and off-site functions and values.
- A better understanding is needed about the conditions under which some form of hardscaping (e.g., rock riprap) can be used along streams to protect urbanized areas and channel stability. For example, Ann Riley (1998) uses groupings of rock along stream channels to emulate natural pool-riffle sequences in some of her restoration projects. These "structures" can stabilize the channel invert from downcutting and help the stream dissipate its energy, both of which can protect stream habitat within the treated stream reach.
- Changes in river and stream morphology are generally related to changes in the volume and rate of runoff and sediment supply. Implementation of BMPs may reduce these changes, but it would be difficult to quantify without better data on current and future river discharges. Consequently, a permanent station to monitor river discharge rates is warranted in the lower part of the watershed.
- Changes in the rate of erosion can have dire and costly consequences for urban infrastructure installed in or adjacent to stream channels and impair beneficial uses. A bi-annual assessment of channel stability in selected

stream reaches using a standardized classification system such as proposed by Rosgen (2001) would provide a very useful method to track changes to the stream cross-section and profile.

- Increases in bacterial concentrations in dry weather flows may affect designated recreational beneficial uses and further contribute to the impairments already identified in neighboring San Diego Bay. Implementation of an ambient bacteria monitoring program in selected receiving waters would be helpful.
- Regular bioassessments provide an integrated approach to assessing changes in the river ecosystem and water quality and provide a direct measurement of the degree to which the river supports warm water ecosystems, which is a specific beneficial use of several streams on the watershed. Previously collected data upstream of the reservoir will provide important benchmark information.
- Percent impervious cover is a proxy indicator for non-point water quality and quantity stressors within a watershed. In addition, impervious cover has received more study recently relative to thresholds for effects to aquatic life. Therefore, tracking of percent impervious cover within the watershed can provide additional information in making weight-of-evidence type evaluations of watershed effect.
- Point source water quality stressors are typically associated with industrial and commercial activities. A drill-down of commercial license databases, identifying potential pollutant sources by Standard Industrial Classification (SIC) Codes and location in terms of proximity to receiving waters, can help assess potential hotspots within the watershed.
- Trash and litter are common components of stormwater runoff, and TMDLs have been developed to address this issue in the Los Angeles area. The 303(d) Monitoring List already identifies Proctor Valley Creek as a candidate for trash and litter monitoring. Monitoring of representative storm drain outfalls (rather than the river itself) may provide useful information on the degree to which trash is contained in stormwater discharges.

C. WATERSHED STRESSORS AND STRATEGIES FOR PROTECTING, ENHANCING, RESTORING, AND MANAGING WATERSHED RESOURCES

C.1 PURPOSE OF THIS SECTION

This section describes key stressors on the health of the 145-mi^2 Otay River watershed and strategies for protecting, enhancing, and restoring watershed resources in consideration of these varied stressors. There are many dimensions to the overall health of a watershed. For example, the health of a watershed can be variously indicated by:

- Hydrology;
- Water quality;
- Floodplain functions;
- Sediment tranport;
- Integrity of habitat
- Abundance, health, and diversity of species; and
- Economic development.

These dimensions or indicators of watershed health are inter-related, so a change in one can create a stress or benefit to the others. Also, these indicators are all affected to some degree by various stressors that can be characterized as "external," or at least "extraordinary" in the stricter sense of a deviation from the ordinary condition. These stressors are sometimes natural in origin, such as wildfires or drought. Other stressors can be linked to human activity. These anthropogenic stressors are often persistent and can disproportionately affect the natural health of the watershed, including its ability to recover from adverse effects caused by natural stessors.

This section characterizes key stressors to watershed health. Because of its pervasive and persistent impact, the discussion approaches the topic from the perspective of human activites, generally categorized by land use. The first focus (Sections C.1 to C.7) is on the water quality and hydrologic effects of these land uses and activities, which often drive other watershed indicators, such as the diversity, health, and abundance of habitat and native species. The discussion categorizes these "water quality stressors" as point and nonpoint pollutant sources. The characterization is based on available data from the Otay River watershed, studies of similar watersheds, and general research on water quality stressors.

Section C.8 summarizes some of the other effects of anthropogenic and natural watershed stressors on watershed health, including alterations to hydrology and sediment transport; the direct effects of human development on habitat and species; "edge effects" of this human development; the introduction or increase in species that are harmful to native flora and fauna; and fire and erosion, which naturally occur in southern California watersheds but can be increased by anthropogenic activities. In addition to the information in Section C.8, many of these topics are covered in detail in Section B of this document.

Section C.9 specifies the strategies proposed to protect, enhance, restore, and manage this watershed's resources in consideration of the watershed stressors as economic development and other uses continue.

Types of Water Quality Stressors

Pollutants can be classified using several different categories. These categories have different definitions depending on the context in which they are used, and in many cases these definitions can overlap. This section briefly describes pollutant categories based on origin and regulation in order to facilitate the discussion of water quality stressors.

Discrete and Diffuse Pollutant Sources

Pollutants have traditionally been classified according to their physical origin. In this sense, pollutants were classified as either point (discrete) or nonpoint (diffuse) sources. Under this classification, point-source (discrete) pollutants enter transport routes at discrete, identifiable locations. Conversely, non-point (diffuse) pollutants originate from diffuse, difficult to identify, and intermittent sources usually associated with land or land use. Diffuse pollutant sources are often intermittent because they are correlated to rainfall and snowmelt events. To avoid confusion with the current regulatory classifications, it is best to describe the origin of pollutants simply as either discrete or diffuse.

Point (Permitted) and Nonpoint (Non-Permitted) Pollutant Sources

Regulations have refined the definition of point and nonpoint source pollutants since passage of the Clean Water Act (CWA) (1977) and the Water Quality Act (1987). In a regulatory sense, the definition of point and nonpoint veers away from a pollutant's origin and instead indicates where a pollutant enters receiving waters.

Under current regulations, "point source" means a pollutant entering receiving waters from a "discernable, confined and discrete conveyance." Examples of such conveyances include effluent pipes (including storm drains), ditches, channels, tunnels, rolling stock (i.e., railroad cars or vehicles), concentrated animal feeding operations, and boats. Point-source waste discharges are regulated by law, which mandates their control and requires that permits be obtained for their release. Pollutants from diffuse sources such as urban land use are considered point sources from a regulatory perspective, because they enter the stream system at discrete points such as storm drains. Thus, from a regulatory standpoint, "point sources" are synonymous with "permitted sources."

Nonpoint pollutant sources are defined simply as any pollutant source that is not a point source. Therefore, nonpoint sources are not regulated by law, and permits are not required for their release. Examples of nonpoint sources include agricultural runoff (other than from confined animal feeding operations), silvicultural runoff, pastures and rangeland, and wet or dry atmospheric chemical deposition. Federal statute excludes communities with populations of 10,000 or fewer and those without a municipal separate storm sewer system (MS4) from regulation as point sources; therefore, from a regulatory perspective, these are classified as nonpoint sources. Generally speaking, septic systems are nonpoint sources from the National Pollutant Discharge Elimination System (NPDES) standpoint, though various state and local health ordinances regulate their installation and NPDES permits monitor septic systems as part of their discharge detection requirements. Federal statute also specifically excludes return flows from irrigated agriculture from regulation as a point source.

Some non-point sources not regulated by water quality laws may be controlled indirectly by other means. For instance, health laws may regulate nonpoint sources like septic systems, and air pollution regulations can help control nonpoint source pollutants due to atmospheric deposition. Further, atmospheric deposition becomes regulated as a point source if runoff transports it to a municipal storm drain system or other permitted entity.

This discussion uses the convention of describing pollutants from the regulatory perspective, with point (permitted) or nonpoint (non-permitted) sources.

Land Uses and Affiliated Activities

There is a multiple-level and dynamic relationship between land-use, activities, and storm water pollution. Land use designations imply certain physical features, such as a degree of impervious cover. Land uses are also associated with particular activities that have the potential to generate pollutants. For instance, residential land use introduces certain physical features such as streets, rooftops, and driveways that will change the hydrologic features of a watershed. These physical elements have the potential to generate pollutants (for example, sediments or the wash-off of dry deposition).

Land use also implies many types of activities that have the potential to generate pollutants. Examples of such activities for residential land use include lawn maintenance and gardening (specifically, over-application of pesticides and herbicides); pet ownership; household trash management; and possibly automobile maintenance and washing. Each of these activities has the potential to generate storm water pollution.

Table C.1-1 (on the following page) offers further examples of land use and affiliated activities that have the potential to generate storm water pollutants. The table is not meant to be an exhaustive list of every activity that might take place given a specific land use, nor does it imply that every parcel with a given land use includes all the suggested activities. Moreover, with appropriate application best management practices, many of these activities can be accomplished with little or no storm water pollution. However, implementing BMPs to minimize storm water pollution will not necessarily prevent other types of stress to watershed health from occurring, as discussed in Section C.8.

C.2 STORM WATER QUALITY STRESSORS IN THE OTAY RIVER WATERSHED

This section presents a summary of the various classes of point (permitted) sources, and a short assessment of their relative scope and importance on the Otay River watershed. The pretext of this discussion is the potential of particular point sources for generating anticipated pollutants, and does not comment on the generation of any actual pollutants from a particular point source. Because point sources are under permit, there is (by definition) a regulatory mechanism in place for monitoring, inspecting, and enforcing pertinent water quality regulations. Section C.4 provides more detailed information on the types of pollutants mentioned in this discussion.

Point (permitted) sources can generally be classified as either municipal or industrial. Municipal point sources include municipal operations, commercial activities, and residential or urban development. Industrial point sources comprise sources from general industry and the construction industry. Some major municipal operations such as wastewater treatment plants and landfills are regulated under separate permits, or Waste Discharge Requirements (WDRs) issued by the applicable Regional Water Quality Control Board (RWQCB). The State Water Resources Control Board (SWRCB) administers the general industrial permit and construction permit; the RWQCBs administer permits for municipal point sources. The RWQCBs, along with municipalities, are charged with the day-to-day enforcement of the permits.

Table C.1-1 Land Uses, Related Activities, and Potential Storm Water Pollutants

Land Use	Related Activities	Sediments	Nutrients	Heavy Metals	Organic Substances	Trash and Debris	O_2-Demanding Substances	Oils and Grease	Bacteria and Viruses	Pesticides
Residential	Landscape Maintenance	✓	✓			✓	✓	✓	✓	✓
	Gardening	✓	✓			✓	✓	✓	✓	✓
	Pet Ownership		✓			✓			✓	
	Automobile Parking			✓	✓	✓		✓		
	Automobile Washing	✓	✓	✓	✓	✓	✓	✓		
	Household Trash Management		✓	✓	✓	✓	✓	✓	✓	✓
Commercial	Automobile Parking			✓	✓	✓		✓		
	Commercial Trash Management		✓	✓	✓	✓	✓	✓	✓	✓
	Food Service					✓	✓	✓	✓	
	Landscape Maintenance	✓	✓			✓	✓	✓	✓	✓
	Fleet Maintenance and Vehicle Fueling			✓	✓	✓		✓		
	Loading/Unloading Docks					✓		✓		
	Outdoor Material Storage	✓	✓			✓	✓			
	Equipment Washdown	✓	✓	✓	✓	✓	✓	✓		
	Outdoor Processing Areas		✓			✓	✓	✓	✓	
Parks and Open Space	Automobile Parking			✓	✓	✓		✓		
	Hiking					✓				
	Off-Road Vehicles	✓		✓	✓	✓	✓	✓		
	Picnicking and Camping					✓		✓	✓	
	Transient Population		✓			✓		✓	✓	

Land Use	Related Activities	Sediments	Nutrients	Heavy Metals	Organic Substances	Trash and Debris	O_2-Demanding Substances	Oils and Grease	Bacteria and Viruses	Pesticides
Industrial	Automobile Parking			✓	✓	✓		✓		
	Landscape Maintenance	✓	✓			✓	✓	✓	✓	✓
	Loading/Unloading Docks					✓		✓		
	Trash and Industrial Waste Management	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Fleet Maintenance and Vehicle Fueling			✓	✓	✓		✓		
	Equipment Washdown	✓	✓	✓	✓	✓	✓	✓		
	Outdoor Processing Areas	✓	✓			✓	✓	✓	✓	
	Outdoor Material Storage	✓	✓			✓	✓			
Institutional (e.g., Schools, Government)	Automobile Parking			✓	✓	✓		✓		
	Landscape Maintenance	✓	✓			✓	✓	✓	✓	✓
	Loading/Unloading Docks					✓		✓		
	Food Service					✓	✓	✓	✓	
	Fleet Maintenance and Vehicle Fueling			✓	✓	✓		✓		
	Trash Management		✓	✓	✓	✓	✓	✓	✓	✓
Agriculture	Field Crops	✓	✓				✓			✓
	Livestock	✓	✓				✓		✓	
	Equipment Maintenance and Fueling			✓	✓	✓		✓		
	Equipment Washdown	✓	✓	✓	✓	✓	✓	✓		
	Outdoor Processing Areas	✓	✓			✓	✓	✓	✓	

Source: RBF Consullting (2005) in consideration of the applicable SUSMPs.

C.2.1 Municipal Activities

Municipalities own infrastructure and facilities and engage in activities that might present a threat to water quality. Specific examples of infrastructure and facilities with intrinsic water quality implications include roads, streets, highways, parking facilities, and storm drains and flood management devices. Other facilities also have activities associated with them that present particular water quality issues. These include parks, airfields, water treatment plants, wastewater reclamation plants, landfills and transfer centers, and corporate yards. Municipalities also own and administer areas and activities tributary to impaired water bodies and/or water quality sensitive areas that might be harmful to water quality in those waters. As further discussed in Section C.8, municipal activities also stress watershed health by altering hydrology and sediment transport, directly eliminating habitat and species, causing a variety of edge effects on biological resources, introducing or increasing non-native species, and increasing the frequency of fire above natural levels.

The Municipal Permit (RWQCB-9 Order No. 2001-01, see Section C.2.5.3) regulates municipal activities on the Otay River watershed. Co-permittees operating under the Municipal Permit on the Otay River watershed include (in alphabetical order): City of Chula Vista, City of Imperial Beach, City of San Diego, the County of San Diego, and the San Diego Unified Port District. The California Department of Transportation (Caltrans) holds a separate permit that addresses stormwater pollution from major highways and other Caltrans-owned and maintained facilities.

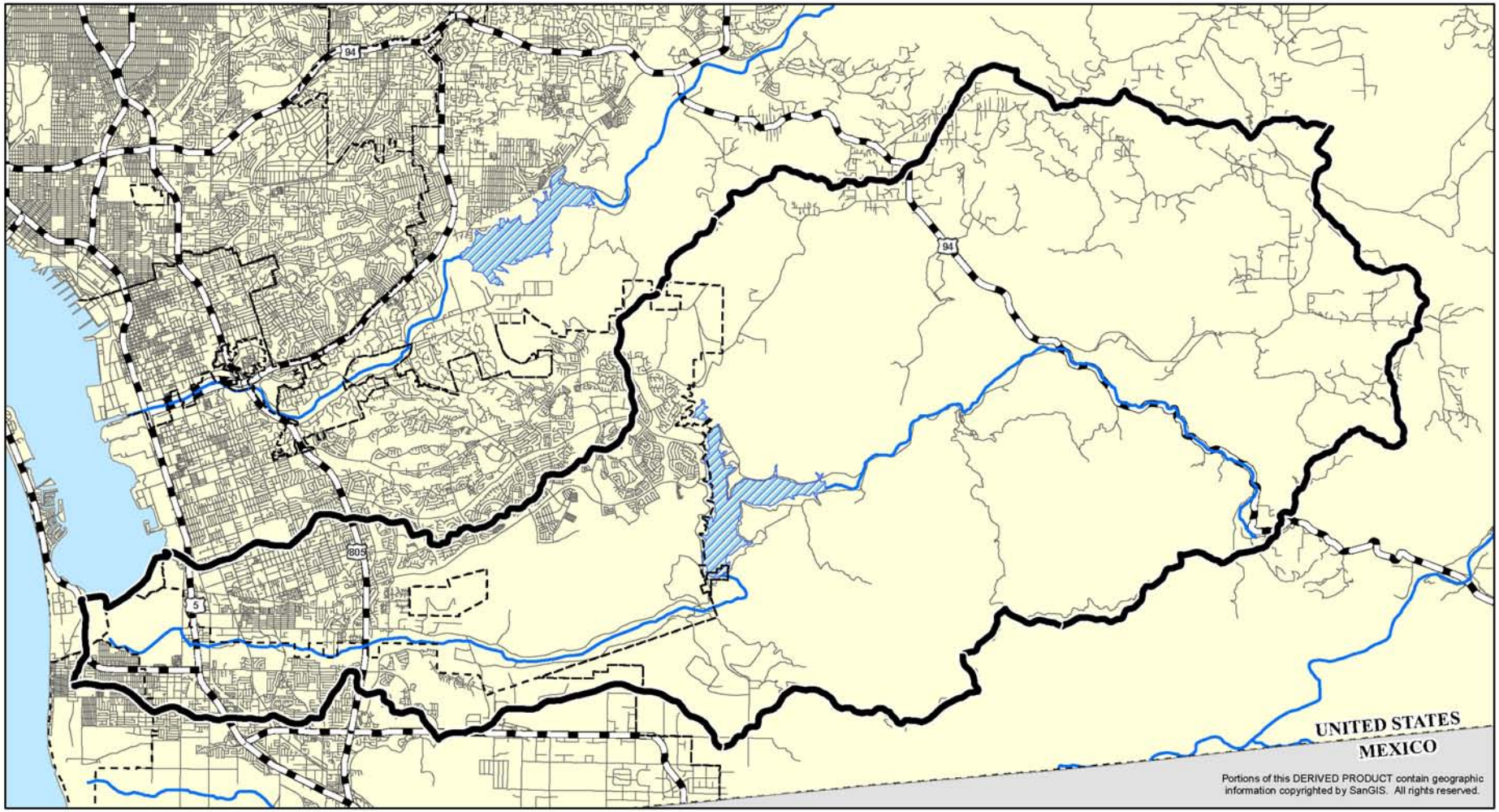
C.2.1.1 Transportation Infrastructure

Transportation infrastructure such as roads, streets, highways, and parking facilities can have significant effects on water quality. These transportation facilities can contribute to levels of sediment, heavy metals, organic compounds (including petroleum hydrocarbons), oxygen-demanding substances (see Section C.4.2), and oil and grease. Transportation facilities also generate trash and debris, and nutrients if landscaping is present on site. Transportation facilities also affect water quality through modification of natural hydrologic condition of the watershed. By adding impervious area, streets and roads tend to increase the peak runoff from a watershed; curbs and gutters tend to shorten the time of concentration in comparison to natural conditions. This alteration can increase downstream erosion potential, generate dry-weather flows that might contain pollutants, or increase the concentration of pollutants during wet weather flows.

There are approximately 524 miles of roads, streets, and highways within the Otay River watershed, mostly located downstream of the Otay Reservoir (Figure C.2-1). Major freeways include Interstate 5 and Interstate 805, both of which traverse the western part of the watershed in a north-south direction. State Route 94 is the only major highway upstream of the Otay Reservoir.

Roads and streets will continue to be built as new residential tracts are developed, primarily in the eastern portion of Otay Ranch and western parts of the watershed. State Route (SR) 125 is the only new major highway facility planned or under construction in the vicinity. SR-125 will transect the watershed from north to south just downstream of the Otay Reservoir, and is due to be complete in late 2006 (SANDAG, 2004b). Other highway projects include possible capacity enhancements to SR-94 (turning lanes and passing lanes, though no extra traffic lanes) in the eastern portion of the watershed (SANDAG, 2001).

Because much of the transportation infrastructure on the watershed was in place or under construction before implementation of the current Municipal Permit in 2001 (see discussion of Municipal Permit



Legend
- Roads
- Freeways

Basemap Legend
- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes

N

0 2.5 5
Scale in Miles

Source: TAIC, 2004

Otay River Watershed Management Plan

Figure C.2-1

Streets, Roads, and Highways on the Otay River Watershed

Aspen Environmental Group

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under "Control of Point Sources," below), these facilities have minimal measures in place for the preservation of water quality, unless they have been retrofitted with treatment-control Best Management Practices (BMPs). Facilities constructed after implementation of the Municipal Permit will have BMP measures to preserve water quality to the maximum extent practical (MEP).

Transportation infrastructure will continue to be a water quality stressor on the Otay River watershed, though the added stress of new local streets and roads (i.e., those facilities maintained by municipal governments) will be attenuated (theoretically to a level of no significant effect) by implementation of BMPs mandated by the Municipal Permit and through the CEQA and/or NEPA process. Caltrans holds a separate permit that addresses storm water pollution from major highways, such as Interstate 5, Interstate 805, SR-94, and SR-125.

C.2.1.2 Storm Drains and Flood Management Projects

Storm drains and flood management facilities (e.g., storm drainage channels and culverts) affect the quality of receiving waters. Often the facilities themselves do not generate large amounts of storm water pollutants, but rather concentrate pollutants from diffuse sources from their tributary watershed (such as roads, highways, parking facilities, urban and residential development) and efficiently deliver them to receiving waters at discrete outfalls. Because sediment and debris, along with other pollutants, tend to accumulate in catch basins and other locations in a storm drain system, storm drainage systems can change the rate of delivery of pollutants entering receiving waters into a concentrated pulse.

Storm drains and other flood management facilities also affect water quality through modification of natural hydrologic condition of the watershed. Both storm drains and flood management facilities tend to shorten the time of concentration (i.e., the time it takes for water to travel from the headwaters to the outlet of a watershed). A lower time of concentration generally results in an increase in the peak discharge rate. Impervious surfaces also reduce the infiltration capacity of natural soils, increasing the runoff volume to receiving waters. Flood management facilities such as detention basins can partially counteract these effects, but can also cause local erosion as the stream system attempts to restore sediment balance downstream of the detention facility if not designed thoughtfully.

There are approximately 80 miles of storm drain and drainage channels on the Otay River watershed. The majority of this drainage infrastructure is located on the lower part of the watershed, below the Otay Reservoir. Figure C.2-2 illustrates the relative location of storm drain facilities on the Otay River watershed.

Drainage facilities will continue to be built as new residential, commercial, and industrial tracts are developed, primarily the eastern portion of Otay Ranch and the western part of the watershed. Because much of the drainage infrastructure on the watershed was in place or under construction before implementation of the current Municipal Permit in 2001, existing facilities have minimal measures in place for the preservation of water quality, unless they have been retrofitted with treatment-control BMPs. Post-Municipal Permit facilities will have measures to help maintain water quality to the MEP, and the current regulatory climate encourages preservation of natural channels, which helps to minimize hydromodification. Hydromodification is the change in watershed hydrology as a result of urbanization. For example, lined conveyance systems tend to translate flow hydrographs (i.e., accelerate peak flood flows) rather than attenuate hydrographs (i.e., slow down and reduce peak flood flows), as do natural channels. This results in relatively greater peak discharges and concomitant potential for flooding and erosion. The preservation of natural channels provides for greater flow attenuation, as well as minor infiltration of storm water, which can reduce peak flood flow and enhance water quality.

Drainage infrastructure will continue to be a water quality stressor on the Otay River watershed, though the added stress of new drainage infrastructure will be attenuated by implementation of BMPs mandated by the Municipal Permit. The Municipal Permit also requires that Copermittees evaluate the feasibility of retrofitting existing structural flood control devices and retrofit where needed. In addition, because the Municipal Permit encourages the implementation of low-impact design principles (such as leaving natural channels undisturbed or using vegetation-based channel linings when drainage channels are modified), the potential deleterious water quality effects of additional drainage infrastructure on the watershed will be significantly minimized.

C.2.1.3 Parks and Recreation

Parks and recreational facilities can have noticeable effects on water quality. Passive recreational facilities such as bike paths, bridle paths, and hiking trails represent a low-intensity land use and level of human activity. Therefore, they generally are not considered a significant source of pollutants. Active recreational areas such as golf courses, picnic areas, swimming pools, playgrounds, and ball fields generally have higher levels of human activity and active landscape maintenance. Therefore, there is greater potential for generating pollutants from these sites. The primary water quality stressors associated with active-recreational facilities include pesticides, herbicides, and fertilizers. Active recreational facilities can also generate significant amounts of trash. Trails can become a source of excess sediment due to erosion when facilities are over-used and not maintained adequately.

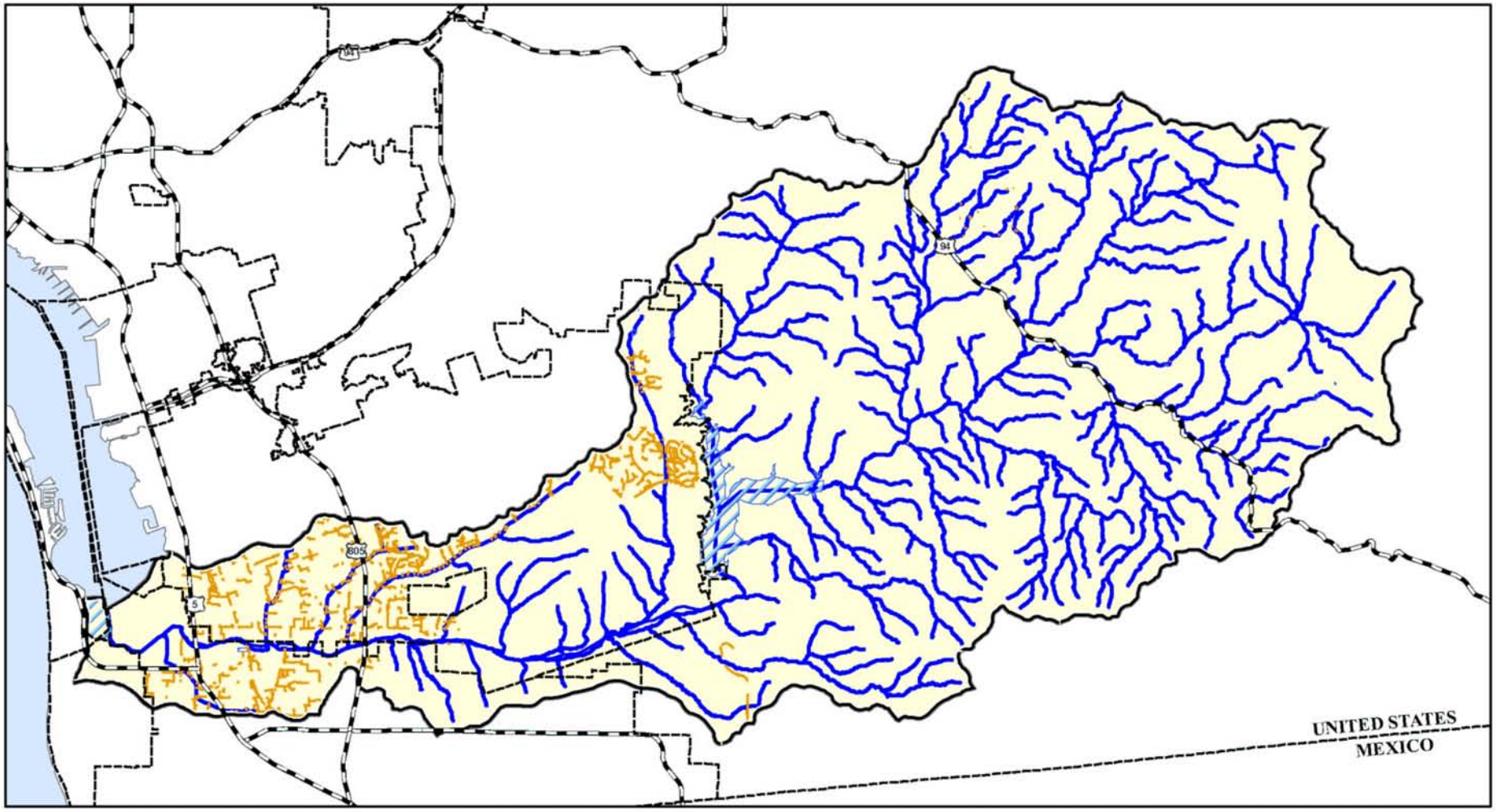
The Otay River watershed has many parks and recreational facilities, ranging from small neighborhood amenities to large regional parks. The vast majority of the recreational area on the watershed is composed of over 74,000 acres of open space and publicly owned preserves, mostly in the eastern part of the watershed (Figure B.3-16). These spaces primarily provide passive recreational opportunities. They also provide infiltration potential. The western, more urbanized part of the watershed contains many small neighborhood parks with active uses such as picnic areas and swimming pools. These parks typically have more impervious surfaces (e.g., community centers, courts, skateboard areas, parking lots, roads) and lower infiltration potential.

Future trends indicate a continued mix of small and large, active and passive recreational facilities (Figure B.3-16) As new residential tracts are developed, mainly on the western part of the watershed below the Otay Reservoir, they will incorporate neighborhood amenities such as parks, ball fields, and other recreational facilities. A major indicator of future trends for regional facilities is the Otay Valley Regional Park Concept Plan, which envisions a major regional park that extends approximately 13 linear miles along the Otay River from San Diego Bay to and around the Otay Reservoir.

Active recreational facilities will continue to be a significant water quality stressor for the watershed. In addition to sediment, nutrients and pesticides used in vegetation management are highly soluble and can create problems in receiving waters, such as eutrophication, low dissolved oxygen, and water-column toxicity.

C.2.1.4 Sanitary Sewer Systems

Aging municipal sanitary sewer systems have significant potential to become a water quality stressor when they release sewage to the surface water system. Such sewer overflows are typically acute and severe water quality stressors because sanitary sewers, which typically function by gravity, are often located in canyons or valleys in close proximity to surface waters. Sanitary sewers have many modes of failure ranging from complete collapse or breakage, slow leaks, or impinged capacity. Major sewer line



Legend
Stormwater Line Feature

Basemap Legend
Otay River Watershed Boundary
City Boundary
Rivers
Lakes

N

0 2.5 5
Scale in Miles

Source: TAIC, 2004

Otay River Watershed Management Plan

Figure C.2-2

Storm Drainage Facilities on the Otay River Watershed

Aspen Environmental Group

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failures due to collapse or breakage can send large volumes of sewerage very rapidly into local watercourses. Partial failures that cause "slow leaks" can be just as damaging to the environment, and are often more difficult to detect. In addition, tree roots often invade sewer lines and private laterals, creating a partial blockage and can lead to sewer system surcharging and significant discharges to the environment. The effects of failure could be experienced for several days up to several weeks or months.

Municipal sanitary sewers service a significant portion of the Otay River watershed downstream of the Otay Reservoirs (Figure B.3-15). Much of this infrastructure is relatively new, as it is associated with residential development in and around the Otay Ranch area. The potential for unregulated sewage releases to surface waters will increase as the sanitary infrastructure ages. The Municipal Permit Co-permittees have discharge detection and elimination programs such that any sewage discharge would likely be short-term in nature. Thus, sanitary sewer systems are not anticipated to be a significant water quality stressor on the Otay River watershed.

C.2.1.5 Other Municipal Operations

Other municipal facilities have associated activities that can present particular water quality issues. These include corporate yards, water treatment plants, wastewater reclamation plants, landfills and transfer centers, airfields, and correctional facilities.

C.2.1.5.1 Corporate Yards

Municipal operations centers, often called corporate yards, serve as hubs for providing municipal services. One of the primary functions of a corporate yard is to provide fueling and maintenance of automobile fleets and storage of equipment and supplies. Therefore, corporate yards generally have the same anticipated pollutants as streets, highways, and parking lots, as well as contributions from stored raw materials. Corporate yards also have water quality concerns with vehicle fueling; material delivery and storage; chemical handling; and the storage, handling, and disposal of waste. Potential corporate yard pollutants include sediment, heavy metals, organic compounds (including petroleum hydrocarbons), oxygen-demanding substances, and oil and grease. Corporate yards generate trash and debris, and nutrients if landscaping is present on site.

The largest municipal operation center in the Otay River watershed is the City of Chula Vista's facility located at 1800 Maxwell Road. Because these municipal facilities must have comprehensive Storm Water Pollution Prevention programs in place, municipal corporate yards should not present a significant contribution to water quality stressors on the Otay River watershed.

C.2.1.5.2 Wastewater Reclamation and Recycled Water

Wastewater reclamation facilities are municipal facilities that can have a significant effect on water quality because of their industrial nature. Some of the most significant pollutants that might be generated from wastewater reclamation facility include bacteria and viruses, heavy metals, organic compounds, total dissolved solids, and oxygen demanding substances.

There are currently no municipal wastewater reclamation facilities located on the Otay River watershed. Municipal wastewater generated on the watershed is delivered to the South Bay Water Reclamation Plant (SBWRP), which is located along the United States border with Mexico and within the Tijuana River Watershed. The SBWRP treats wastewater and provides recycled water, along with the Ralph W. Chapman Water Recycling Facility (located in the community of Spring Valley, on the San Diego River

watershed), to portions of the Otay River watershed. While not in the Otay River watershed, the SBWRP enhances water quality in the watershed by removing municipal wastewater that might otherwise make its way to receiving waters in the watershed.

Water can also be recycled by installation of commercially available "grey water" systems, where grey water such as wash water is used more than once. Grey water recyling systems can be used in a variety of contexts, including car washes and some industrial processes. Grey water recycling can alleviate potential water quality stressors on the watershed because it both reduces fresh water demand and delays the entry of water into wastewater stream.

There are two primary sources of recycled water in the South Bay region. The Ralph W. Chapman Water Recycling Facility provides tertiary treatment for up to 1.3 million gallons per day (1,456 acre-feet/year). The South Bay Water Reclamation Plant, located along the United States border with Mexico, is anticipated to ultimately produce approximately 8,400 acre-feet/year of recycled water for distribution and use in the South Bay.

The majority of the demand for recycled water is for irrigation with the potential of some industrial uses. Demand for recycled water within the City of San Diego in the South Bay region is projected to reach approximately 1,000 acre-feet/year. Demands within the Otay Water District are projected to reach approximately 7,800 acre-feet/year by 2030.

Recycled water is generally considered an asset to the regional water supply and the preservation of water resources. However, recycled water presents some water quality liabilities that should be noted. First, recycled water tends to contain high levels of nutrients and total dissolved solids (TDS). Reclaimed water from the South Bay Water Reclamation Plant is expected to contain 5-10 mg/L of nitrogen as nitrate and approximately 1,000 mg/L of TDS. Therefore, extreme over-irrigation with recycled water might present similar water quality issues as over-application of fertilizers.

Because of its source from reclaimed domestic wastewater, recycled water has an inherent chance of containing certain pathogens that are not reliably tracked by typical water quality indicators (see Section C.4.8, below). However, the risk of these pathogens causing disease is significantly lessened when using recycled water for irrigation and industrial use, as ingestion is usually required for significant morbidity.

Recycled water should not present a significant water quality stressor on the Otay River watershed, though its significance may grow with future increases in the application of recycled water for irrigation.

C.2.1.5.3 Water Treatment Plants

Water treatment plants are municipal facilities that can have a significant effect on water quality. Because of the chemical processes involved in the treatment process, water treatment facilities often have many of the same water quality issues as industrial facilities. A variety of pollutants might be generated from water treatment plants, the most significant being accidental release of chemicals used in treating raw water and disposal of the "floc" resulting from the water treatment process.

The Otay Water Treatment Plant (WTP) is located at Savage Dam, and is currently the only water treatment plant in the Otay River watershed. The treatment plant currently has a capacity of approximately 34 million gallons/day (mgd), and serves a demand that averages approximately 22 mgd. This demand varies in seasonal cycles, with maximum demand during the summer months. The average annual demand has been increasing, and the City of San Diego's current capital improvement program

calls for the Otay WTP to be upgraded to a capacity of approximately 40 mgd. Long-range projections expect the plant to supply up to 60 mgd of drinking water to the area.

The Otay WTP does not represent a significant stressor to water quality on the Otay River watershed; as long as chemicals used for the treatment of raw water such as chlorine are stored and handled in an appropriate manner, as well as chemical floc discharge from the water treatment plant. Under current operational procedure, floc from the Otay WTP is returned to the Otay Reservoir. The Otay WTP currently does not have an industrial NPDES permit. Most water quality effects of the Otay WTP are isolated within the Otay Reservoir, and the WTP has little or no direct influence on overall watershed water quality. Therefore, the Otay WTP is not anticipated to present a significant stress to water quality.

C.2.1.5.4 Landfills

Landfills can present a significant threat to water quality. The primary threat is landfill leachate, which can degrade the quality of local groundwater resources. Fortunately, most modern landfills incorporate impermeable liners and other measures to protect groundwater resources. Surface runoff that is exposed to landfill waste can bring numerous pollutants to receiving waters. Engineered landfill caps and runoff diversion and treatment systems prevent contamination of surface water, and landfills are subject to strict permitting water quality monitoring requirements. There are on-going efforts to close and "cap" older landfills without such precautions and outfit them with long-term remedial clean-up systems if necessary, as well as to detect and eliminate illegal landfill sites.

Otay Landfill

The Otay Landfill is a major regional municipal solid waste landfill located within the Otay River watershed. Otay Landfill activities take place on 464 acres south of Olympic Parkway and east of Brandywine Avenue, with 230 acres available for disposal of solid waste (CIWMB, 2004). The landfill is located on an abandoned bentonite mine and is constructed in a "canyon fill" configuration. The landfill has a maximum capacity of approximately 59.9 million cubic yards of waste, of which 44.3 million cubic yards are still available. The City of Chula Vista has established a 1,000-foot buffer around the property with no residential development permitted under current zoning. However, current zoning does allow for industrial land uses adjacent to the landfill within the 1,000-foot buffer.

Older portions of the Otay Landfill do not have an engineered liner system, but do have leachate interception barriers at the lower end of the canyon. However, newer portions of the landfill (i.e., those built since 1993) do have an engineered lining system per contemporary regulations.

Historic Fills

The Otay River watershed has several past uncontrolled grading and fill activities. The County of San Diego Solid Waste Local Enforcement Agency (LEA) has documented and characterized several of these fills (Table C.2-1). Historic grading/fill sites using burn ash and a site using shipyard sandblasting grit and demolition debris may act as sources for heavy metal contamination within the watershed due to usage of the materials as fill. The trace metals most commonly associated with burn ash include: arsenic, beryllium, cadmium, chromium, lead, mercury, nickel, copper, and zinc. The trace metals most commonly associated with sandblasting grit include: chromium, lead, nickel, and copper.

Table C.2-1 Historic Fill/Grading Potential Pollution Sites

Site	Import Material of Concern	Status
Shinohara 1	Landfill Incineration Ash	Closed; Exported to Landfill
Shinohara 2	Landfill Incineration Ash	Open, Site is Fenced-Off
Dennery Ranch	Landfill Incineration Ash	Open; In The Process of Capping
South Bay Municipal Refuse Site	Landfill Incineration Ash	Closed: Exported to Shinohara 1, Notice of No Further Action Issued
Crossing Project	Shipyard Sand Blasting Grit & Demolition Debris	Open: In The Process of Capping

Source: County of San Diego LEA (Porter, 2005)

Regulation of Landfills

The RWQCBs regulate new, existing, and former landfills through the issuance of general permits, site-specific permits, and permit waivers. The San Diego RWQCB (SDRWQCB) actively enforces such Waste Discharge Requirements (SDRWQCB Order Nos. 90-09, 93-86, and Addendums) at the Otay Landfill. The County of San Diego and SDRWQCB also target smaller and/or illegal landfills for closure when they are found on the watershed. The County of San Diego Landfill Management unit manages and maintains the County's inactive landfills and burn sites. Although these sites no longer accept solid waste, the County monitors these sites for landfill gas, groundwater quality, and maintains the sites to prevent storm water runoff contamination, and vegetation is used to control surface erosion. Such sites are also regulated by the SDRWQCB, which may require cleanup and abatement.

Modern landfill designs include a leachate collection system and a liner composed of an impermeable plastic membrane coupled with a low-permeable clay layer to protect local groundwater resources. Most scientists readily agree that even the best landfill leachate collection and lining systems can fail over the long term. There is debate whether the integrity of a landfill lining system can be maintained long enough to meet the cover needed to ensure that waste in a landfill will no longer generate leachate that threatens groundwater quality (Lee, 2004).

Because of the engineered lining systems, leachate interception barriers, and monitoring programs associated with modern landfill operations, the Otay Landfill is not expected to be a significant stressor on the Otay River watershed.

C.2.1.5.5 Airfields

Airfields have the same anticipated pollutants as facilities, streets, highways, and parking lots. In addition, airfields have special operational issues such as fuel storage. John Nichols Field is a small landing strip used for parachute jump school flights and ultralight aircraft located near Dulzura Creek upstream of the Otay Reservoir. Brown Field municipal airfield is located on the Otay Mesa on the south perimeter of the Otay River watershed. The City of San Diego has obtained coverage under the General Industrial Permit (Waste Discharge Identification or WDID No. 9-37I003024) for Brown Field. Proper implementation of the required comprehensive storm water pollution prevention program should prevent airfield facilities from being significant water quality stressors on the Otay River watershed.

C.2.1.5.6 Correctional Facilities

The Otay River watershed is home for two of the County of San Diego's major correctional facilities, the East Mesa and George Bailey Correctional Facilities. Donovan State Prison and a large privately run detention facility for federal inmates are located near the County facilities on East Otay Mesa on the south side of the watershed. Correctional facilities are associated with many of the potential stressors

typical of other urban development, including trash and debris, nutrients, and oxygen-demanding substances. County records have classified the East Otay Mesa detention facility as a commercial restaurant facility for the purposes of storm water prioritization.

Correctional facilities are termed as non-traditional NPDES Phase II entities, meaning they will receive coverage under Phase II of the NPDES program. At the time of writing, correctional facilities had not yet received coverage under the Phase II NPDES program. Coverage of these facilities is on a region-by-region basis, and should occur over the next few years. Because these facilities are subject to other regulations (for instance, health department and environmental rules), they likely do not currently present a significant source of pollutants. NPDES permit coverage requirements will provide additional assurances and ways to verify that they do not present a significant water quality stressor on the watershed.

C.2.2 Commercial and Industrial Activities

The Municipal Permit requires each Copermittee to develop a comprehensive program of storm water pollution prevention, source identification, BMP implementation, inspection, and enforcement for commercial and industrial sites and sources. The Municipal Permit identifies 25 different high-priority commercial activities that have potential to threaten water quality. Many of these priority commercial activities are mobile (e.g., carpet cleaning, pest control, painting, and landscaping services). As further discussed in Section C.8, commercial and industrial activities also stress watershed health by altering hydrology and sediment transport, directly eliminating habitat and species, causing a variety of edge effects on biological resources, introducing or increasing non-native species, and increasing the frequency of fire above natural levels.

GIS-based analysis of property tax data indicates that 3,058 acres, or 3.3 percent of the watershed, are designated with commercial or industrial uses. These parcels are generally located in the western portion of the Otay River watershed.

A meta-analysis of available industrial activity and commercial license databases was conducted to evaluate the relative magnitude and type of commercial activities taking place within the Otay River watershed. The City of Chula Vista was able to provide a well-populated database of industrial and commercial licenses, with Standard Industrial Classification (SIC) codes (now the North American Industry Classification System, or NAICS) and assessor parcel numbers (APNs) that could be geographically referenced with respect to the watershed. Many of the records in the industrial activities database were also included in the commercial activities database. The County of San Diego had a limited number of records, which were classified by watershed. At the time of document preparation, the City of San Diego and City of Imperial Beach had limited records available for analysis, which were not associated by APN or watershed. The scale and type of commercial sites in these cities were evaluated using land use maps and/or brief site visits. While not specifically quantified, commercial activities present in the City of San Diego and City of Imperial Beach are generally consistent with those in the City of Chula Vista.

The City of Chula Vista and San Diego County have identified approximately 589 fixed-location water-quality priority commercial activities, with approximately 246 commercial activities located on 174 unique parcels within the Otay River watershed. These commercial activities are classified as a priority based upon their classifications matching the categories defined in the Municipal Permit (Table C.2-2 and Figure C.2-3. The vast majority of records were from the City of Chula Vista; County records identified one auto repair shop, two restaurant facilities (County records list the East Otay Mesa detention facility as a restaurant for storm water prioritization purposes), and four nursery facilities.

Table C.2-2 Priority Commercial Activities within the Otay River Watershed

Municipal Permit Category	Industry Description	Count
(a),(c),(e)	Automobile & Boat Repair	104
(d)	Equipment Repair	32
(g)	Parking Lots and Storage	1
(h)	Retail/Wholesale Fueling	11
(j)	Eating and Drinking Establishments	84
(q)	Nurseries and Greenhouses	7
(r)	Golf Courses/Recreation	7
TOTAL		246

Source: City of Chula Vista, County of San Diego (2004). Appropriate data were not available for City of San Diego and City of Imperial Beach.

A large majority of the fixed commercial activities in the Otay River watershed are either related to automobile or boat repair and maintenance (104) or eating and drinking establishments (84). The largest category by acreage is recreational activities (206 acres), including golf courses (the Auld Course and Eastlake Country Club) and amusement parks (Knott's Soak City Water Park). Available County records did not include acreage for commercial sites. Additional businesses in the City of Chula Vista records have a priority classification, but are considered mobile and therefore cannot be associated specifically with the Otay River watershed (Table C.2-3). The County of San Diego listed 17 mobile commercial activities with addresses with ZIP codes coincident with the Otay River watershed and outside of Chula Vista.

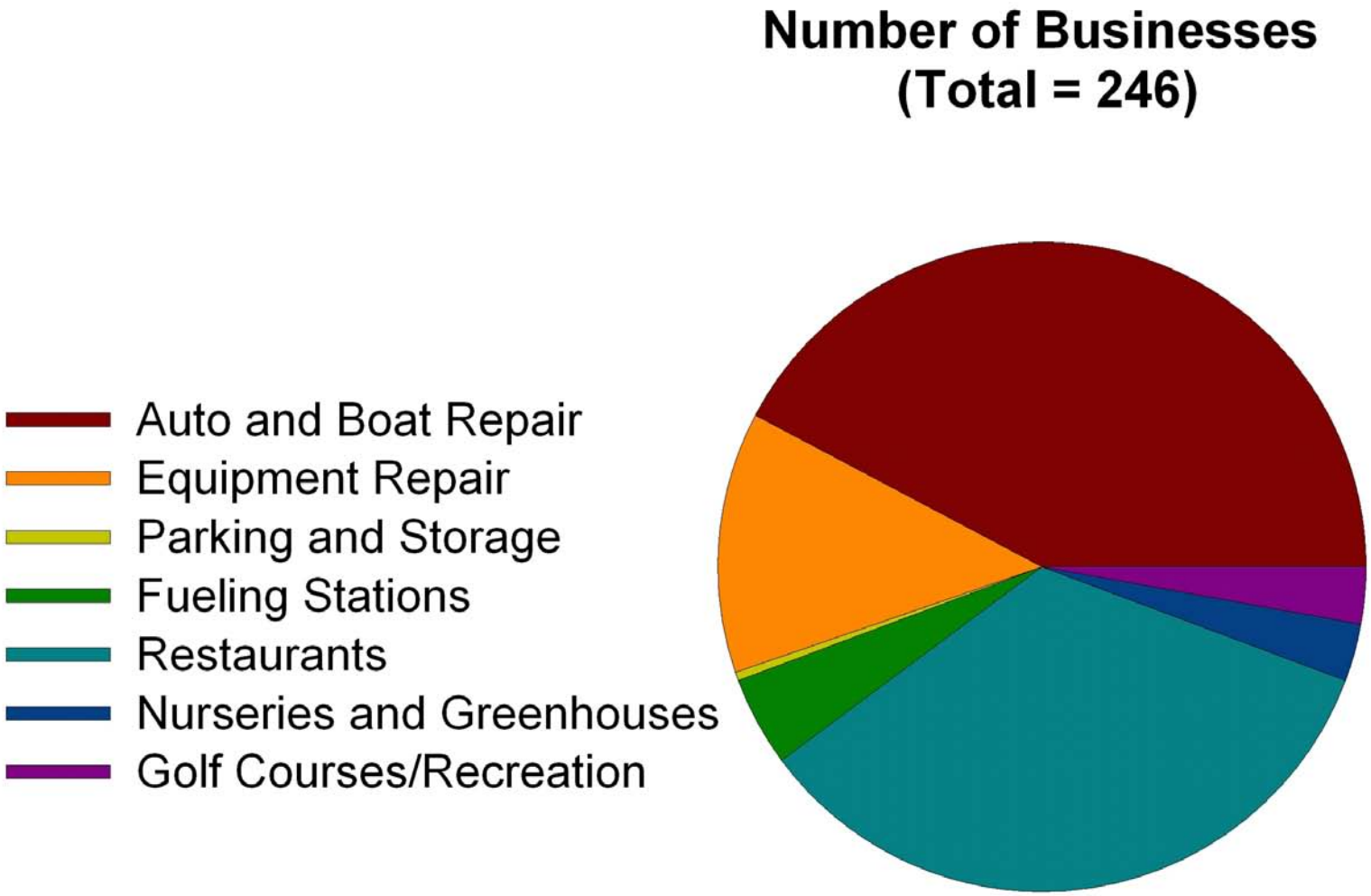
Table C.2-3 Mobile Commercial Activities near Otay River Watershed

Mobile Potential Sources	Records*
Mobile Auto or Vehicle Washing	9
Carpet, Drape or Furniture Cleaning	24
Pest Control Services	16
Cement Mixing or Cutting	17
Masonry	20
Painting and Coating	14
Landscaping	41
Pool and Fountain Cleaning	27
Port-A-Potty Servicing	0
TOTAL	168

* Sum of Chula Vista records of mobile commercial activities and County records with mailing addresses in community of Jamul.
Source: City of Chula Vista, County of San Diego (2004).

Combining information from the City of Chula Vista, City of San Diego, County of San Diego, and Imperial Beach, there are a total of 143 priority industrial sites located in the Otay River watershed (Figure C.2-4). Aside from salt evaporation ponds, there appear to be no significant commercial or industrial activities on San Diego Unified Port District lands within the Otay River watershed. These sites were classified as priority based upon their SIC code, information from previous inspections, or the fact that the SWRCB had issued an industrial storm water permit for the site. All but one (the bus maintenance facility near Lyons Valley) of these sites is located downstream or west of the Otay Reservoir. At the time this document was prepared, the SWRCB had granted Statewide Industrial Permit coverage to approximately 84 sites on the Otay River watershed.

The Statewide Industrial Permit requires industries with SIC codes to test for particular analytes (i.e., chemical compounds that are the subjects of chemical analysis), which provides a means for a qualitative assessment of the types of potential pollutants that might be generated by industrial activities



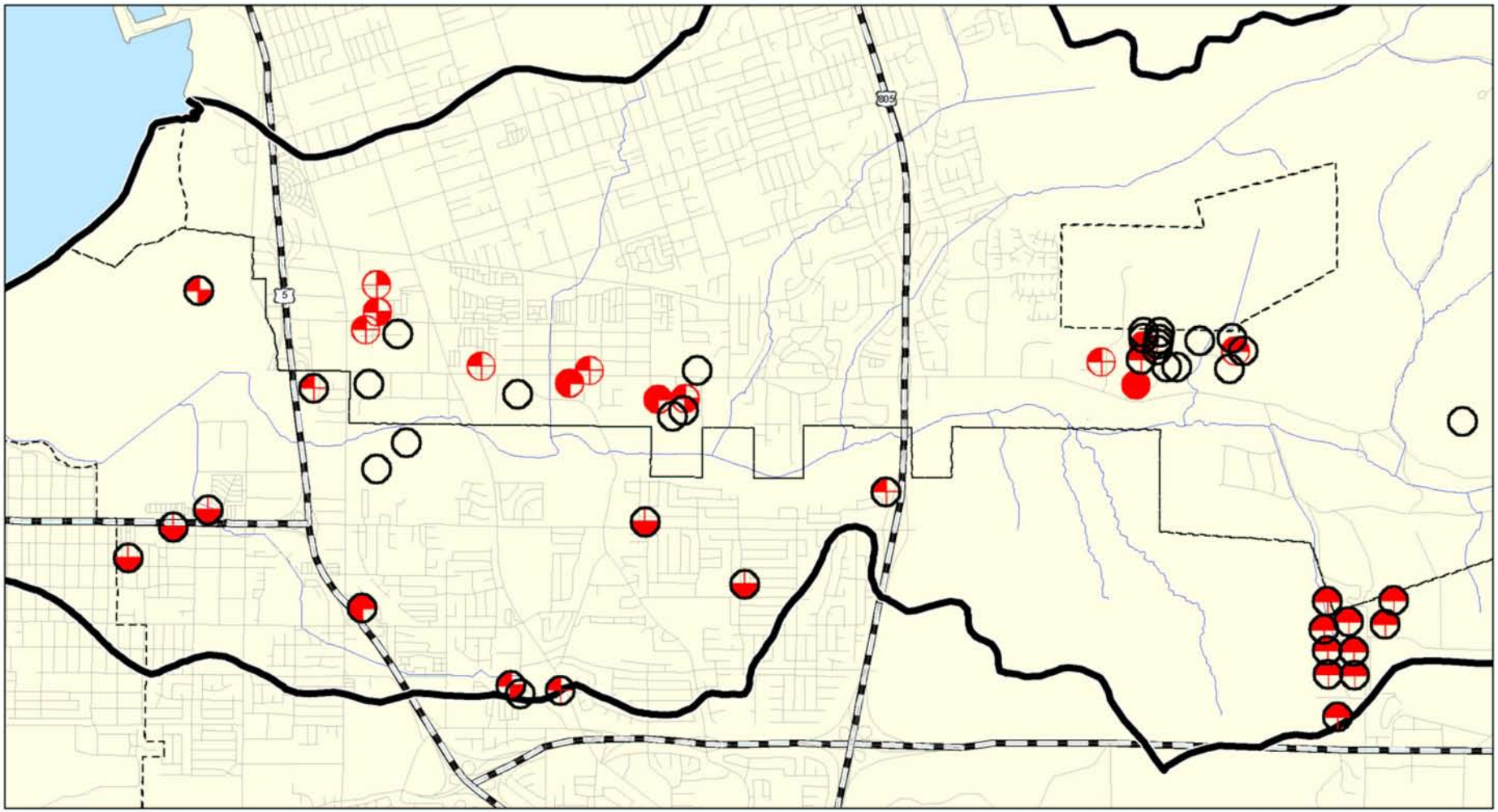
Source: City of Chula Vista, County of San Diego

Otay River Watershed Management Plan

Figure C.2-3

Priority Commercial Sites in the Otay River Watershed

Aspen Environmental Group



Legend

- Priority Industrial Site (44 sites)
- Potential Pollutant - Metals (28 sites)
- Potential Pollutant - Biological Oxygen Demand (9 sites)
- Potential Pollutant - Nitrogen and Phosphorous (10 sites)
- Potential Pollutant - Total Suspended Solids (18 sites)

Basemap Legend

- Otay River Watershed Boundary
- City Boundary
- Streams
- Roads

N

0 3000 6000

Scale in Feet

Source: TAIC, 2004

Otay River Watershed Management Plan

Figure C.2-4

Priority Industrial Activities on the Lower Otay River Watershed

Aspen Environmental Group

on the watershed. A number of the sites on the Otay River watershed might generate pollutants of concern specifically associated with their SIC code: 64 (45 percent) for metals; 54 (38 percent) for total suspended solids; 12 (8 percent) for oxygen-demanding substances; and 10 (8 percent) for nutrients.[1]

C.2.2.1 Sand and Gravel Mining

In-stream sand and gravel mining has significant effects on the geomorphology of a stream system. In-stream mining can degrade and destabilize a stream by causing headcutting, reduction in downstream sediment supply, erosion, degradation and damage to infrastructure. Off-stream mining can avoid many of these effects, but can have similar effects in the floodplain during large floods.

In-Stream Sand and Gravel Mining

Sand and gravel extraction on the Otay River has a history dating back to the 1910s. The USGS has mapped approximately nine major ponds, and twenty-two smaller borrow pits have been mapped on the Otay River Main Stem. At present, most of the useful material has been depleted from these sites and there are currently no in-stream extraction activities on the Otay River. Both the Fenton Materials and Nelson & Sloan Materials companies maintained major extraction operations on the Otay River through much of the 20th century. Fenton Materials extracted materials between I-5 and I-805 through the 1970s. The Nelson & Sloan Materials operations extended from I-805 to Otay Ranch near the Lower Otay Dam. The excavation covered most of the riverbed, with an average depth of 12 to 15 feet from original bed levels. The majority of the excavation of the lower 75 percent of the Nelson & Sloan reach was accomplished before 1973, while the Otay Ranch portion of the extraction was accomplished later. The Nelson & Sloan operations ended in approximately 1985.

The riverbed of the Otay River has a wide variation of bed materials, including sand, clay, silt, and gravel. Extensive sand and gravel extraction and the subsequent migration of foreign materials into the area have changed the original sediment distribution on the Otay River, which has affected the fluvial equilibrium of the stream and may have implications to future geomorphic changes to the system.

Off-Stream Mining Activities

There is a limited amount of off-stream mining on the Otay River watershed. The City of San Diego Water Department identifies three specific quarries upstream of the Otay Reservoir in their watershed sanitary survey (Table C.2-4).

Table C.2-4 Mining Activities within the Otay River Watershed

Site	Mining Activity	Location	Status
Ponds Borrow Pits on Otay River Main Stem	Aggregate Extraction	In-Stream	Closed
Jamul Quarry	Aggregate Extraction	Off-Stream	Closed
Jamul	Limestone Quarry	Off-Stream	Closed
Hillside Materials	Granite Quarry	Off-Stream	Closed
Hanson Aggregate Quarry	Aggregate Extraction	Off-Stream	Open
Otay Hills Quarry	Aggregate Extraction	Off-Stream	Proposed

Source: City of San Diego Sanitary Survey; USGS Maps

[1] Percentages do not necessarily add to 100 percent, as certain sites may be required to test for more than one category of analytes.

Off-stream mining can be expected to continue on the Otay River watershed for the foreseeable future. The 135-acre Hanson Aggregate Quarry, just east of Otay Valley Road and north of the Otay River, is expected to continue to operate for about the next 50 years, after which the site may be appropriate for active recreation (County of San Diego, 1997). The Otay Hills Quarry is a proposed 210-acre extraction site in the East Otay Mesa area, approximately 0.25 miles north of the intersection of Alta Road and Otay Mesa Road (USEPA, 2005). The proposed quarry operations will include phased recovery of rock resources, materials processing, concrete batch plant, cement treated base plant, asphalt batch plant, and recycling of asphalt and concrete products. Operations are expected to last approximately 50 years. The total anticipated production of the extraction operations is estimated to be 50 million tons (25 million cubic yards).

C.2.2.2 Other Historic Commercial/Industrial Land Use

Historic commercial and industrial land uses may affect water quality on the Otay River watershed, specifically in the form of impacted soils and sediments from past activities. The RWQCB has targeted one specific site on the Otay River watershed, the former Omar Rendering Facility on Otay Valley Road in Chula Vista (RWQCB, 1997). The 40-acre animal rendering facility ceased operation in 1982. It is contained within a Class 1 waste containment cell, though there is information that groundwater contamination plume may be emanating from the site.

Two other possible sites of contamination due to commercial activities are an inactive gun club and an inactive firing range (Theresa Acerro, pers. comm.) The gun club site is located on the south side of the Otay River at Heritage Road. The firing range is located in O'Neal Canyon. Both sites may be contributing lead to the environment.

C.2.2.3 South Bay Power Plant

Another significant industrial site located on or near the Otay River watershed is the Duke Energy South Bay Power Plant (SBPP). The SBPP is a fossil-fueled steam electric power generating station that began operation in 1960. The facility is located the southern edge of San Diego Bay, on a 150-acre site at 990 Bay Boulevard in Chula Vista. The SBPP generates up to 737-gross megawatt (MW) and draws up to 417,400 gpm of cooling water from San Diego Bay.

The operation of the SBPP is primarily a water quality stressor for San Diego Bay, because the intake and outflow of the plant are on that water body. Nonetheless, the SBPP outlets near the outlet of the Otay River and its thermal influences (SBPP's primary water quality stressor) might make the receiving waters of San Diego Bay more sensitive to water quality conditions in the outflows (as minimal as they generally are) of the Otay River.

Power plant discharges are heavily regulated by several agencies. In addition to RWQCB waste discharge requirements, the SBPP must comply with CWA Sections 316(a) and 316(b). Studies conducted in 2003 assessed the effect of SBPP cooling water intake and discharges to biological resources and beneficial uses of San Diego Bay. The RWQCB renewed and updated the SBPP NPDES permit at the end of 2004 (Order No. R9-2004-0154, November 2004).

Commercial and industrial activities will continue to present a potential for water pollution on the Otay River watershed. The potential for pollution may increase with development of new commercial establishments and industrial sites. However, because point sources are under permit, there is a regulatory mechanism in place for monitoring, inspecting, and enforcing pertinent water quality regulations including the Best Management Practices. Consistent inspection and enforcement permit

requirements should effectively attenuate the potential deleterious water quality effects of both existing and new commercial and industrial activities.

C.2.3 Residential/Urban Development

Residential and urban development is often a significant source of storm water pollution. As further discussed in Section C.8, residential and urban development also stresses watershed health by altering hydrology and sediment transport, directly eliminating habitat and species, causing a variety of edge effects on biological resources, introducing or increasing non-native species, and increasing the frequency of fire above natural levels.

Development and redevelopment activities have two primary effects on water quality. First, they are sources of erosion and sedimentation during the construction phase (see "Construction Activities," below). Second, they have long-term effects on runoff once the development is complete; although redevelopment, which would have to comply with the 2001 Municipal Permit, has the potential to have fewer long-term adverse effects than the original development. Residential and urban development can affect water quality in three important ways:

1. Impervious surfaces associated with development increase the rate and volume of storm water runoff, which increase downstream erosion potential.
2. Urban activities generate dry-weather or "nuisance" flows, which may contain pollutants and/or may convert ephemeral or intermittent streams to perennial streams and degrade certain habitats.
3. Impervious surfaces increase the concentration of pollutants during wet weather flows.

The potential for negative water quality effects is generally correlated to the density of development and the amount of impervious area associated with development. While correlations have not been firmly established for the arid southwest, previous studies from other parts of the U.S. have estimated that an impervious cover percentage of as little as 10 percent can result in stream degradation, with more severe degradation occurring as impervious cover increases (Schueler, 1994; Center for Watershed Protection, 1999). Recent work by the County of San Diego Department of Land Use (DPLU) (2003) has suggested protecting areas with less than 15 percent cover to avoid further degradation. Results from a study by the Southern California Coastal Water Research Project (April 2005) suggest that as little as 2 to 3 percent impervious cover can have deleterious effects on smaller watersheds (less than 5 square miles) in southern California.

At present, approximately 10 percent of the watershed has been developed with residential or other urban uses. The most intense development is located within the western part of the watershed, below the Otay Reservoirs. Less-dense development is located in the eastern headwaters of the watershed. Figure B.3-10 illustrates the estimated impervious area associated with existing residential and urban development on the Otay River watershed. As discussed in Section B.3, current regional land-use planning calls for significant increases in land area devoted to urban development, including a quadrupling of area developed as permanent residential housing (from approximately 8,958 acres to 37,092 acres). Figure B.3-14 illustrates the estimated impervious area associated with residential and urban development under projected conditions.

Residential and other urban development will continue to be one of the most significant water quality stressors on the Otay River watershed in both scope and magnitude. The stress from residential and urban development will originate primarily from intensely developed areas below the Otay Reservoirs (Hydrologic Sub-Area 910.20). Development prior to the implementation of the 2001 Municipal Permit, primarily west of Interstate 805, will generally not have BMPs to help preserve water quality.

Newer development, primarily located east of Interstate 805, will be under regulation by the Municipal Permit and will attenuate their effect on water quality by appropriate implementation of BMPs. New development is also subject to the CEQA process, other local, State, and federal regulations, including Clean Water Act Sections 404 and 401 and California Fish and Game Code 1602 permitting processes, which should attenuate impacts to water quality from future development. Low-impact planning design principles can also help minimize the effect of residential and other urban development on water quality.

C.2.4 Construction Activities

Construction activities have often been a significant source of storm water pollution. While excessive erosion and sediment are the visible pollutants from construction activities, construction activities can also generate non-visible pollutants such as metals, nutrients, pesticides, fertilizers and soil amendments, construction chemicals, and other construction waste. The magnitude of pollutants from construction sites depends on the type of construction, the timing of the activity (i.e., dry versus rainy season), and site conditions. As further discussed in Section C.8, construction activities also stress watershed health by altering hydrology and sediment transport, directly eliminating habitat and species, causing a variety of edge effects on biological resources, introducing or increasing non-native species, and increasing the frequency of fire above natural levels.

The public SWRCB database of construction storm water permits does not specify which hydrologic unit any particular construction site is located, nor Assessor Parcel Number (APN) to facilitate accurate geographic indexing of the sites. Therefore, ZIP codes were used as a surrogate for watershed location to estimate the level of permitted construction activities on the Otay River watershed. Figure C.2-5 illustrates the relative coincidence of the ZIP codes within the Otay River watershed.

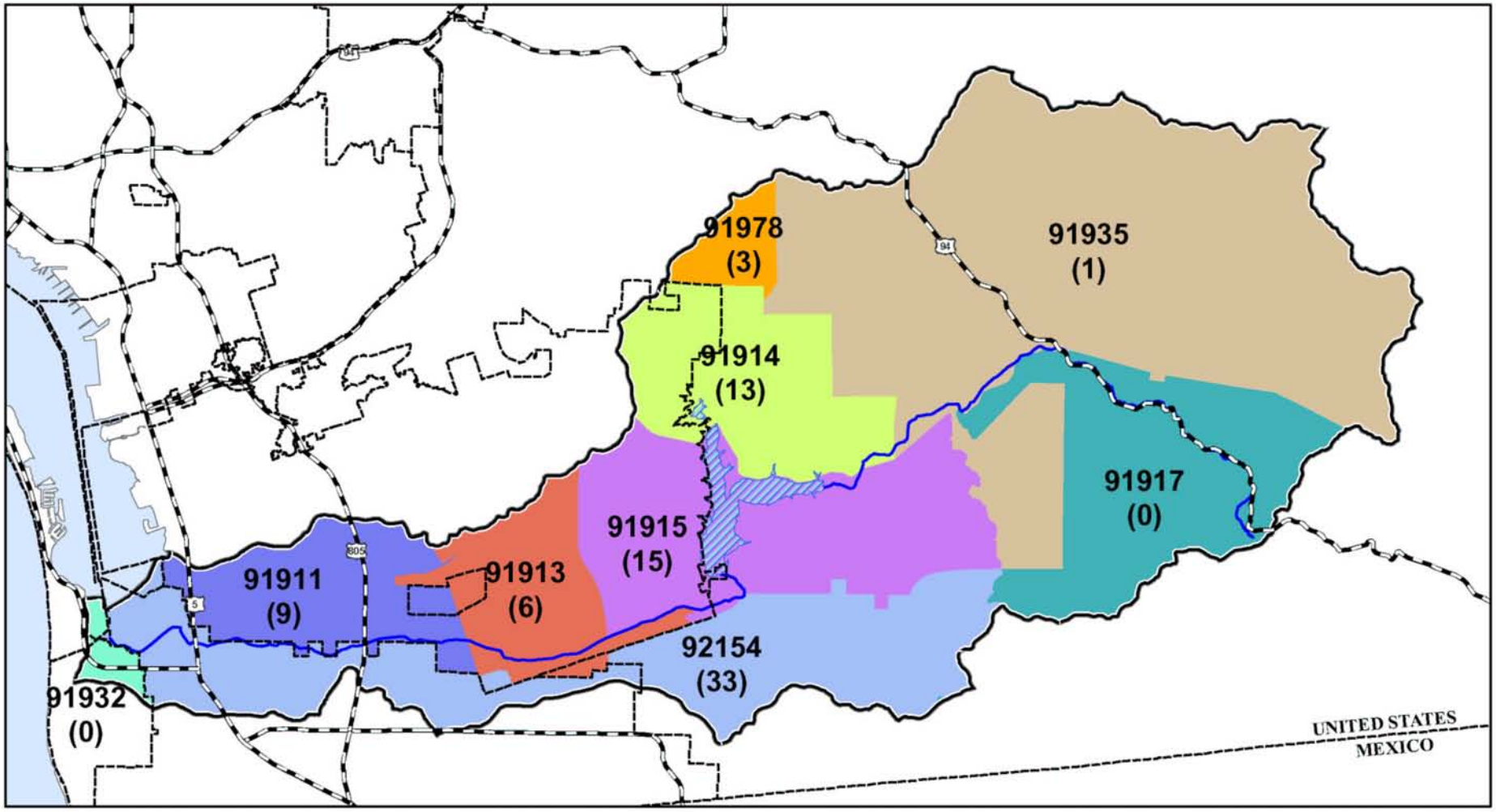
The SWRCB Construction Permit database showed 80 construction sites comprising approximately 3,430 acres within ZIP codes coincident with the Otay River watershed as of November 2004. Approximately 62 percent of the actively permitted construction area is residential development, followed by commercial (12 percent of area), industrial (7 percent) and transportation (3 percent) projects. Approximately 16 percent of the permitted construction area is designated utilities, other unclassified construction. The majority of this construction activity is located downstream of the Otay Reservoir. Figures C.2-5 and C.2-6 summarize the results of the SWRCB's construction storm water permit database.

The Otay River watershed continues to experience substantial growth in development, especially west of the Otay Reservoir, and the potential for pollution from construction activities will continue into the foreseeable future. Consistent BMP application, inspection, and enforcement of Construction Permit requirements will attenuate the negative effects of construction activities on water quality.

C.2.5 Control of Point Sources

The Clean Water Act was amended in 1972 prohibiting the discharge of pollutants to waters of the United States without an NPDES permit. In 1990, the USEPA published final regulations (commonly referred to as the Phase II rule) prohibiting the discharges of storm water to waters of the U.S. from construction projects without an NPDES permit.

The Phase II rule describes six minimum control measures that most NPDES General Permittees will need to implement. These minimum control measures will typically be implemented by applying BMPs that are appropriate to the project source, location, and climate. These six minimum control measures are:



Legend

- 91911
- 91913
- 91914
- 91915
- 91917
- 91932
- 91935
- 91978
- 92154

Basemap Legend

- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes

N

0 2.5 5

Scale in Miles

Source: TAIC, 2004

Otay River Watershed Management Plan

Figure C.2-5
Active Construction Stormwater Permits within ZIP Codes Coincident with Otay River Watershed

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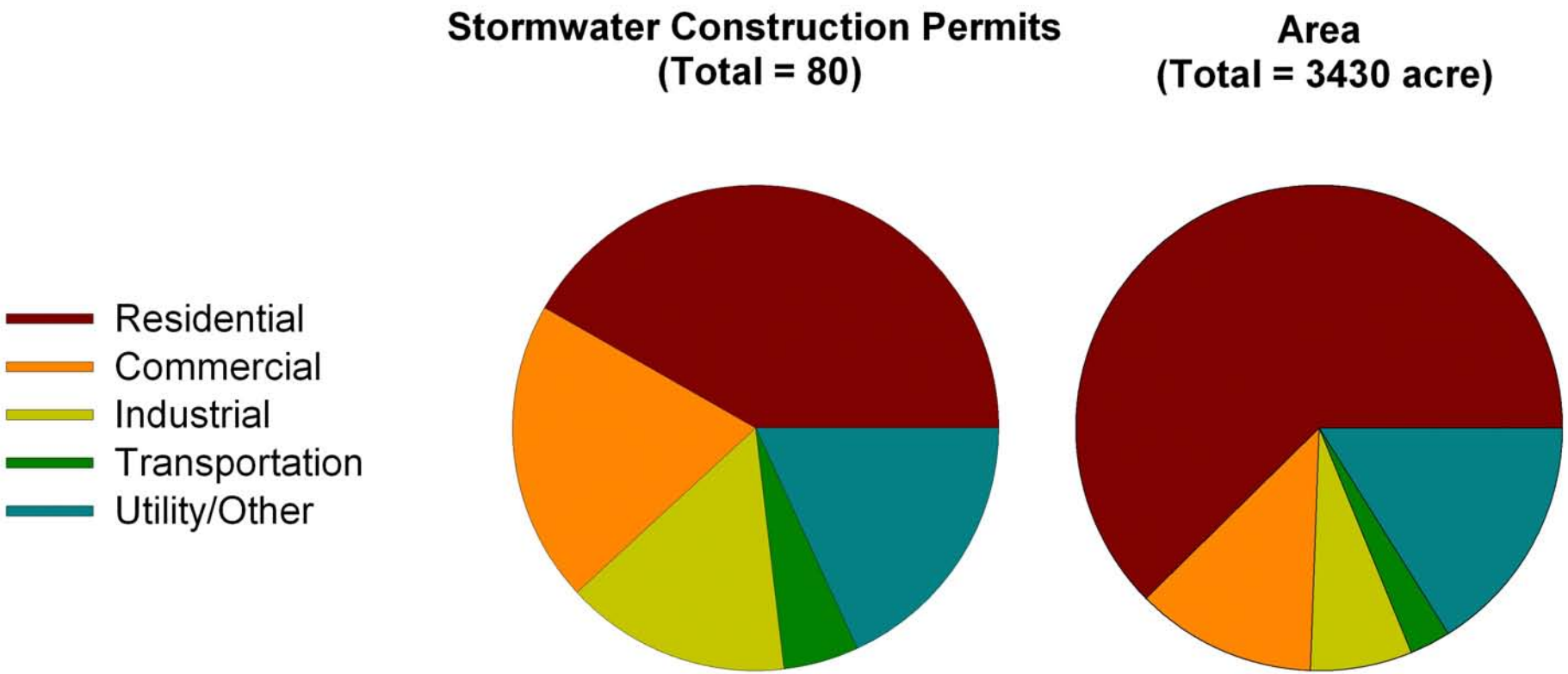


Source: SWRCB (2004)

Otay River Watershed Management Plan

Figure C.2-6

Active Stormwater Construction Permits in ZIP Codes Coincident with Otay River Watershed (November 2004)

Aspen Environmental Group

- Public education and outreach on storm water impacts;
- Public involvement/participation;
- Illicit discharge detection and elimination;
- Construction site storm water runoff control;
- Post-construction storm water management in new development and redevelopment; and
- Pollution prevention/good housekeeping for municipal operations.

The USEPA allows for two permitting options to meet these requirements, individual permits and general permits. The SWRCB has elected to adopt statewide General Permits for California that apply to all wastewater discharges except for those on tribal lands, in the Lake Tahoe Hydrologic Unit, and those generated by the California Department of Transportation (Caltrans).

There are three major general permitting programs in the State of California, covering construction activities, industrial activities, and municipal activities. These general permits provide regulatory mechanisms for monitoring, inspecting, and enforcing pertinent water quality regulations. A project or activity gains coverage under the "umbrella" of a particular General Permit by submitting a Notice of Intent (NOI) and complying with permit requirements.

The California storm water general permits mandate the use of BMPs to control storm water pollution. These BMPs must be designed to reduce pollutant discharges to the MEP, and protect receiving water quality by promoting the attainment of water quality objectives necessary to support designated beneficial uses.

C.2.5.1 Construction Permit (SWRCB Order No. 99-08-DWQ)

The Construction General Permit (SWRCB Order No. 99-08-DWQ, or the "Construction Permit") requires the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP) for all construction activities that disturb more than one acre. Smaller projects are subject to the Construction Permit if they are part of a larger, common plan of development. Construction activities subject to the Construction Permit include: all clearing, grading, and ground disturbances such as stockpiling or excavation. Regular maintenance activities performed to restore the original line, grade, or capacity of a facility are not subject to the Construction Permit. The Construction Permit is administered by the SWRCB and generally enforced by the RWQCBs and separately through Municipal Permit programs.

The heart of a Construction SWPPP is a program of BMPs that will protect storm water runoff from the project site. BMP programs include source control measures that are essentially good-housekeeping rules that prevent the exposure of runoff to pollutants. Erosion control measures aim to prevent the movement of soil particles from the construction site into storm water runoff. Sediment control measures are designed to manage and treat sediment-laden runoff before it leaves the construction site. The SWPPP must also contain a visual monitoring program; a chemical monitoring program for "non-visible" pollutants to be implemented if there is a failure of BMPs or if the project is adjacent to sensitive water bodies; and a sediment monitoring plan (if the site discharges directly to a water body listed on the 303(d) list for sediment).

The Statewide California General Construction Permit is currently being revised. It is likely that monitoring requirements will be increased as well as additional specificity provided regarding required BMP application.

C.2.5.2 Industrial Permit (SWRCB Order No. 97-03-DWQ)

Since 1990, the SWRCB has required that certain industrial businesses obtain a storm water permit in order to discharge runoff into a city's storm drain system or a local water body. The SWRCB adopted the current version of this storm water permit (SWRCB Water Quality Order No. 97-03-DWQ, or "Industrial Permit") in 1997. The Industrial Permit mandates that regulated industrial businesses develop and implement programs to prevent the contamination of urban runoff draining off their site. The Industrial Permit is intended to cover all new or existing storm water discharges and authorized non-storm water discharges as required by federal regulations. The Industrial Permit is administered by the SWRCB, and is generally enforced by the RWQCBs and separately through Municipal Permit Programs.

The Industrial Permit covers ten general categories of industrial activities, as summarized in Table C.2-5. Industrial Permittees are required to collect and analyze samples of storm water discharges. The analyses must evaluate pH, total suspended solids (TSS), total organic carbon (TOC), specific conductance, toxic chemicals, and other pollutants that are likely to be present in storm water discharges in significant quantities. In addition, certain industries are required to test for specific analytes, including metals (such as Al, As, Cu, Fe, Mg, Pb, and Zn), nitrate and nitrite, phosphorus, chemical oxygen demand (COD), and TSS.

Table C.2-5 General Activity Categories Covered by the Industrial Storm Water Permit

1. Facilities Subject to Storm Water Effluent Limitations ("Subchapter N")
2. Manufacturing Facilities
3. Oil and Gas/Mining Facilities
4. Hazardous Waste Treatment, Storage, or Disposal Facilities
5. Landfills, Land Application Sites, and Open Dumps
6. Recycling Facilities
7. Steam Electric Power Generating Facilities
8. Transportation Facilities
9. Sewage or Wastewater Treatment Works
10. Manufacturing Facilities Where Industrial Materials, Equipment, or Activities Are Exposed To Storm Water

Source: SWRCB Water Quality Order No. 97-03-DWQ, Attachment 1.

The statewide California General Industrial Permit is currently being revised. It is likely that monitoring requirements will be increased as well as additional specificity provided regarding required BMP application.

C.2.5.3 Municipal Permit (RWQCB-9 Order No. 2001-01)

In 2001, the SDRWQCB issued the second round of its Municipal Storm Water Permit (SDRWQCB Order No. 2001-01, or "Municipal Permit") under the NPDES Phase I program. The permit specifies waste discharge requirements for discharges of urban runoff from MS4s draining the watersheds of the County of San Diego, the eighteen incorporated cities of San Diego County, and the San Diego Unified Port District. The Municipal Permit outlines the responsibilities of these municipalities (referred to as "Copermittees" by the Municipal Permit), which generally include the implementation of storm water management programs, BMP programs, and storm water quality monitoring programs.

Section A of the Municipal Permit prohibits discharge into and from MS4s that might cause "pollution, contamination, or nuisance" in receiving waters, more specifically targeting discharges that might cause detrimental effect to the stated water quality objectives for receiving waters. Pollutant discharges must be reduced to the maximum extent practical before reaching receiving waters.

Section B of the Municipal Permit requires each Copermittee to effectively prohibit all types of non-storm water discharges into its Municipal Separate Storm Sewer System, unless a non-storm water discharge is authorized by a separate NPDES permit, or specifically excluded from the non-storm prohibition by the Municipal Permit. The Municipal Permit lists 17 categories of non-storm water discharges. When a discharge category is a significant source of pollutants to receiving water, Copermittees must either prohibit the pollutant from their MS4s entirely, or allow the discharge and implement BMPs that will reduce pollutants to the MEP.

Section F of the Municipal Permit requires each Copermittee to develop a Jurisdictional Urban Runoff Management Plan (JURMP). The JURMP represents an overview of a Copermittee's plan for managing urban runoff water quality at point sources within its jurisdiction. The JURMP covers municipal point sources, including municipal operations, commercial activities, and residential or urban development. The JURMP also contains industrial and construction components that complement the Industrial Permit and Construction Permit, primarily through monitoring, inspection, and enforcement measures.

Under the Municipal Permit, each Copermittee has developed a Standard Urban Stormwater Mitigation Plan (SUSMP) to reduce pollutants and runoff flows from all new development and significant redevelopment projects falling under certain priority project categories or within water quality sensitive areas.

C.2.5.4 Best Management Practices

Best Management Practices are measures that reduce or eliminate pollutants in storm water discharges and authorized non-storm water discharges. BMPs include treatment requirements, operating procedures, and practices to control site runoff, spillage or leaks, waste disposal, and drainage from raw material storage.

There are two general categories of BMPs, structural BMPs and non-structural BMPs. Structural BMPs involve the specific construction, modification, operation, maintenance, or monitoring of facilities to minimize the introduction of pollutants into the drainage system or to remove pollutants from the drainage system. Non-structural BMPs are activities, programs, and other non-physical measures that will contribute to the reduction of pollutants from diffuse sources to the drainage system.

Construction BMPs are the schedule of activities, prohibitions of practices, maintenance procedures, and other management practices that reduce or eliminate storm water pollutants and authorized non-storm water discharges during the construction phase of a project. Construction BMPs are generally temporary measures, and include activities such as soil stabilization during construction, construction materials handling procedures, and silt fence installation. Three basic categories of construction BMPs are source control/good housekeeping, erosion control, and sediment control.

Post-construction BMPs are designed as a permanent feature of a project to reduce or eliminate storm water pollutants. Like construction BMPs, post-construction BMPs can be structural or non-structural in nature. Post-construction BMPs are selected based upon the pollutants of concern, site constraints, BMP performance relative to constituents of concern, permit requirements, and watershed-specific requirements such as Total Maximum Daily Loads (TMDLs).

Post-construction BMPs are classified under three basic categories, site design, source control, and treatment control.

Site design BMPs aim to conserve natural areas and minimize impervious cover, especially impervious areas "directly connected" to receiving waters, in order to maintain or reduce increases in peak flow

velocities from the project site. The USEPA (2002) has listed several site design BMPs that can be implemented for development projects. Table C.2-6 lists site-design BMP alternatives that can be applied to a project site.

TableC.2-6 Site Design BMP Alternatives

Buffer Zones	Open Space Design
Narrower Residential Streets	"Green" Parking
Alternative Turnarounds	Alternative Pavers
Urban Forestry	Conservation Easements
Eliminating Curbs And Gutters	Landscape Design

Source-control BMPs are activities, practices, and procedures (primarily non-structural) that are designed to prevent urban runoff pollution. These measures either reduce the amount of runoff from the site or prevent contact between potential pollutants and storm water. Source-control BMPs are often the best method to address non-storm (dry-weather) flows. Table C.2-7 lists source-control BMP alternatives that can be applied to a project site.

TableC.2-7 Source-Control BMP Alternatives

Storm Drain Stenciling and Signage	Homeowner Outreach
Material and Trash Storage Area Design	Lawn and Gardening Practices
Efficient Irrigation Systems	Water Conservation
Low-Irrigation Landscape Design	Hazardous Waste Management
On-Lot Treatment Measures	Trash Management
Riprap or Other Flow Energy Dissipation	Outreach for Commercial Activities

The selection, design, and siting of structural BMPs within a project depend largely on the project-wide drainage plan. Contemporary structural BMPs that are effective in controlling the types of pollutants identified herein are listed in Table C.2-8. Table C.2-9 summarizes the effectiveness of contemporary structural BMPs in controlling the types of identified pollutants.

Table C.2-8 Treatment-Control BMP Alternatives

Vegetated Swales and/or Strips	Wet Ponds/Wetlands
Dry Extended Detention Basins	Infiltration Basins
Bio-Retention Areas	Sand or Organic Filters
Hydrodynamic Storm Water Separators	Infiltration Trenches
Catch Basin/Inlet Inserts	

Post-construction "treatment control" storm water management BMPs provide treatment for storm water emanating from the project site. Structural BMPs are an integral element of post-construction storm water management and include storage, filtration, and infiltration practices. BMPs have varying degrees of effectiveness versus different pollutants of concern (Table C.2-9). Section C.4 ("Constituents of Concern for Receiving Waters") discusses various pollutants of concern in more detail.

TableC.2-9 Treatment Control BMP Selection Matrix

Pollutant of Concern	Treatment Control BMP Categories						
	Biofilters	Detention Basins	Infiltration Basins (1)	Wet Ponds or Wetlands	Drainage Inserts	Filtration	Continuous Flow Deflection Systems (2)
Sediment	◒	○	○	○	◒	○	◒
Nutrients	●	◒	◒	◒	◒	◒	●
Heavy Metals	◒	◒	◒	○	◒	○	●
Organic Compounds	?	?	?	?	●	◒	●
Trash & Debris	●	○	?	?	◒	○	◒
Oxygen Demanding Substances	●	◒	◒	◒	●	◒	●
Bacteria	?	?	○	?	●	◒	●
Oils and Grease	◒	◒	?	?	●	○	●
Pesticides	?	?	?	?	●	?	●

○ High Removal Efficiency
◒ Medium Removal Efficiency
● Low Removal Efficiency
? Unknown Removal Efficiency

(1) Including trenches and porous pavement. (2) Also known as hydrodynamic devices and baffle boxes.
Original Sources: Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters (1993), National Storm Water Best Management Practices Database (2001), and Guide for BMP Selection in Urban Developed Areas (2001).

C.2.5.5 Source Water Protection Guidelines

The City of San Diego Water Department has developed *Source-Water Protection Guidelines for New Development* (Guidelines) (City of San Diego Water Department, 2004) to guide future activities in watersheds that drain into drinking water reservoirs (including the Otay Reservoirs) in San Diego County. The Guidelines facilitate site design, planning, and selection of BMPs that protect or improve the quality of runoff draining into the reservoirs. The Guidelines specifically address pollutants of concern to drinking water supply, and tailor a BMP selection process that emphasizes BMPs that will best protect drinking water supplies. The Guidelines provide an evaluation form, decision guides, a BMP treatment technologies matrix (similar to Table C.2-9), and BMP summary data.

C.3 NONPOINT (NON-PERMITTED) SOURCES

This Section discusses major nonpoint (non-permitted) pollutant sources of concern on the Otay River watershed, including: agriculture, silviculture, and other non-permitted sources. Nonpoint sources are controlled primarily through the implementation of BMPs, though there is no regulatory mandate to apply nonpoint source BMPs unless a receiving water is subject to TMDL limitations (see Section C.5.2).

C.3.1 Agriculture

Agricultural nonpoint source pollution enters receiving waters by direct runoff to surface waters or seepage to ground water. The nonpoint source pollutants typically associated with agriculture are nutrients, pathogens, sediments, and herbicides and pesticides. Runoff of nutrients can result from excessive application of fertilizers and animal waste to land, and from improper storage of animal waste. Farming activities can cause excessive erosion, which results in sediment entering receiving waters. Improper use and over-application of herbicides and pesticides can cause water column and sediment toxicity. Improper grazing management can cause erosion, soil compaction, and excessive nutrients, all of which impair sensitive areas. Over-application of irrigation water can cause runoff of sediments and pesticides to enter surface water or seep into groundwater. Sediment, pesticides, and excess nutrients all affect aquatic habitats by causing eutrophication, turbidity, temperature increases, toxicity, sanitary quality problems, and decreased dissolved oxygen. As further discussed in Section C.8, agricultural activities also stress watershed health by altering hydrology and sediment transport, directly eliminating habitat and species, causing a variety of edge effects on biological resources, introducing or increasing non-native species, and increasing the frequency of fire above natural levels.

The Otay River watershed has supported Western-style agriculture since non-native settlement of the region and the founding of the Missions in 1769. Historically, agricultural activities have not been very intense, characterized by free-range cattle and crop production. Agriculture on the Otay River watershed has declined in contemporary times, and livestock is generally limited to equestrian "ranchettes" on the more rural eastern parts of the watershed. Currently, land use on approximately 1,741 acres (1.9 percent) of the watershed is characterized as agriculture. Figure C.3-1 illustrates the location of agricultural areas in the Otay River watershed. Agricultural activities are expected to remain at existing scale and intensity in the foreseeable future.

C.3.1.1 Agricultural Nonpoint Pollution BMPs

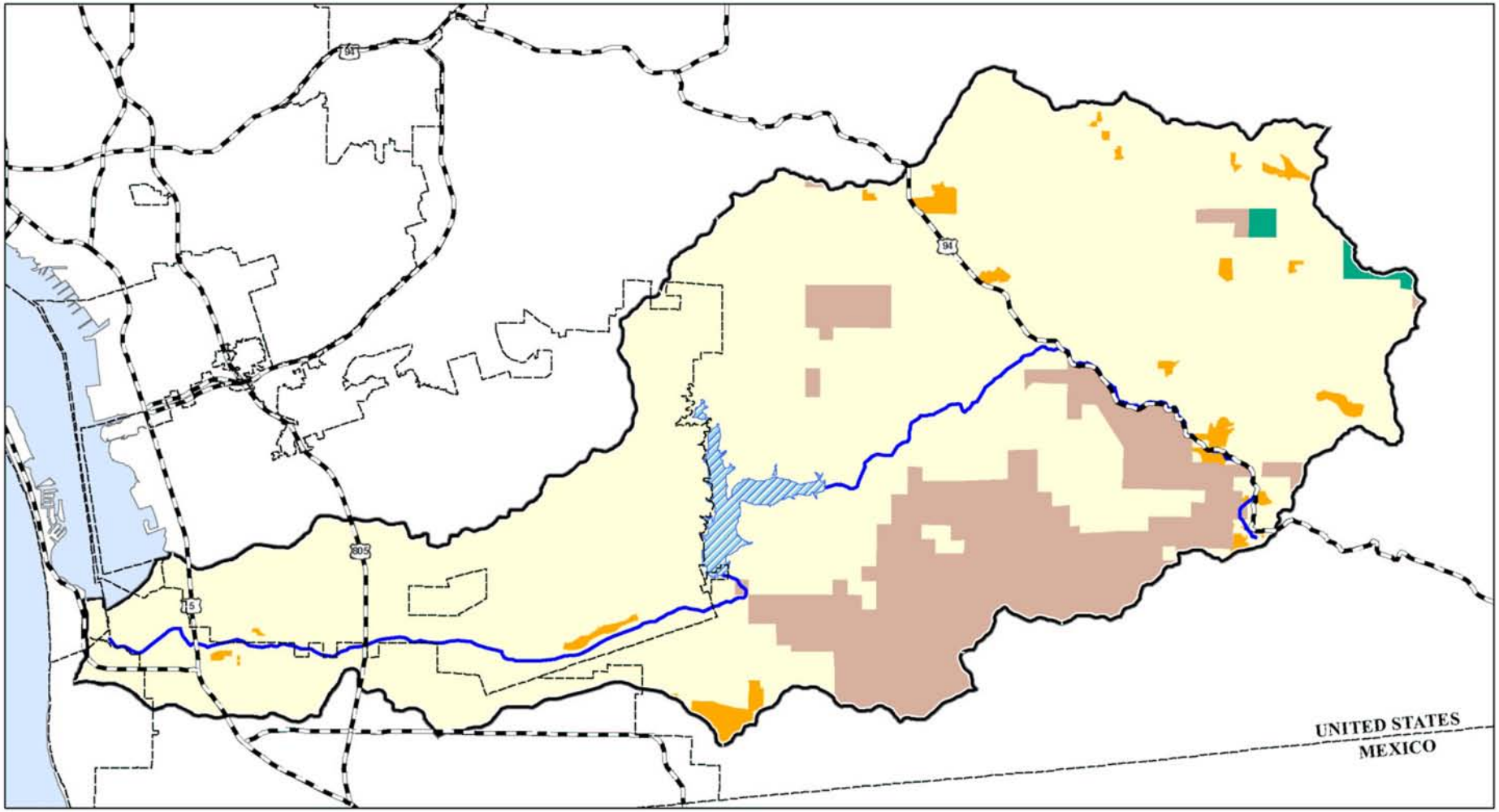
There is a large, well-established suite of BMPs for the control of agricultural nonpoint source pollution. The SWRCB has identified seven specific measures for the control of agricultural nonpoint source pollution:

- Erosion and sediment control
- Non-CAFO Wastewater and Runoff Control
- Nutrient Management Programs
- Pesticide Management Programs
- Grazing Management Programs
- Irrigation Management Programs
- Education and Outreach

The current discussion explains BMPs in an agricultural context. However, the fundamental bases of many of these BMPs can be applied in urban and suburban settings through the landscape management of lawns, gardens, and public parks.

C.3.1.1.1 Erosion and Sediment Control

The purpose of erosion and sediment control measures is to prevent and reduce the amount of soil entering surface water. Strategies recommended for the control of rill and sheet erosion, streambank erosion, soil mass movement, and irrigation-induced erosion include:



Legend
- Agriculture
- Bureau of Land Management
- U.S. Forest Service

Basemap Legend
- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes

N

0 2.5 5
Scale in Miles

Source: TAIC, 2004

Otay River Watershed Management Plan

Figure C.3-1

Forest and Agriculture on the Otay River Watershed

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- Leaving crop residues on the field, planting cover crops or other vegetative cover, and applying mulch to bare fields.
- Contour farming (i.e., grading fields to reduce slope length, steepness, or unsheltered distance), terraces, and/or diversions can be used to reduce slope length.
- Installation of cross-wind strips and hedgerows, trees, and shrubs along edges of fields or against prevailing winds to prevent wind erosion.
- Crop rotation (i.e., planting crops in a recurring sequence on the same field) and conservation tillage to improve soil properties and improve water infiltration.
- Installation of filter strips, field borders, fiber mats, and buffers to filter and trap sediment before it leaves the field.
- Installation of grassed waterways to prevent gullies and to filter and trap sediment.
- Installation of sediment ponds, basins, and traps to treat sediment-laden runoff.

C.3.1.1.2 Non-CAFO Wastewater and Runoff Control

Non-concentrated animal feeding operations (Non-CAFO) are operations that fall below the regulatory limits defined by the USEPA (40 CFR Parts 9, 122, 123, and 412). Smaller animal feeding operations, while not required to obtain a NPDES permit, must implement best management practices to contain wastewater and contaminated runoff from their operations. These BMPs include:

- Appropriately sized manure storage structures that store facility wastewater and contaminated runoff at all times, up to and including storms exceeding a 25-year, 24-hour frequency event.
- Protective cover from rainwater for dry manure.
- Development of a nutrient management plan, and land-apply manure and process wastewater in accordance with the plan.
- Diversion of clean water around feedlots and holding pens, animals, and manure storage facilities through the use of berms, diversions, roofs, or enclosures.
- Proper disposal of animal carcasses.
- Proper lining of waste lagoons with impermeable lining and installation of concrete pads for solid storage and animal traffic areas to prevent seepage of liquid wastes into ground and surface water.

C.3.1.1.3 Nutrient Management Plans

The development and implementation of a comprehensive nutrient management plan will reduce the nutrient loss from agricultural lands. A nutrient management plan entails a careful evaluation of field conditions and crop nutrient needs to establish a mix of nutrient sources and requirements for the crop based on realistic yield expectations. The fundamental basis of a nutrient management program is to apply nutrients as prescribed on the label with respect to timing and rate of application. The nutrient management program should also address proper maintenance, calibration, and operation of nutrient application equipment.

C.3.1.1.4 Pesticide and Herbicide Management Programs

The development and implementation of a comprehensive pesticide and herbicide management program will reduce or eliminate pesticide and herbicide runoff into surface water. The fundamental basis of a management program is to apply compounds as prescribed on the label with respect to timing and rate of chemical application. Integrated pest management can reduce the amount of chemicals required to manage pest damage. Pesticide and herbicide management programs also include good housekeeping

measures to prevent spills, measures to protect surface waters from spills if they do happen, and proper maintenance of application equipment.

C.3.1.1.5 Grazing Management Programs

Grazing management programs protect sensitive areas such as streambanks, lakes, wetlands, estuaries, and riparian zones by reducing direct loadings of animal wastes and sediment. Grazing management can achieve this through several means, including:

- Carefully monitoring and manage grazing intensity, frequency, and duration.
- Installing fencing, hedgerows, or other measures to keep animals, people, and/or vehicles out of drainage courses and away from sensitive areas.
- Discouraging animals from seeking out streams by installing alternative drinking sources (e.g., water troughs) and providing shade and nutrients away from streams and sensitive areas.
- Providing stream crossings to minimize impacts on stream habitat and water quality.
- Providing improvements such as stabilized access roads, trails, and walkways that will help contain vehicular, foot, and animal traffic and limit damage to sensitive areas.

C.3.1.1.6 Irrigation Management Planning

Irrigation management measures help ensure that irrigation water is applied in a manner that ensures efficient use and distribution of the water and minimizes runoff and soil erosion. An irrigation management plan comprises a careful evaluation of crop water needs and the hydrologic characteristics of the soil. Irrigation facilities should control the application and timing of irrigation to minimize water runoff and soil erosion.

C.3.1.1.7 Education and Outreach

Education and outreach measures provide greater understanding of watersheds and increase the use of the agricultural standards and practices discussed here. Educational materials that have been developed to address the many agricultural activities and practices affecting nonpoint source pollution are widely available. The University of California Division of Agriculture and Natural Resources (http://anrcatalog.*ucdavis.edu/index.ihtml*) offers information about agricultural BMPs and many other topics. Public education and outreach programs are most effective when they are tailored for the stakeholder group or audience they are designed to reach. The basic components of education and outreach campaign might include:

- Training programs to teach proper application of agriculture management practices.
- Bulletin boards or other information centers for farmers, growers, and producers to obtain information on nonpoint source (NPS) pollution prevention techniques, technologies, information resources, and idea sharing.
- Fact sheets, flyers, and pamphlets on controlling agricultural NPS pollution.
- Handbook for local or regional producers and growers with recommended practices and standards to meet BMP requirements.
- Meetings with local stakeholders.
- A directory of farm advisors, crop advisors, and nutrient management planners for producers and growers to contact for technical advice.
- Local extension service offices and Natural Resources Conservation Service (NRCS) offices to establish certification and continuing education programs in comprehensive nutrient management planning, grazing, irrigation, and pesticide management.

C.3.2 Silviculture

The field of silviculture (i.e., forestry) includes the management of the establishment, growth, composition, health, and quality of forests and woodlands to meet the diverse needs and values of landowners and society on a sustainable basis (SAF, 1998).

Forestry operations can often degrade water quality, primarily through increased sediment concentrations due to accelerated erosion. Other effects of forestry on water quality include increases in water temperatures due to removal of overstory riparian shade, depletion of dissolved oxygen because of debris accumulation, and increased concentrations of organic and inorganic chemicals because of harvesting and fertilizers and pesticides. Other pollutants of concern include nutrients, toxic chemicals and metals, organic matter, pathogens, and herbicides and pesticides. Forest harvesting can also affect the hydrology of a watershed, and hydrologic alterations within a watershed have the potential to degrade water quality and adversely affect wetlands.

Historically, the Otay River watershed has not supported significant forest industry in the context of wood or paper products. Forests on the eastern part of the watershed were likely used as a source of timber in the early days of settlement in San Diego County, but there is currently no industrial forestry present on the watershed. Silviculture on the Otay River watershed therefore primarily consists of the preservation, maintenance, and restoration of recreational and wildlife habitat resources in areas such as the Cleveland National Forest (CNF).

The 460,000-acre CNF is the southern-most National Forest in California, and was established in 1908 by the consolidation of the Trabuco Canyon and San Jacinto National Forests. Figure C.3-1 illustrates the location of the forest and other preserved land in the Otay River watershed. The forest offers a wide variety of terrains and recreational opportunities. Recreation residences (summer homes) were first established in the CNF as early as 1920. Today, there are 330 recreation residences located within 16 recreation residential tracts in the Forest (85 lots in the Trabuco Ranger District and 245 lots on the Descanso Ranger District).

The SWRCB has identified twelve specific measures for the control of nonpoint source pollution associated with forestry activities, including: pre-harvest planning; streamside management areas; road construction/reconstruction; road management; timber harvesting; site preparation and forest regeneration; fire management; revegetation of disturbed areas; forest chemical management; wetlands forest management; post-harvest evaluation; and education and outreach. Most of these BMPs are applicable in the context of tree harvest for wood and paper products. Therefore, they have little application to forestry practices on the Otay River watershed.

Because of the lack of industrial silviculture, forestry does not present a significant water quality issue for the Otay River watershed. The most significant nexus of water quality and silvicultural practice on the Otay River watershed is the management of wildfires that periodically sweep through the region. An example of this was the devastating Cedar Fire of October 2003, which burned almost 275,000 acres of forest, a portion of which was in the Otay River watershed (Table B.1-1 and Figure B.1-5). In total, the Cedar Fire and the October 2003 Otay Fire burned nearly 28,000 acres of habitat in this watershed.

Watersheds affected by wildfires experience hydromodification in the form of an increase in peak runoff flow rate and volume, partially due to lack of vegetative cover and the tendency of soils to become hydrophobic after a fire. Post-wildfire watersheds are prone to erosion and runoff will carry pollutants such as suspended solids. Therefore, post-wildfire erosion control (e.g., erosion control

mats, fiber rolls, and silt barriers) and forest restoration have a significant role in helping to preserve water quality and maintaining the beneficial use of waters on the watershed after burn events.

C.3.3 On-Site Wastewater Disposal (Septic Systems)

On-site wastewater disposal systems typically consist of a septic tank and a soil absorption system, such as a leach field or seepage pit. These septic systems are a relatively inexpensive and effective method of wastewater treatment in low-density areas if they are correctly designed and responsibly maintained. However, when systems fail, poorly treated effluent may surface and drain to nearby storm drain systems and receiving waters. About 15 percent of people living in unincorporated areas of San Diego County use some type of on-site system for the treatment and disposal of domestic wastewater (County of San Diego Department of Environmental Health, 2004). Nearly all the Otay River watershed east of the Otay Reservoirs is outside the municipal sewer service area and must depend on on-site wastewater disposal (Figure B.3-15).

Water quality regulations such as the Municipal Permit address septic systems primarily in the context of illegal discharge detection and elimination; other regulations effectively protect water resources through their requirements. By County ordinance, septic systems must maintain a minimum clearance from potable water supply, including at least 5 feet of unsaturated soil between the bottom of the sewage disposal system and the highest anticipated ground water level for the site. Septic systems (including both tanks and leach lines) must be set back at least 50 feet from drainage courses, and at least 100 feet from a flowing stream.

There are no data specifically regarding failure rates of septic systems on the Otay River watershed. The San Diego County Department of Environmental Health estimates that overall, septic systems fail at a rate of less than 1 percent during the first ten years of operation (Giesick, 2005). A recent survey of septic systems in Orange County, California found a failure rate of approximately 1.25 percent (Orange County, 2003). This finding was consistent with a similar study in Oregon, which recorded a failure rate of 1.3 percent. Literature indicates that while excessive water and insufficient capacity contribute to septic system failure, most failures are primarily due to poor operation and maintenance (O&M).

The Orange County study concluded that septic systems did not represent a significant source of constituents of concern for receiving waters, primarily because failure rates are relatively low. In addition, the flow path of septic tank effluent to receiving waters provides for significant storage and infiltration, as well as opportunity for discovery and correction, prior to the possibility of conveyance and discharge to receiving waters. Finally, there is a steady conversion of septic systems to sewer service as service becomes available in rural areas, and as existing homes are sold and connections are made to available service by the new owner.

The most effective BMP for controlling nonpoint source pollution from septic systems is source control through periodic homeowner education. This education can be reminder notices to service septic systems, and notification to homeowners with septic systems when sewer system service becomes available in their area. Regulation of the construction of new systems, and regular maintenance of existing systems will remain the foundation of the program to ensure that septic systems do not adversely impact receiving waters.

C.3.4 Illegal Dumping, Transient Encampments, and Litter

Because these sources are illegal and most are somewhat diffuse by nature, dumping, transient encampments, and litter are not very easily quantified or resolved. The most common pollutants

associated with these sources are trash and debris, though they may generate significant amounts of other pollutants of concern. These issues are a particularly consistent and recurring problem on urbanized watersheds such as the Otay River. As further discussed in Section C.8, these activities also stress watershed health by altering hydrology or sediment transport, directly eliminating habitat and species, causing a variety of edge effects on biological resources, introducing or increasing non-native species, and increasing the frequency of fire above natural levels.

Illegal dumping commonly occurs as scofflaws attempt to avoid tipping fees at municipal landfills. Illegal dumpsites commonly contain construction or demolition debris and household waste. Thickly vegetated open spaces such as floodplains of urban rivers offer ideal locations for transient encampments. Transient encampments are filled with building materials (used for constructing shelters) and all manner of household wastes. With no sanitary facilities available, transient encampments are a source of human sanitary waste. Drug paraphernalia is also commonly found in transient encampments, which present a unique pollutant of concern with implications for both public health and water quality.

Litter is common in areas without adequate trash control facilities. These might include locations without a collection system or a system that is easily overwhelmed (e.g., areas with few public trash receptacles or small dumpsters with infrequent collection). It is often more difficult to enforce litter-control regulations in remote areas (e.g., remote campgrounds and hiking trails), and therefore, it is easier to ignore or circumvent proper trash disposal methods. Roads and freeways generate significant trash and debris due to litter-control offenders and more importantly, litter blowing off from transport vehicles.

Illegal dumping, transient encampments, and litter are significant issues on the Otay River watershed. For instance, in one weekend-long OVRP clean-up project on the Otay River main stem, crews removed 60 tons of trash and cleaned up eight homeless encampments (OVRP, 2005). The RWQCB has placed Proctor Valley Creek on the SWRCB's 303(d) Monitoring List for trash.

Control of illegal dumps, homeless encampments, and litter require perennial efforts for both prevention (source control BMPs) and clean up (treatment control BMPs). Volunteer efforts such as the Western Otay River Valley Park Cleanup Project identify and clean up illegal dumps and pick up litter, effectively operating as non-structural treatment-control BMP for trash. The County of San Diego and SDRWQCB also target smaller and/or illegal landfills for clean up and closure when they are found on the watershed. Structural treatment control BMPs can also effectively exclude trash and debris from streams and rivers.

Trash and debris problems are also very amenable to source control measures. Public education and outreach such as recycling campaigns are effective means of reducing the amount of trash and debris generated on the watershed. Other variations on source control include offering social service referrals to encourage transients to leave the area and installing fencing and trimming foliage to prevent re-establishment of transient encampments.

C.4 CONSTITUENTS OF CONCERN FOR RECEIVING WATERS

Constituents or pollutants of concern are determined by correlating the potential pollutants generated by a particular activity to the beneficial uses and impairments (if any) of downstream receiving waters. This section presents a general summary of pollutant categories, their potential effect on beneficial uses, and specific impairments (or potential impairments) that have been identified on the Otay River watershed.

Water quality reflects the type and quantity of chemical constituents and state of indicators in water, expressed in terms of measurable quantities and related to intended beneficial water use. Beneficial uses on the Otay River watershed tend to focus on the general categories of recreational uses and habitat uses as well as drinking water supply from the Otay Reservoir system. Tables C.4-1 through C.4-4 compile the beneficial uses for waters in the Otay River watershed as described in the San Diego Basin Plan (SDRWQCB, 1994, as amended).

Table C.4-1 Beneficial Uses of Downstream Inland Surface Waters (RWQCB, 1998)

Receiving Water (Hydrologic Unit Code)	Beneficial Use														
	Municipal/Domestic Supply	Agricultural Supply	Industrial Service Supply	Industrial Process Supply	Groundwater Recharge	Freshwater Replenishment	Hydropower Generation	Contact Water Recreation	Non-Contact Water Recreation	Significant Biological Habitats	Warm Freshwater Habitat	Cold Freshwater Habitat	Wildlife Habitat	Rare Species	Fish Spawning and Development
Jamul Creek (HSA 10.34)	●	●	●	●				●	●		●		●		
Jamul Creek (HSA 10.33)	●	●	●	●				●	●		●		●		
Jamul Creek (HSA 10.36)	●	●	●	●				●	●		●		●		
Dulzura Creek (HSA 10.37)	●	●	●	●				●	●		●		●		
Dulzura Creek (HSA 10.36)	●	●	●	●				●	●		●		●	●	
Dutchman Canyon (HSA 10.36)	●	●	●	●				●	●		●		●		
Pringle Canyon (HSA 10.36)	●	●	●	●				●	●		●		●		
Sycamore Canyon (HSA 10.36)	●	●	●	●				●	●		●		●		
Hollenbeck Canyon (HSA 10.36)	●	●	●	●				●	●		●		●		
Lyons Valley (HSA 10.35)	●	●	●	●				●	●		●		●		
Cedar Canyon (HSA 10.36)	●	●	●	●				●	●		●		●		
Little Cedar Canyon (HSA 10.36)	●	●	●	●				●	●		●		●		
Jamul Creek (HSA 10.31)	●	●	●	●				●	●		●		●	●	
Lower Otay Reservoir (HSA 10.31)	See Reservoirs & Lakes														
Un-named tributary (HSA 10.31)	●	●	●	●				●	●		●		●	●	
Upper Otay Reservoir (HSA 10.32)	See Reservoirs & Lakes														
Proctor Valley (HSA 10.32)	●	●	●	●				●	●		●		●		
Otay River (has 10.20)	+	●	○					○	●		●		●	●	
O'Neal Canyon (HSA 10.20)	+	●	○					○	●		●		●		
Salt Creek (has 10.2)	+	●	○					○	●		●		●		
Johnson Canyon (HSA 10.20)	+	●	○					○	●		●		●		
Wolf Canyon (HSA 10.20)	+	●	○					○	●		●		●		
Dennery Canyon (HSA 10.20)	+	●	○					○	●		●		●		
Poggi Canyon (HSA 10.20)	+	●	○					○	●		●		●		

● Existing Beneficial Use
○ Potential Beneficial Use
+ Exempt from Municipal Use

Table C.4-2 Beneficial Uses of Lakes and Reservoirs (RWQCB, 1998).

Receiving Water (Hydrologic Unit Code)	Beneficial Uses												
	Municipal/Domestic Supply	Agricultural Supply	Industrial Service Supply	Industrial Process Supply	Groundwater Recharge	Freshwater Replenishment	Contact Water Recreation	Non-Contact Water Recreation	Warm Freshwater Habitat	Cold Freshwater Habitat	Wildlife Habitat	Rare Species	Hydropower Generation
Lower Otay Reservoir (HAS 10.31)	●	●	●	●			●	●	●	●	●		
Lower Otay Reservoir (HAS 10.32)	●	●	●	●			●	●	●	●	●		

● Existing Beneficial Use
○ Potential Beneficial Use

*Fishing from shore or boat permitted, but other water contact recreational uses are prohibited.

Table C.4-3 Beneficial Uses of Downstream Coastal Waters (RWQCB, 1998)

Receiving Water (Hydrologic Unit Code)	Beneficial Use														
	Industrial	Navigation	Contact Water Recreation	Non-Contact Water Recreation	Commercial/Sport Fishing	Significant Biological Habitats	Estuarine Habitat	Wildlife Habitat	Rare Species	Marine Habitat	Aquaculture	Aquatic Organism Migration	Spawning	Warm Freshwater Habitat	Shellfish
San Diego Bay (HA 910)	●	●	●	●	●	●	●	●	●	●		●			●

● Existing Beneficial Use
○ Potential Beneficial Use

Table C.4-4 Beneficial Use of Downstream Groundwater Resources (RWQCB, 1998)

Receiving Water (Hydrologic Unit Code)	Beneficial Use					
	Municipal/Domestic Supply	Agricultural Supply	Industrial Process Supply	Industrial Service Supply	Groundwater Recharge	Freshwater Replenishment
Otay Valley (HA 910.20)	●	●	●			
Otay Valley (HA 910.20)	+		●			
Dulzura (HA 910.30)	●	●	●			

● Existing Beneficial Use
○ Potential Beneficial Use
+ Excepted from Municipal Use

Lands within and tributary to Salt Creek on the east and Poggi Canyon Creek on the west, and including the several smaller drainage courses between these tributaries on the Otay River.

C.4.1 Trash and Debris

Trash (such as paper, plastic, polystyrene packing foam, and aluminum materials) and biodegradable organic matter (such as leaves, grass cuttings, and food waste) are general waste products on the landscape of a watershed. Trash and debris are sometimes referred to as "gross pollutants."

The presence of trash and debris may have a significant effect on water quality, especially the recreational value of a water body and aquatic habitat. Excess organic matter can create a high biochemical oxygen demand in a stream, thereby lowering its water quality. Also, in areas wherestagnant water exists, the presence of excess organic matter can promote septic conditions resulting in the growth of undesirable organisms and the release of odorous and hazardous compounds such as hydrogen sulfide.

Almost every human use or development in a watershed has the potential to generate trash or debris. Major sources of trash and debris (municipal, commercial, industrial, construction, and residential areas) usually have well-developed systems for the collection, transportation, and proper disposal of trash and debris. While they do not generate trash and debris in significant quantities, some locations and activities might have a disproportionately negative effect on water quality. These might include locations without a collection system or a system that is easily overwhelmed (e.g., small dumpsters with infrequent collection). It is often more difficult to enforce litter-control regulations in remote areas (e.g., remote campgrounds and hiking trails), and therefore, it is easier to ignore or circumvent proper trash disposal methods. Roads and freeways generate significant trash and debris due to litter-control offenders and more importantly, litter blowing off from transport vehicles.

Proctor Valley Creek is on the SWRCB's 303(d) Monitoring List for trash. Agency Staff have reason to believe that a significant trash and debris problem exists, based on personal observations and prior experience with the watershed/water body. However, data were unavailable to justify designating an official 303(d) impairment at the time of preparation of the 2002 CWA Section 303(d) List of Water Quality Limited Segments. As part of the 303(d) Monitoring List, Proctor Valley Creek receives

priority for the additional monitoring needed to confirm the possible extent of deleterious effects to beneficial uses.

C.4.2 Low Dissolved Oxygen and Biochemical Oxygen Demand

Aquatic life is dependent on the oxygen dissolved in the water, and dissolved oxygen (DO) is often used as a surrogate variable for the general health of an aquatic ecosystem. Low levels of dissolved oxygen result when the rate of oxygen demand exceeds the rate of oxygen replenishment. Oxygen demand is estimated by direct measure of DO and indirect measures such as biochemical oxygen demand (BOD), COD, oils and greases, and TOC.

Many microorganisms consume dissolved oxygen as they consume organic matter. This organic matter might include biodegradable organic material, as well as chemicals that react with dissolved oxygen in water to form other compounds. Proteins, carbohydrates, and fats are examples of biodegradable organic compounds. Compounds such as ammonia and hydrogen sulfide are also examples of oxygen-demanding compounds. The oxygen demand of a substance can lead to depletion of dissolved oxygen in a water body and possibly the development of septic conditions.

Most common significant sources of oxygen-demanding pollutants include effluent from industrial processes, concentrated animal feeding operations, and wastewater treatment facilities. Oxygen-demanding substances (e.g., trash, debris, and other pollutants) also accumulate on the watershed, and rainfall events will release these accumulations and deposit large quantities of oxygen demanding substance in lakes and streams. Studies have shown that biochemical oxygen demand of typical urban runoff is on the same order of magnitude as the effluent from an effective secondary wastewater treatment plant (Novotny and Olem, 1994).

Many of the reservoirs in San Diego County experience seasonal problems with low dissolved oxygen conditions in the summer and fall (July through November), and taste and odor problems during the summer months (City of San Diego Water Department, 2004). The Lower Otay Reservoir is on the 303(d) Monitoring List for color and odor because sampling by the City of San Diego between 1997 to 2000 indicated a possible exceedance of San Diego Basin Plan objectives. However, data justifying an official 303(d) impairment at the time of preparation of the 2002 CWA Section 303(d) List of Water Quality Limited Segments were unavailable. This potential impairment may be due in part to oxygen-demanding substances stressing the aquatic system.

C.4.3 Nutrients (Nitrogen and Phosphorus)

In the context of water quality, nutrients primarily include inorganic substances, such as nitrogen and phosphorus. They commonly exist in the form of mineral salts that are either dissolved or suspended in water. Nutrients such as nitrogen and phosphorus (usually the limiting nutrient) are the principal stimulants that cause cultural eutrophication, which is the excessive growth of aquatic algae and microphytes (Thomann and Mueller, 1987). This hyperstimulation of plant growth lowers dissolved oxygen levels through respiration, decomposition of dead plant material, and nitrification. Common measures for nutrients are total nitrogen, organic nitrogen, total Kjeldahl nitrogen (TKN), nitrate, ammonia, total phosphate, and TOC.

The orthophosphorus form of phosphorus is readily available for plant growth. The ammonium form of nitrogen can also have severe effects on surface water quality. The ammonium is converted to nitrate and nitrite forms of nitrogen in a process called nitrification. This process consumes large amounts of oxygen, which can impair the dissolved oxygen levels in water (see “Low Dissolved Oxygen and

Biochemical Oxygen Demand," above). The nitrate form of nitrogen is very soluble and is found naturally at low levels in water.

Excessive plant growth can in turn lead to low dissolved-oxygen levels, excessive decay of organic matter, release of toxins in sediment, and stress upon aquatic organisms. Algal blooms also generate taste and odor producing compounds that can make water difficult to use for drinking water supply. Algae typically become problematic from mid-spring through early fall, when there is a relatively longer period of sunlight to support photosynthesis. In eutrophic waters, there is a diurnal fluctuation in dissolved oxygen as oxygen is produced during the day (from photosynthesis) and consumed at night (respiration).

Nutrients originate from both discrete and diffuse sources. The most common discrete sources of nutrients include municipal and industrial wastewaters. Agricultural and urban/suburban runoff are the most significant diffuse sources of nutrients. Typically, nutrient export is greatest from development sites with the most impervious area. When nitrogen fertilizer is applied to agricultural fields or lawns in excess of crop needs, nitrates can leach below the root zone and eventually reach groundwater. Atmospheric deposition can also contribute to nutrient pollutant loading in areas with heavy automobile traffic, in the form of orthophosphate from auto emissions.

Many of the reservoirs in San Diego County experience seasonal problems with excessive algae growth in the summer and fall (July through November), and taste and odor problems during the summer months (City of San Diego Water Department, 2004). The Lower Otay Reservoir is on the 303(d) Monitoring List for color and odor because sampling by the City of San Diego between 1997 to 2000 indicated a possible exceedance of San Diego Basin Plan objectives. However, data justifying an official 303(d) impairment at the time of preparation of the 2002 CWA Section 303(d) List of Water Quality Limited Segments were unavailable. This potential impairment may be due in part to excessive amounts of nutrients from the contributing watershed.

Dulzura Creek is also on the 303(d) Monitoring List for eutrophic conditions, which are typically caused by an excess of nutrients. Agency staff have reason to believe that a significant eutrophication problem exists based on personal observations and prior experience with the watershed/water body. However, data were unavailable to justify designating an official 303(d) impairment at the time of preparation of the 2002 CWA Section 303(d) List of Water Quality Limited Segments. As part of the 303(d) Monitoring List, Dulzura Creek and Lower Otay Reservoir receive priority for the additional monitoring needed to confirm the possible extent of deleterious effects to beneficial uses.

C.4.4 Sediment

Sediments are soils or other surface materials eroded and then transported and deposited by the action of wind, water, ice, or gravity. Sediments can increase turbidity, abrade fish gills, reduce spawning habitat, lower young aquatic organisms survival rates, smother bottom dwelling organisms, and suppress aquatic vegetation growth. Fine sediment particles also act as a vehicle to transport other pollutants including nutrients (particularly phosphorous), trace metals, and hydrocarbons.

Construction sites (a point/permitted pollution source) are typically the largest source of sediment for urban areas under development. In-stream activities (e.g., sand and gravel mining), excessive grazing, poor tillage practices, or poor silvicultural practices can generate significant amounts of sediment from non-urbanized parts of a watershed. Hydromodification (i.e., the alteration of stream and river channels, installation of dams and water impoundments) can also contribute to increased sediment levels in a stream by eroding streambanks and streambeds.

In-stream mining can contribute to increased sediment levels by degrading and destabilizing a stream through a reduction in downstream sediment supply and the consequent erosion and degradation downstream through processes such as headcutting. Such streams are characterized as "transport limited." Sand and gravel extraction took place on the Otay River from 1910s to the 1970s, and was focused between the I-5 and I-805 freeways. Most of the useful material has been depleted and there are currently no in-stream extraction activities on the Otay River. However, because the mining operations ceased before regulations required the restoration of mining sites, there still might be potential for degradation near the former gravel pits or simply the exposure of erosive material.

Dulzura Creek is on the 303(d) Monitoring List for sediment/siltation and hydromodification. Agency Staff have reason to believe that significant sediment/siltation and erosion/incised channel problems exist, based on personal observations and prior experience with the watershed/water body. However, data were unavailable to justify designating an official 303(d) impairment at the time of preparation of the 2002 CWA Section 303(d) List of Water Quality Limited Segments. As part of the 303(d) Monitoring List, Dulzura Creek and Lower Otay Reservoir receive priority for the additional monitoring needed to confirm the possible extent of deleterious effects to beneficial uses.

C.4.5 Heavy Metals

The most common trace metals found in urban runoff are lead, zinc, and copper. Trace metals are primarily a concern because of their potential acute toxic effects on aquatic life and their potential to contaminate drinking water supplies.

Trace metals are typically associated with discrete sources such as industrial activities and wastewater reclamation. Fallout from automobile emissions is a major diffuse source of lead in urban areas. A large fraction of the trace metals in urban runoff is attached to sediment. Metals associated with the sediment settle out rapidly and accumulate in the soils, which effectively reduces the level immediately available for biological uptake and subsequent bioaccumulation. In addition, urban runoff events typically have a short duration, which reduces the exposure that could be toxic to the aquatic environment. The toxicity of trace metals in runoff varies with the hardness of the receiving water. As total hardness of the water increases, the threshold concentration levels for adverse effects increases.

C.4.6 Herbicides and Pesticides

Pesticides (including herbicides, fungicides, rodenticides, and insecticides) are chemical compounds (typically organophosphate or pyrethroid) commonly used to control nuisance growth of organisms. Excessive application of a pesticide may result in runoff containing toxic levels of its active component; though there is risk of toxicity even when applied in accordance with label instructions. The toxic compounds in legacy pesticides (e.g., DDT) can accumulate in simple aquatic organisms and be magnified through the food chain. Pesticides can have a negative effect upon many beneficial uses, from domestic water supply to habitat.

Agricultural application, as well as application to landscaped areas of commercial and industrial facilities or municipal facilities such as parks recreational fields, can contribute to pesticide concentrations on a watershed.

C.4.7 Other Toxic Chemicals

Storm water often has pollutants that are generally related to hazardous wastes or toxic chemicals. Some of the pollutants that may be present in urban runoff include phthalate (a plasticizer used in a wide range of consumer and industrial products), and phenols and creosols (typically used as wood

preservatives). Toxic chemicals can have a significant effect on many beneficial uses of receiving waters, including domestic water supply and habitat-related benefits.

Toxic chemicals are most commonly associated with commercial and industrial sites. Suburban residential areas are generally not expected to have many sources of toxic pollutants, with the possible exception of illegally disposed or applied household hazardous wastes. Runoff studies conducted in suburban areas, scanning for the presence of over 120 toxic chemicals and compounds, have rarely revealed toxins that exceeded current safety criteria. However, it is important to note that there are tens of thousands of chemical compounds in use in a typical watershed, while chemical testing is usually limited to several hundred constituents at most. Many pollutants are "discovered" only after they have an observable adverse effect in the receiving water. Outside of catastrophic releases, non-storm discharge of toxic chemicals should be negligible, because their use and disposal are regulated through programs such as the Statewide Industrial Permit.

C.4.8 Bacteria and Viruses

Bacteria and viruses are ubiquitous microorganisms that thrive under certain environmental conditions. Coliform bacteria are common in the environment and are generally not harmful, but are often coincident with other, more potentially dangerous, human pathogens such as *Escherichia coli* O157:H7. The presence of fecal coliform bacteria often indicates that the water may be contaminated with human or animal wastes, and is often used as an indicator for the level of bacteria and viruses in receiving waters. However, these indicators do not always reliably predict the presence of certain pathogens such as *Giardia*, *Cryptosporidia*, and enteroviruses that cause human disease (Lee, 1993).

Bacteria and viruses have a significant effect on water supply and recreational uses, because such microbes can cause diarrhea, cramps, nausea, headaches, other symptoms, and in rare cases, death. Their proliferation is typically caused by the transport of animal or human fecal wastes from the watershed. Water containing excessive bacteria and viruses can alter the aquatic habitat and create a harmful environment for humans and aquatic life. Also, the decomposition of excess organic waste can cause increased growth of undesirable organisms in the water.

Bacteria and viruses are commonly associated with effluent from wastewater reclamation facilities. A significant amount of bacteria can be attributed to wild animals, birds, and waste from other natural sources. Urbanization can also be a significant source of bacteria and viruses (e.g., pet waste). Almost without exception, bacteria levels in urban runoff exceed public health standards for water contact recreation. Studies have found that total coliform counts exceeded USEPA water quality criteria at almost every site and almost every time it rained (USEPA, 1999).

C.4.9 Oil and Grease

Oil and grease are characterized as high-molecular weight organic compounds. Oil and grease contain a wide variety of hydrocarbons, some of which could be toxic to aquatic life in low concentrations. Because these materials are hydrophobic (i.e., they do not readily dissolve in water), they initially float on water and create a familiar rainbow-colored film. Hydrocarbons have a strong affinity for sediment and quickly sorb to it.

The primary sources of oil and grease are petroleum hydrocarbon products, motor products from leaking vehicles, esters, oils, fats, waxes, and high molecular weight fatty acids. Introduction of these pollutants to the water bodies are very possible due to the wide uses and applications of some of these products in municipal, residential, commercial, industrial, and construction areas. Elevated oil and grease content can decrease the aesthetic value of the water body, as well as the water quality.

Hydrocarbon levels are highest in the runoff from parking lots, roads, and service stations. Residential land uses generate less hydrocarbons export, although illegal disposal of waste oil into storm waters can be a local problem.

C.5 303(D) IMPAIRMENTS AND TMDLS IN THE OTAY WATERSHED

Section 303(d) of the federal CWA requires states to identify waters that do not meet applicable water quality standards. As defined in the CWA and federal regulations, water quality standards include the designated uses of a water body, the adopted water quality criteria, and the state policies against degradation of water resources.

The SWRCB maintains a Section 303(d) List of impaired water bodies in compliance with the CWA. The Section 303(d) List includes descriptions of pollutants causing the violation of water quality standards and a priority ranking of the water quality limited segments. The priority ranking takes into account the severity of the pollution and the uses to be made of the waters. States review their Section 303(d) lists in even-numbered years, making changes as necessary, and submit the list to USEPA for approval. The SWRCB is currently completing their 2004 revisions to the 303(d) List of Water Quality Limited Segments.

C.5.1 303(D) List of Water Quality Limited Segments

According to most recent 2002 CWA Section 303(d) List of Water Quality Limited Segments, the inland surface waters of the Otay River watershed are free of any significant impairment. The one impairment (San Diego Bay Tidelands Park) associated with the Otay River Hydrologic Unit (HU 910) is located on Coronado Island, and is not attributed to the mainland Otay River watershed.

C.5.2 Total Maximum Daily Loads

The SWRCB must propose TMDL limitations for 303(d)-listed water bodies. TMDLs are applied in order to achieve water quality standards for the receiving water. A TMDL is the sum of the individual waste load allocations for point sources, load allocations for nonpoint sources, and natural background loads from tributaries or adjacent stream segments. In addition to these factors, TMDLs include a margin of safety that helps provide a conservative limit on pollutant loading that aggressively pursues water quality objectives. The SWRCB has not proposed TMDLs for any water bodies on the Otay River watershed.

C.5.3 303(d) Monitoring List

The SWRCB also maintains a “Monitoring List” concurrent with the 303(d) and TMDL lists. The Monitoring List includes water bodies where minimal, contradictory, or anecdotal information suggests that standards are not being met, but available data are inadequate to draw a definitive conclusion. In these cases, the SWRCB lists water bodies on the Monitoring List in order to prioritize the collection of additional information to resolve whether water quality objectives and beneficial uses are attained. Waters on the Monitoring List are a high priority for evaluation as to whether they will be listed on subsequent Section 303(d) and/or TMDL lists.

As described in “Constituents of Concern” (above), several inland surface waters on the Otay River watershed are on the 2002 Monitoring List. These surface waters include Dulzura Creek, Proctor Valley Creek, and the Otay Reservoir. Table C.5-1 summarizes the Monitoring List for Otay River Watershed.

Table C.5-1 Otay River Watershed Water Quality Monitoring List

Water Segment	Hydrologic Unit	Potential Impairment
Dulzura Creek	910.36	Eutrophic Conditions
		Hydromodification
		Sediment/Siltation
Lower Otay Reservoir	910.31	Color
		Odors
Proctor Valley Creek	910.32	Trash

Source: SWRCB, 2003.

C.6 ESTIMATION OF ANNUAL POLLUTANT LOADING

As part of the assessment of water quality, the ORWMP Consultant Team developed a model of the annual nonpoint (diffuse) source pollutant loading on the Otay River watershed (Appendix 3). This model calculates annual nonpoint (diffuse)[2] pollutant loads using the USEPA Simple Method, which is an empirical approach developed for estimating pollutant export from urban development sites. The USEPA Simple Method employs runoff coefficients and event mean concentrations (EMCs) to calculate the annual loads (USEPA, 2001b), and is endorsed by the USEPA as a viable screening tool for NPDES storm water projects. More specifically, the diffuse source pollutant loading model utilized PLOAD, a GIS-based tool within the USEPA BASINS model (USEPA, 2001a), to apply the Simple Method to estimate annual loads for a specified pollutants within each subbasin in the Otay River watershed. To address a limitation of PLOAD, which only allows use of one precipitation value for the entire watershed, the Otay Watershed Pollutant Loading (OWPL) Tool was programmed to allow input of different precipitation values for each subbasin in the watershed.

The OWPL Tool was used to estimate existing annual diffuse source pollutant loading on the Otay River watershed based on current land uses on the Otay River watershed. The pollutant loading assessment subdivided the Otay River watershed into 28 planning unit subbasins ranging in size from 815 to 6,725 acres. Analyzed sources did not include discrete sources, which are generally not present on the Otay River watershed. The OWPL Tool was also used to evaluate the effectiveness of particular BMPs to reduce pollutant loads in different sub-basins (Appendix 4).

The basic model output included the area and load for each land use within each subbasin, total loads for each subbasin, and annual mean concentrations. The OWPL Tool is most useful for evaluating potential "hotspots" of diffuse pollutant generation and for comparative studies that evaluate the effectiveness of various BMP or land-use scenarios.

Fifteen constituents were analyzed (Table C.6-1). The discussion here considers a subset of these constituents, comprising three general categories of pollutants (nutrients; heavy metals; oils, grease, TDS, and TSS). The level of detail offered in the diffuse pollutant loading model does not allow for attribution of elevated pollutant loading to any specific land use or project. The results of the annual diffuse pollutant loading model generally corroborate the qualitative analysis of potential water quality stressors on the Otay River watershed in other sections of this document. The pollutants discussed here were chosen to establish and illustrate the general trends of pollutant loading in each category. Constituents not explicitly discussed or illustrated here also demonstrate similar trends.

[2] This discussion will classify pollutants as originating from diffuse and discrete sources to remain consistent with the definitions identified in Section C.1.1.

Table C.6-1 Constituents Modeled with PLOAD

BOD-5	NO_2	TKN	P	Pb
TSS	NO_3	Total N	Cu	Fecal Coliform
TDS	NH_3	PO_4	Zn	Oil and Grease

C.6.1 Precipitation

The most general output variable from the pollutant loading model is the amount of runoff (Figure C.6-1). Runoff in and of itself is not a pollutant, but changes in runoff levels can be partially correlated to pollutants such as the increased generation of sediment due to streambank erosion. Runoff also conveys other pollutants from the watershed into streams and other conveyances, and increase in runoff can cause the perennialization of ephemeral or intermittent streams. Precipitation patterns on the Otay River watershed follow general pattern for coastal watersheds: smaller amounts of precipitation on the coast, with orographic effects producing larger rainfalls in the more mountainous inland parts of the watershed. In a watershed undisturbed by urbanization, one would expect the runoff from the watershed to be highly correlated to this general precipitation pattern: sub-basins with lower precipitation would generate lower amounts of runoff, with slight variations based upon differences in soil infiltration characteristics and other geologic factors. However, Figure C.6-1 indicates that the lower part of the watershed generates the highest relative amount of runoff. This can primarily be attributed to urbanization on that part of the watershed. Evidence of the orographic difference in precipitation and resulting runoff can still be seen upstream of the Otay Reservoir, with the Lyons sub-basin (LY-1) in the headwaters of the watershed having a higher runoff yield than sub-basins at lower elevations.

C.6.2 Nutrients

Nutrients primarily include inorganic substances, such as nitrogen and phosphorus. Figures C.6-2 to C.6-5 illustrate the relative pollutant loading rates for various forms of nutrients on the Otay River watershed. The results of the diffuse pollutant loading model corroborate the qualitative evaluation of nutrient sources in Section C.2 and Section C.4.3. Nutrient loading is highest in sub-basins with the most impervious area: the watersheds downstream of the I-805 freeway generate the highest level of nutrients, and with few exceptions, the watersheds upstream of the Otay Reservoir generate much lower levels of nutrients. The slightly elevated levels of nutrient loading in the upper Jamul Valley (JA3) and other parts of the watershed headwaters might be correlated to slightly elevated levels of impervious area due to urbanization, as well as the higher levels of runoff from those watersheds. The level of detail offered in the diffuse pollutant loading model does not allow for attribution of elevated nutrient loading to any specific land use or project.

C.6.3 Heavy Metals

The most common trace metals found in urban runoff are lead, zinc, and copper. Figures C.6-6 through C.6-8 illustrate the relative pollutant loading rates for these pollutants on the Otay River watershed. The results of the diffuse pollutant loading model corroborate the qualitative evaluation of the sources of heavy metals in Section C.2 and Section C.4.5. The level of detail offered in the diffuse pollutant loading model does not allow for attribution of elevated heavy metal loading to specific commercial or industrial land use. However, it is clear that the sub-basins downstream of the I-805 freeway generate the highest levels of heavy metals, attributable to the higher intensity of commercial and industrial land uses in that part of the watershed. Heavy metal pollutant loading is also evident in areas characterized by residential development. For instance, the pollutant loading of the OVE3 and OVE5 sub-basins is consistently lower than that of adjacent watersheds (OVE1 and OVE6) that have higher intensities of residential development.

C.6.4 Oils, Grease, TDS, and TSS

Figures C.6-9 to C.6-11 illustrate the relative pollutant loading rates for these pollutant on the Otay River watershed. The results of the diffuse pollutant loading model generally corroborate the qualitative assessment of the sources of these pollutants in Section C.2, Section C.4.4, and Section C.4.9, though the level of detail offered in the model does not allow for the attribution of elevated pollutant loading to a specific land use. Typically, hydrocarbon levels are highest in the runoff from parking lots, roads, and service stations. Therefore, the highest levels of pollutants such as oils and grease, TDS, and TSS are highest in the sub-basins downstream of the I-805 freeway. The pollutant loading of the OVE3 and OVE5 sub-basins is consistently lower than that of adjacent watersheds (OVE1 and OVE6) with higher intensities of residential development. The slightly elevated levels of TDS loadings in the upper Jamul Valley (JA3) and other parts of the watershed headwaters can also be correlated to slightly elevated levels of impervious area, as well as the higher levels of runoff from those watersheds.

C.7 POLLUTION SOURCE CONCLUSIONS

C.7.1 Summary of Primary Water Quality Stressors

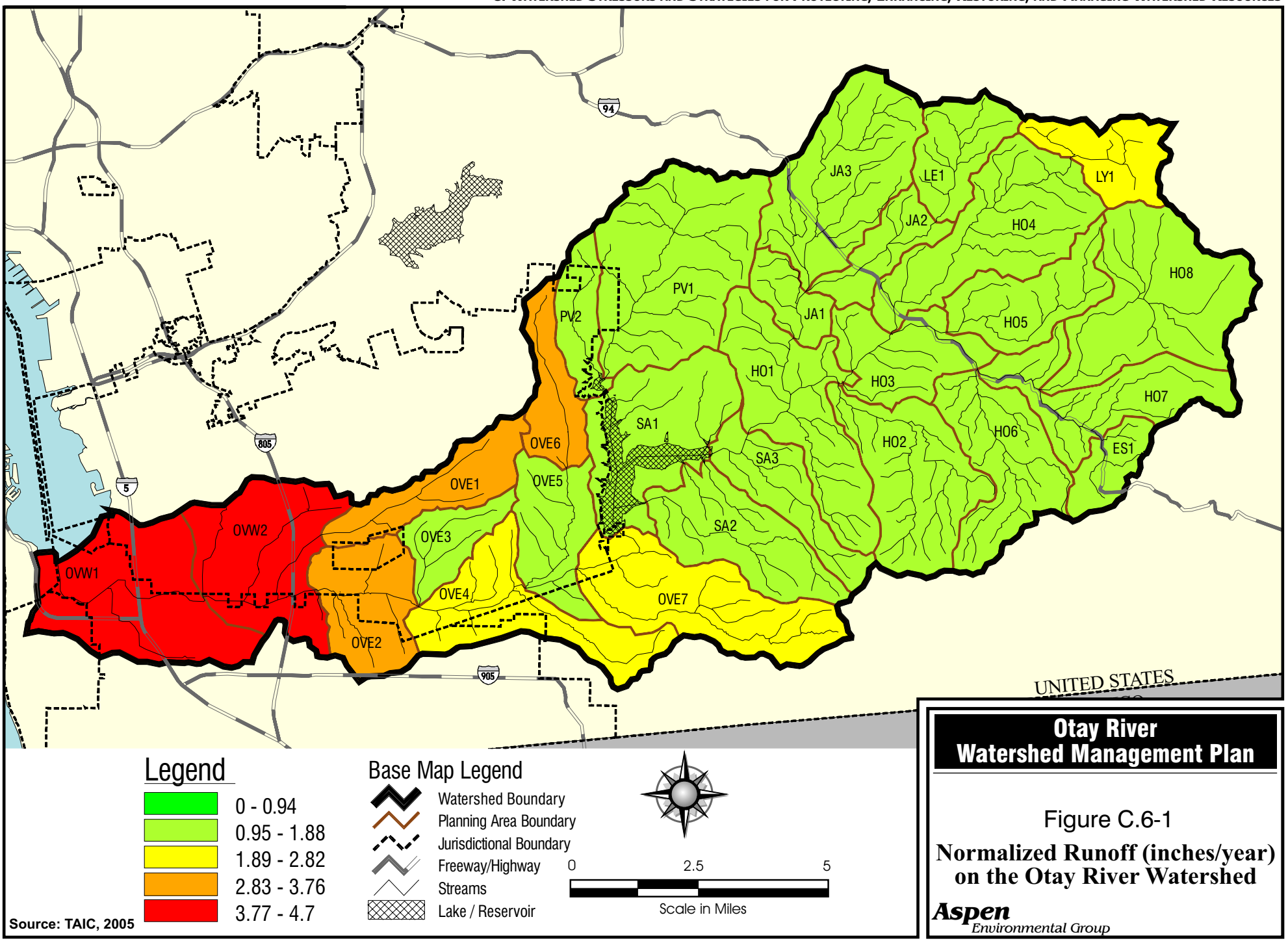
The preceding discussion established a qualitative evaluation of potential point (permitted) and nonpoint (non-permitted) pollution sources ("water quality stressors") on the Otay River watershed. Point sources in the context of this discussion include municipal activities, commercial and industrial operations, residential and other urban development, and construction activities. This section summarizes the primary water quality stressors and to what degree they might be expected to affect the Otay River watershed. Section C.8 summarizes other anthropogenic stressors associated with the various land use types and affiliated activities that can also stress water quality.

C.7.1.1 Point (Permitted) Sources

Municipal, Commercial, and Industrial Activities. Many municipal activities have potential to stress water quality on the Otay River watershed. Fortunately, some significant discrete municipal sources of pollution are simply not present on the watershed (e.g., wastewater treatment plants). The municipal activities with the most potential for generating storm water pollutants on the Otay River watershed include: the Otay Landfill; municipal corporate yards (e.g., 1800 Maxwell Road); park and recreation facilities with "active uses" (e.g., ball fields, community centers); municipal airfields, primarily Brown Field; and the correctional facilities on East Otay Mesa.

Commercial and industrial activities also have potential to generate storm water pollution. These commercial and industrial areas are primarily located between Interstate 5 and Interstate 805, as well as in limited pockets east of Interstate 805, such as Maxwell Road, Heritage Road/Brown Field, and East Otay Mesa. Commercial and industrial activities on the east part of the Otay River watershed upstream of the reservoirs are extremely limited, though there are sites, such as the Lyons Valley bus maintenance facility and possible illicit dumps or drug manufacturing sites scattered throughout this part of the watershed.

Municipal Permit programs provide ample mechanisms for preventing *potential* pollutant sources from becoming *actual* sources through the effective implementation of BMPs, monitoring programs, and enforcement of pollution controls for municipal activities. Both the Municipal Permit and Statewide General Industrial Permit provide controls for municipal activities (e.g., airfields), commercial, and industrial activities on the watershed that should prevent them from becoming a significant pollutant source on the Otay River watershed.


94
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905
JA3
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HO4
HO8
PV1
PV2
JA1
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HO1
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HO7
SA1
HO6
HO2
ES1
SA3
OVE6
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OVE1
SA2
OVW2
OVE3
OVW1
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UNITED STATES
Legend
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1.89 - 2.82
2.83 - 3.76
3.77 - 4.7
Base Map Legend
Watershed Boundary
Planning Area Boundary
Jurisdictional Boundary
Freeway/Highway
Streams
Lake / Reservoir
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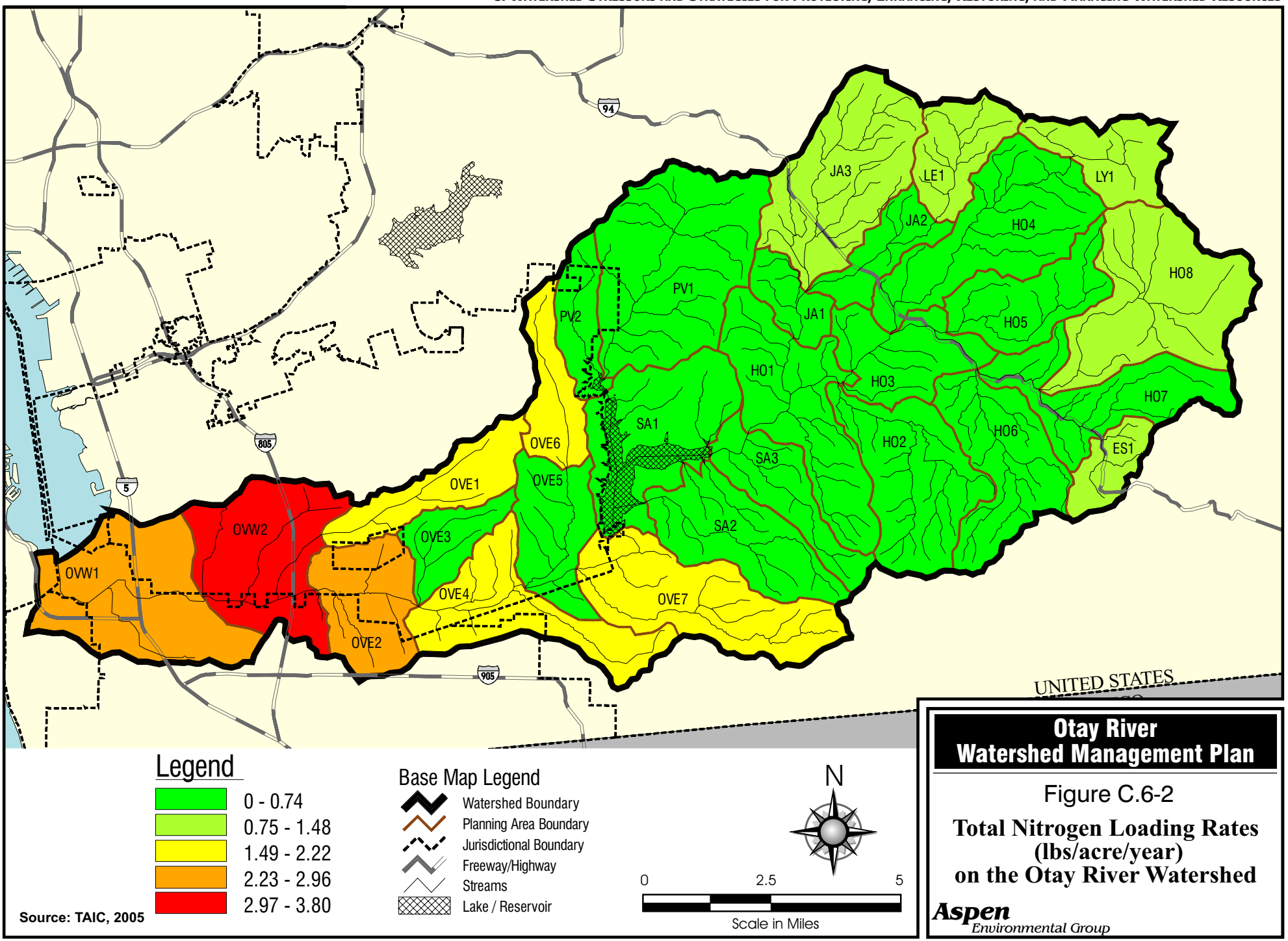
Scale in Miles
Source: TAIC, 2005
Otay River
Watershed Management Plan
Figure C.6-1
Normalized Runoff (inches/year)
on the Otay River Watershed
Aspen
Environmental Group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OVE5
OVE1
OVW2
OVE3
SA2
OVW1
OVE4
OVE7
OVE2
UNITED STATES
Legend
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0.75 - 1.48
1.49 - 2.22
2.23 - 2.96
2.97 - 3.80
Base Map Legend
Watershed Boundary
Planning Area Boundary
Jurisdictional Boundary
Freeway/Highway
Streams
Lake / Reservoir
N
0
2.5
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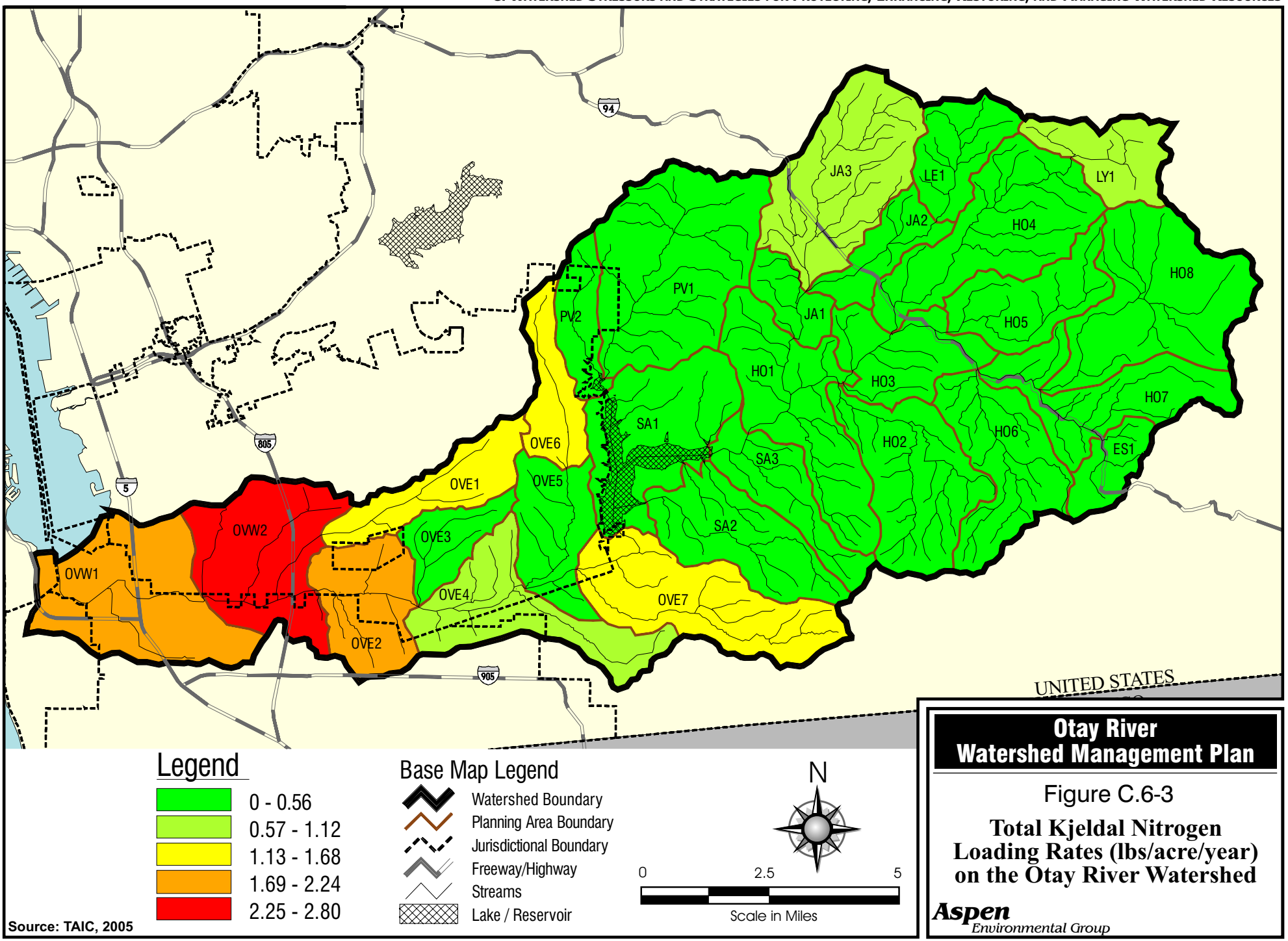
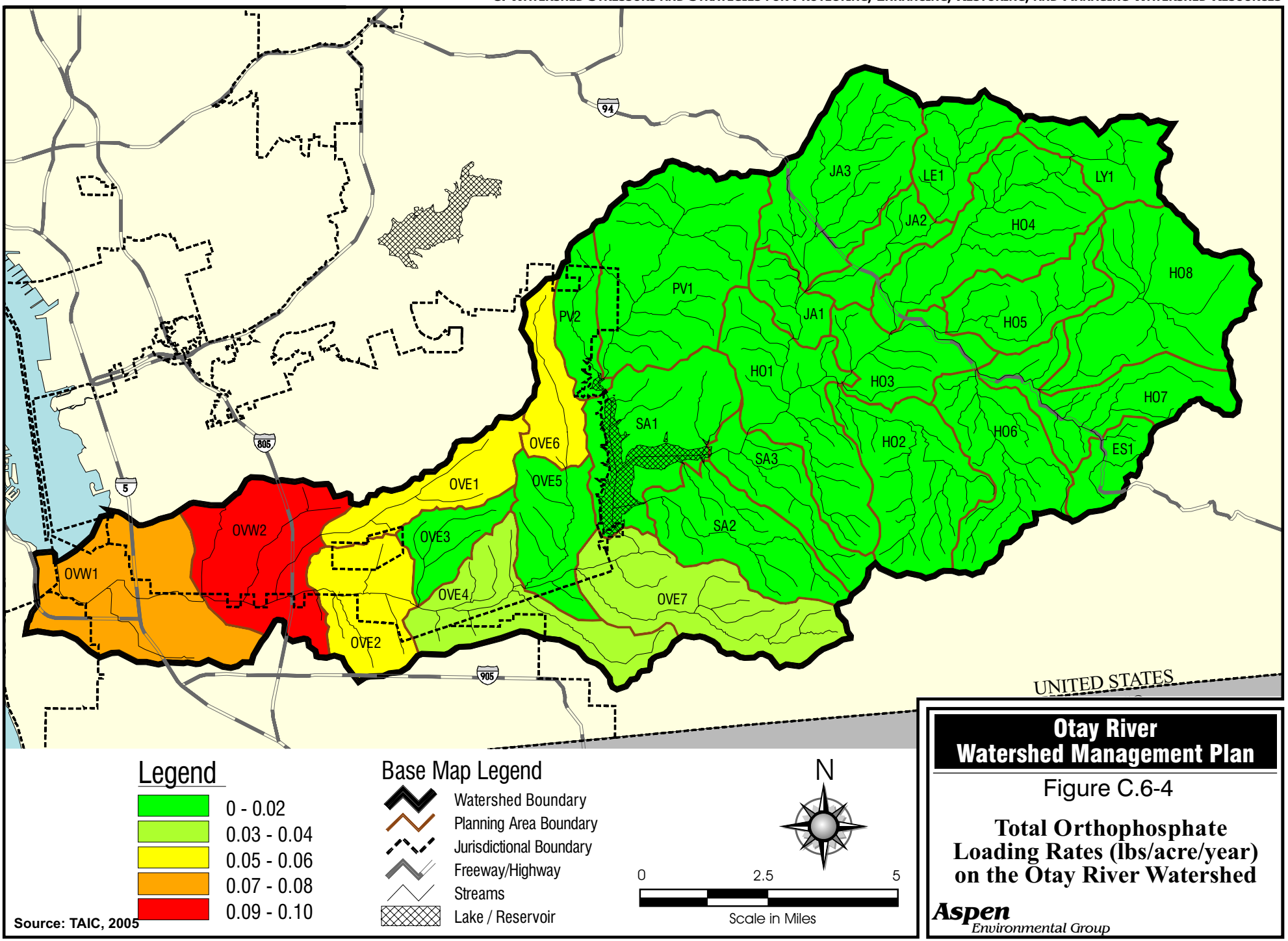
Scale in Miles
Source: TAIC, 2005
Otay River
Watershed Management Plan
Figure C.6-2
Total Nitrogen Loading Rates
(lbs/acre/year)
on the Otay River Watershed
Aspen
Environmental Group



Source: TAIC, 2005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UNITED STATES
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0 - 0.02
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0.05 - 0.06
0.07 - 0.08
0.09 - 0.10
Base Map Legend
Watershed Boundary
Planning Area Boundary
Jurisdictional Boundary
Freeway/Highway
Streams
Lake / Reservoir
N
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2.5
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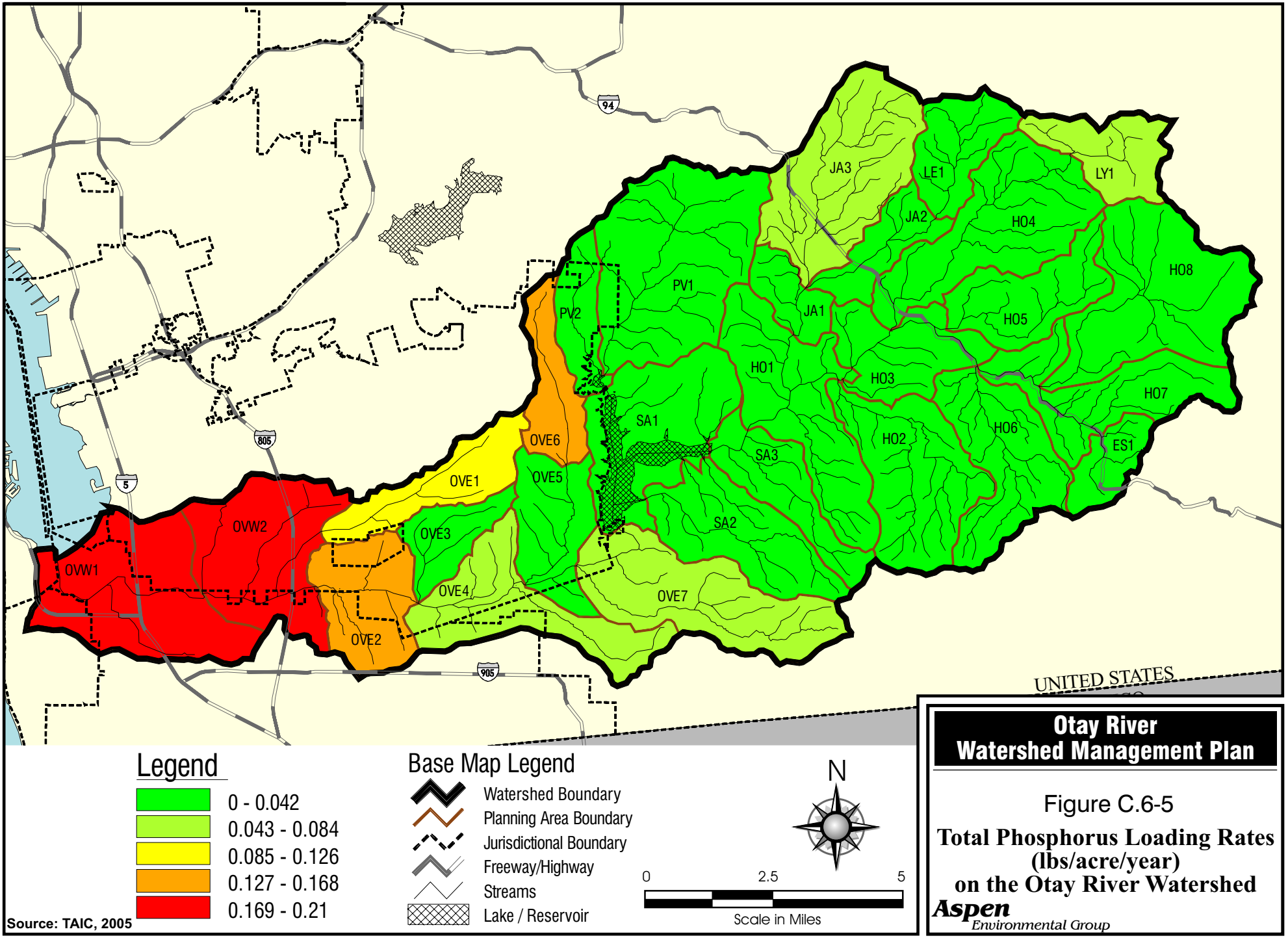
Scale in Miles
Source: TAIC, 2005
Otay River
Watershed Management Plan
Figure C.6-4
Total Orthophosphate
Loading Rates (lbs/acre/year)
on the Otay River Watershed
Aspen
Environmental Group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UNITED STATES
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0.085 - 0.126
0.127 - 0.168
0.169 - 0.21
Base Map Legend
Watershed Boundary
Planning Area Boundary
Jurisdictional Boundary
Freeway/Highway
Streams
Lake / Reservoir
N
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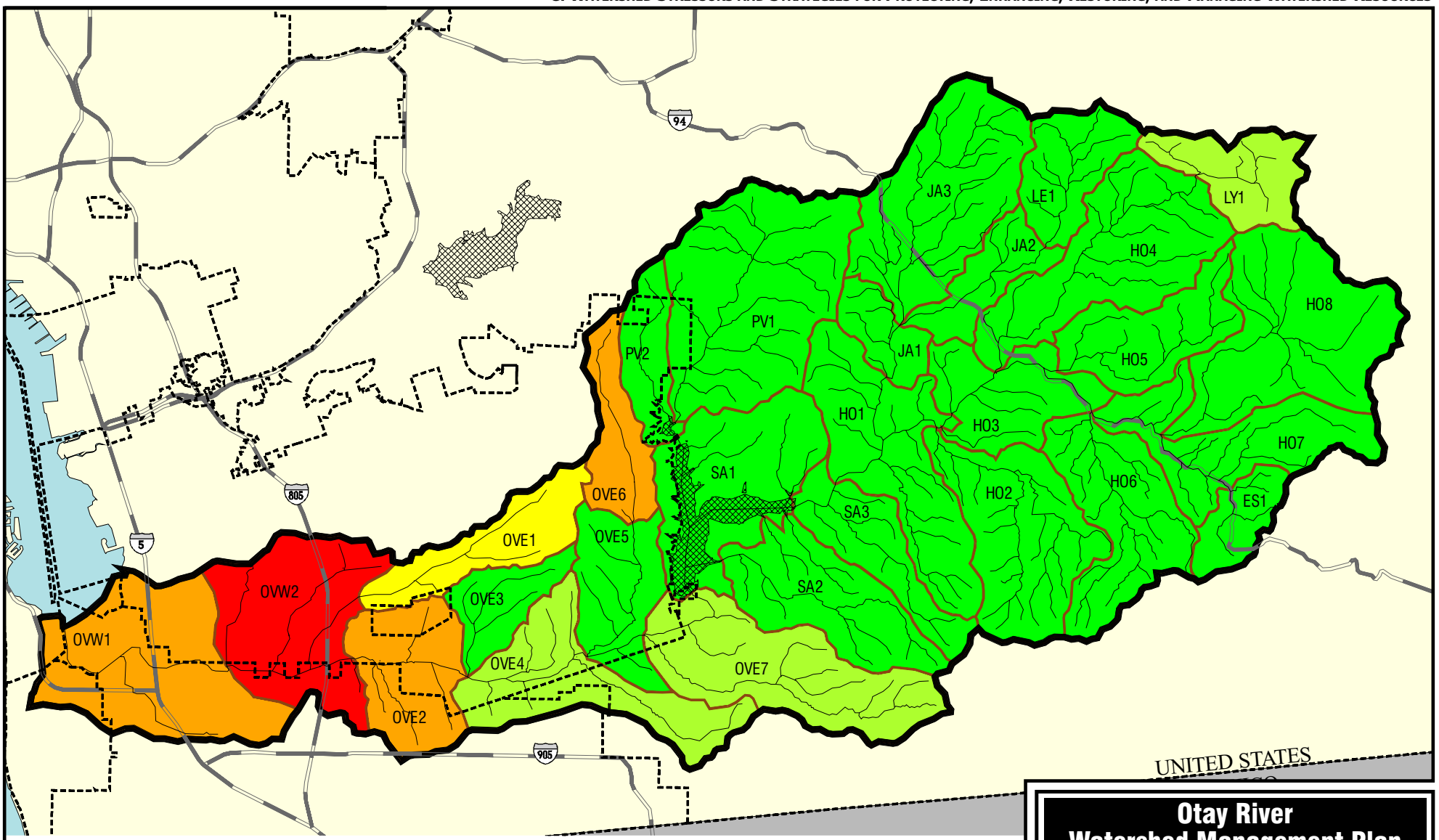
2.5
5
Scale in Miles
Source: TAIC, 2005
Otay River
Watershed Management Plan
Figure C.6-5
Total Phosphorus Loading Rates
(lbs/acre/year)
on the Otay River Watershed
Aspen
Environmental Group



Legend

- 0 - 0.0052
- 0.0053 - 0.0104
- 0.0105 - 0.0156
- 0.0157 - 0.0208
- 0.0209 - 0.0260

Base Map Legend

- Watershed Boundary
- Planning Area Boundary
- Jurisdictional Boundary
- Freeway/Highway
- Streams
- Lake / Reservoir

N

0 2.5 5

Scale in Miles

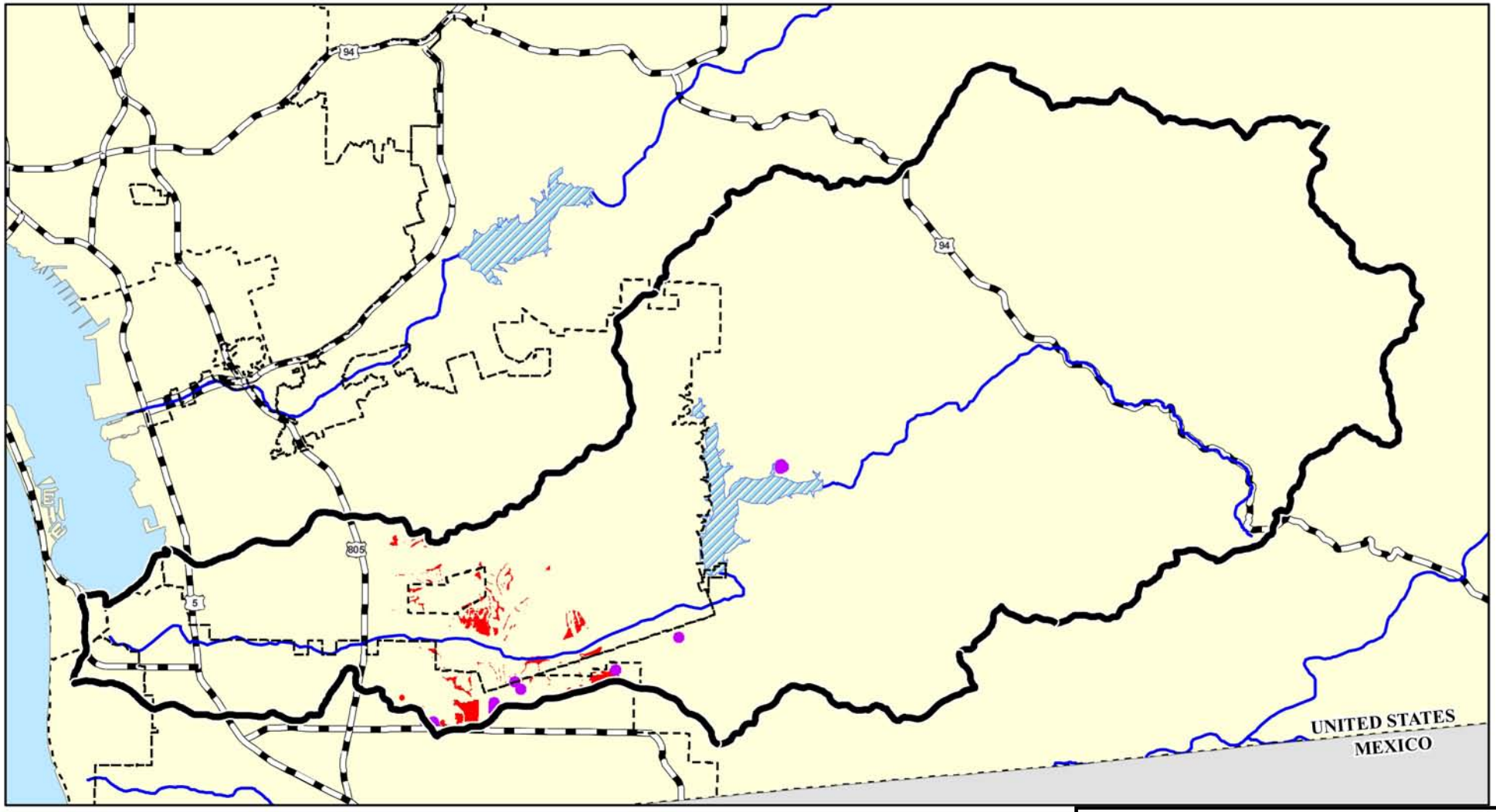
Source: TAIC, 2005

Otay River Watershed Management Plan

Figure C.6-6

Total Lead Loading Rates (lbs/acre/year) on the Otay River Watershed

Aspen Environmental Group



Legend

Predicted Distribution

Known Location

Basemap Legend

Otay River Watershed Boundary

City Boundary

Rivers

Lakes

N

0 2.5 5

Scale in Miles

Source: TAIC, 2004

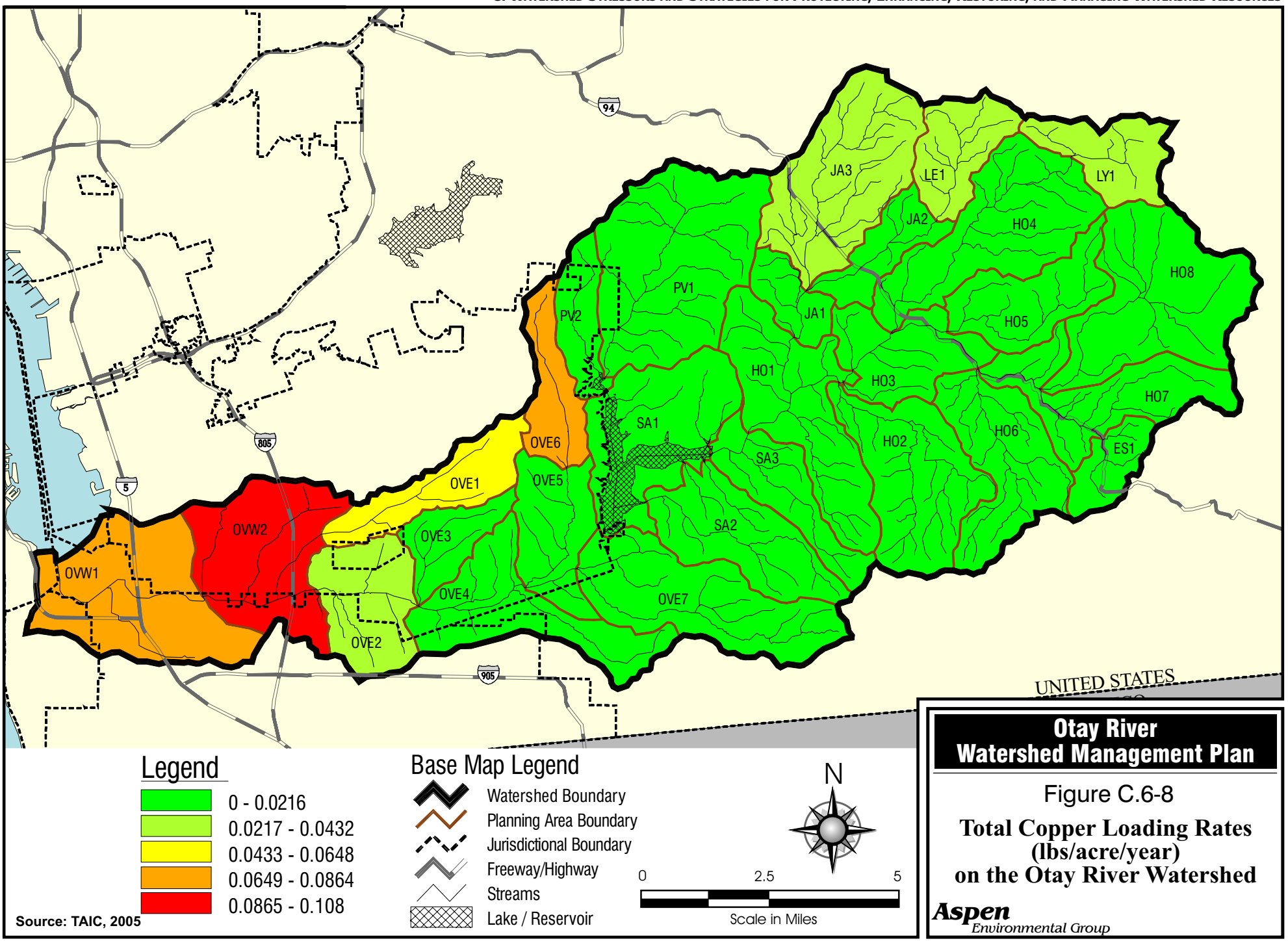
Source: Species Distribution Model and SANDAG Regional Species Database.

Otay River Watershed Management Plan

Figure B.6-7

Modeled Distribution and Observations of San Diego Fairy Shrimp

Aspen Environmental Group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Base Map Legend
Watershed Boundary
Planning Area Boundary
Jurisdictional Boundary
Freeway/Highway
Streams
Lake / Reservoir
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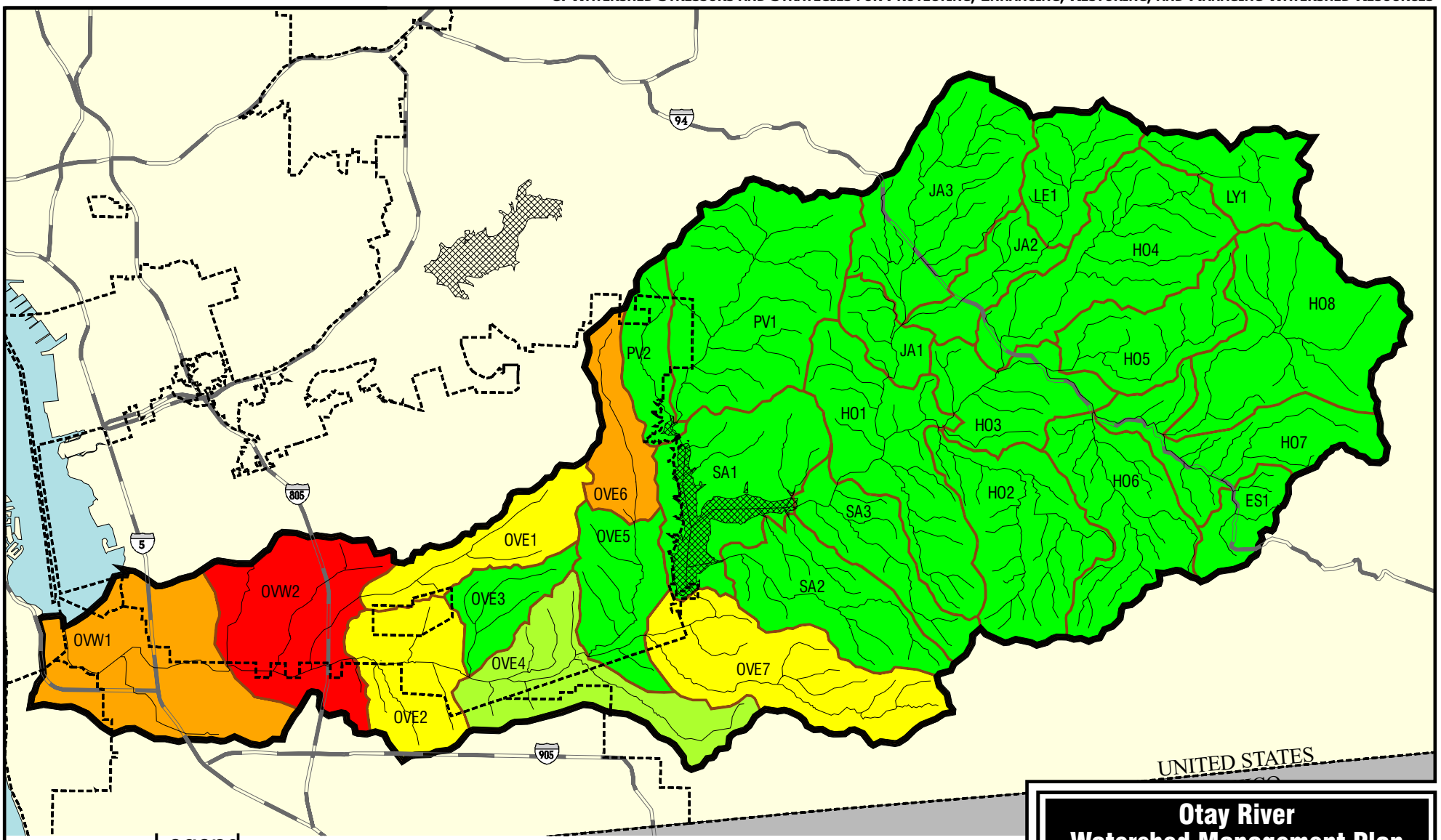
Scale in Miles
Source: TAIC, 2005
Otay River
Watershed Management Plan
Figure C.6-8
Total Copper Loading Rates
(lbs/acre/year)
on the Otay River Watershed
Aspen
Environmental Group



Legend

- 0 - 0.48
- 0.48 - 0.95
- 0.95 - 1.43
- 1.43 - 1.90
- 1.90 - 2.38

Source: TAIC, 2005

Base Map Legend

- Watershed Boundary
- Planning Area Boundary
- Jurisdictional Boundary
- Freeway/Highway
- Streams
- Lake / Reservoir

N

0 2.5 5

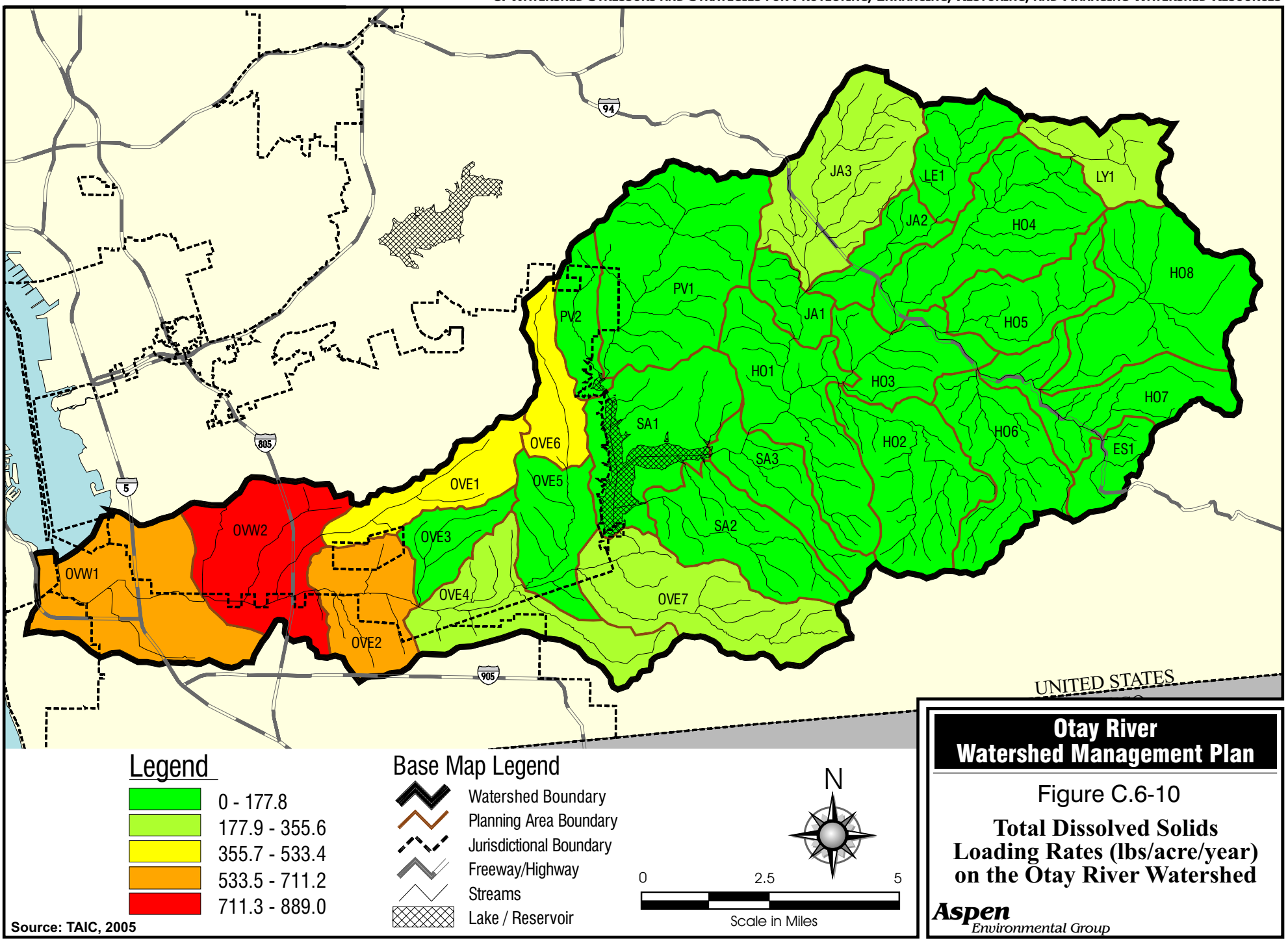
Scale in Miles

Otay River Watershed Management Plan

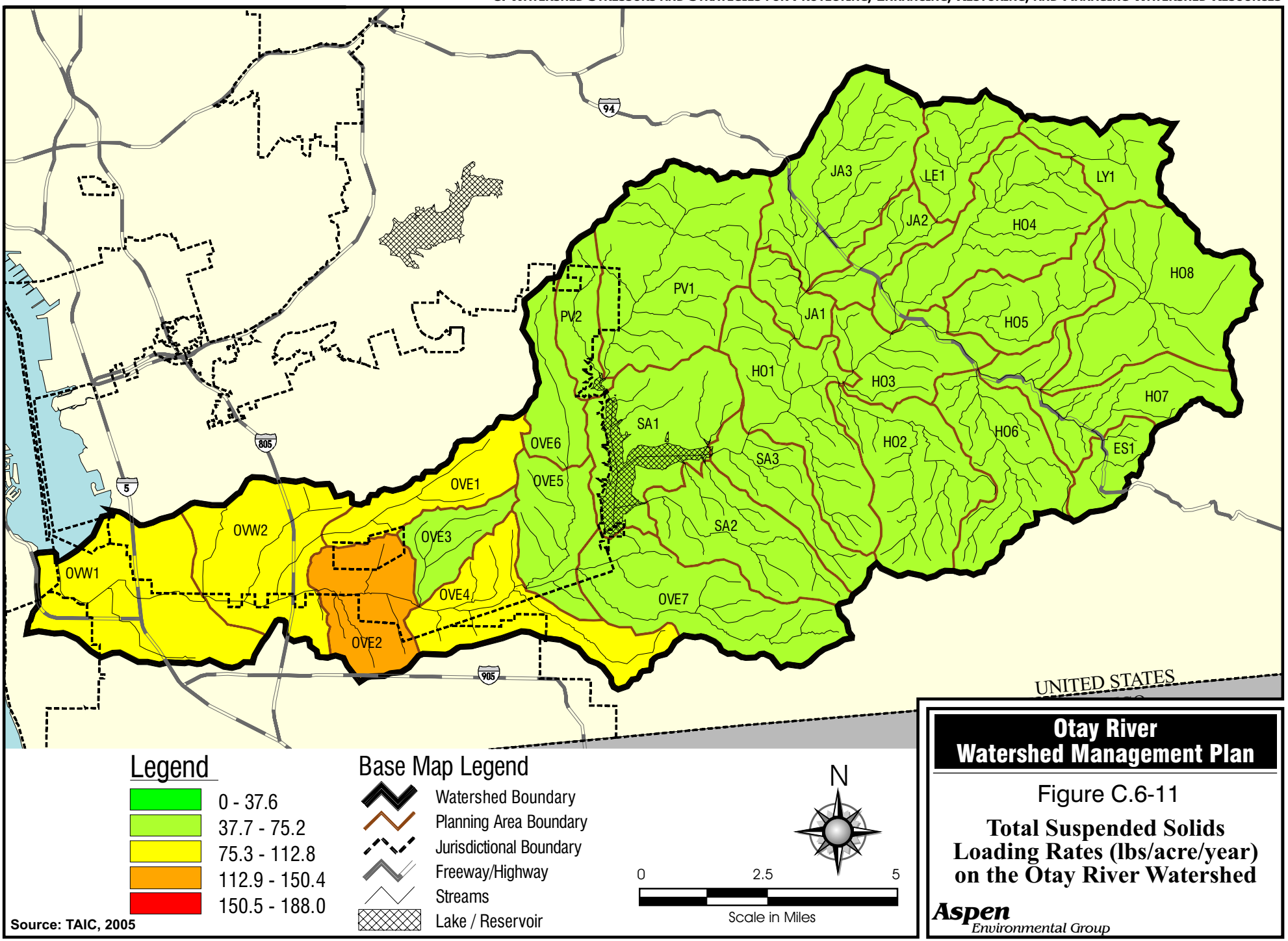
Figure C.6-9

Total Oil/Grease Loading Rates (lbs/acre/year) on the Otay River Watershed

Aspen Environmental Group



Source: TAIC, 2005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UNITED STATES
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75.3 - 112.8
112.9 - 150.4
150.5 - 188.0
Base Map Legend
Watershed Boundary
Planning Area Boundary
Jurisdictional Boundary
Freeway/Highway
Streams
Lake / Reservoir
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Scale in Miles
Source: TAIC, 2005
Otay River
Watershed Management Plan
Figure C.6-11
Total Suspended Solids
Loading Rates (lbs/acre/year)
on the Otay River Watershed
Aspen
Environmental Group

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Construction Activities. The Otay River watershed continues to experience substantial growth in development, especially downstream of the Lower Otay Reservoir, and the potential for pollution from construction activities will continue into the foreseeable future. The primary location for construction activities on the Otay River watershed is currently between Interstate 805 and the Otay Reservoirs. Consistent BMP application, inspection, and enforcement of Construction Permit requirements will be able to attenuate the negative effects of construction activities on water quality.

Residential and Urban Development. The primary stresses on water quality in the Otay River watershed will be from point (permitted) sources with diffuse origins, such as residential and other urban development and activities, and to a lesser extent, transportation infrastructure. Infrastructure and development on the watershed in place or under construction before implementation of the current Municipal Permit in 2001 have minimal measures in place for the preservation of water quality, unless they have been retrofitted with treatment-control BMPs. On the Otay River watershed, most of these pre-Municipal Permit developments are located west of Interstate 805. The Municipal Permit requires that Copermittees evaluate the feasibility of retrofitting existing structural flood control devices and retrofit where needed. Post-Municipal Permit facilities will have measures to help maintain water quality to the MEP. Future residential and urban development will focus on the lower watershed between Interstate 805 and the Otay Reservoirs. The upper watershed will see some development, but to a lesser degree, as the intensity of development will be limited by large minimum lot size and steep slope construction limitations.

C.7.1.2 Nonpoint (Non-Permitted) Sources

In general, nonpoint (non-permitted) sources of storm water pollution do not present a significant threat to water quality on the Otay River watershed. The two major potential nonpoint sources are agriculture and silviculture. Both of these potential nonpoint sources are primarily located on the eastern part of the Otay River watershed, upstream of the Otay Reservoirs. Currently, agricultural land uses comprise approximately 1,741 acres (1.9 percent) of the watershed. Therefore, agricultural activities on the Otay River watershed are not of a scale or intensity to present a significant threat to water quality. Industrial forestry is virtually non-existent within the watershed, though post-wildfire forest management can play a significant role in preserving water quality to maintain the beneficial use of waters after burn events.

The eastern part of the Otay River watershed upstream of the Otay Reservoirs is not serviced by municipal sewer systems. Therefore, on-site wastewater disposal (septic systems) on the eastern part of the watershed will have increased potential to become a nonpoint water quality stressor. Health regulations help limit exposure of septic systems to surface and groundwater resources, but proper operation and maintenance will be necessary to minimize the potential for pollution.

C.7.2 Priority List for Control of Identified Stressors

Conditions of concern result when pollutants interfere with the beneficial use of local water resources. The priority given to identified water quality stressors depends upon the beneficial uses of downstream receiving waters. On the Otay River watershed, these beneficial uses primarily involve recreational uses, habitat uses, as well as the drinking water supply in the Otay Reservoir system. Table C.7-1 summarizes the primary constituents of concern on the three general regions of Otay River watershed (i.e., upper or east watershed, Otay Reservoirs, lower or west watershed).

Table C.7-1 Primary Constituents of Concern on Otay River Watershed

Watershed Region	Primary Constituents of Concern
Upper Watershed	Oxygen-Demanding Substances • Trash • Oils and Grease • Sediment Nutrients Bacteria and Viruses
Otay Reservoirs	Nutrients Total Organic Carbon Total Dissolved Solids Bacteria and Viruses Heavy Metals and Toxic Chemicals
Lower Watershed	Hydromodification Oxygen-Demanding Substances • Trash • Oils and Grease • Sediment Bacteria and Viruses

Both recreational and drinking water uses are particularly affected by bacteria and viruses, as well as heavy metals, herbicides and pesticides, and other toxic chemicals. Recreational uses can also be sensitive to eutrophication (hyperstimulation) due to nutrients such as nitrogen and phosphorus. Beneficial uses associated with wildlife habitat are generally sensitive to pollutants that demand oxygen from the natural aquatic system, such as trash, debris, sediment, nutrients, oils and grease, and sediment that carries oxygen-demanding substances. Herbicides and pesticides, heavy metals, and other toxic chemicals all have negative effects on aquatic and other organisms.

In addition to chemical constituents, habitat can be significantly influenced by hydromodification. Urbanization carries the potential for increased peak flows and erosion that can destabilize channel banks and streambeds, along with "perennialization" of streams that can dramatically change the essential characteristics of the native biological community. Conversely, the loss of stream baseflow can also have detrimental effects on local biology.

C.7.3 Strategies to Minimize Point and Nonpoint Water Quality Stressors

Water quality permit implementation, especially through the use of BMPs, will be the most effective strategy to protect the Otay River watershed from point and nonpoint water quality stressors. The Municipal Permit and the Statewide General Industrial and Construction Permits require mitigation for water quality stressors due to municipal, commercial, industrial, and construction activities on the watershed, as well as for residential and other urban development. Other regulatory permits or processes, such as Sections 401 and 404 of the Clean Water Act, Section 1600 et seq. of the California Fish and Game Code, and compliance with CEQA or NEPA, can also minimize these stressors. These permits provide a regulatory mechanism for monitoring, inspecting, and enforcing pertinent water quality regulations, and will prevent most point (permitted) water quality stressors from becoming a significant pollutant source on the Otay River watershed. Regulatory programs cannot be one hundred percent effective, nor can they completely eliminate the risk of the catastrophic release of pollutants. Nevertheless, the Permits' "regulatory infrastructure" and the evidentiary trail it provides are essential for the identification of water quality exceedances and response to these events when they do become evident.

Best management practices are the most effective means to control diffuse sources of pollution, and they form the heart of the storm water pollution prevention strategies set out in the municipal, construction, and industrial sectors (e.g., San Diego Gas & Electric's Water Quality Construction Best Management Practices Manual, 2002). BMPs include treatment requirements, operating procedures, and practices to control site runoff, spillage or leaks, waste disposal, and drainage from raw material storage. Site design and source control BMPs target pollution generation; treatment-control BMPs reduce pollutants before they enter receiving waters. The City of San Diego Water Department's *Source Water Protection Guidelines for New Development* offer a useful model of BMP-based watershed protection; in this case focused primarily on drinking water protection but also recognizing that other uses and resources would benefit.

C.8 OTHER ANTHROPOGENIC AND NATURAL STRESSORS ON THE OTAY RIVER WATERSHED

There are numerous other stressors to aquatic and upland resources that are important to consider in developing the ORWMP. Many of these stressors result from anthropogenic activities and land use, while others are natural in origin. By definition, anthropogenic stressors result from man's activities. Therefore, the other anthropogenic stressors described below result from man's activities within the watershed. Similar to water quality and hydrologic stress, areas with more anthropogenic activity tend to experience a higher degree of other types of anthropogenic stress (Table C.8-1).

Table C.8-1 Land Uses/Affiliated Activities and Other Anthropogenic Stressors

Anthropogenic Use/ Activity	Affiliated Activities	Altered Hydrology/ Sediment Transport	Direct Habitat/Species Loss	Edge Effects on Biological Resources	Introduction /Increase in Non-Native Species	Increased Fire Frequency
Municipal	Transportation Infrastructure	✓	✓	✓	✓	✓
	Storm Drains and Flood Management Projects	✓	✓	✓	✓	
	Parks and Recreation	✓	✓	✓	✓	✓
	Sanitary Sewer Systems	✓	✓	✓	✓	
	Corporate Yards	✓	✓	✓	✓	✓
	Wastewater Reclamation and Recycled Water	✓	✓	✓	✓	
	Water Treatment Plants	✓	✓	✓	✓	
	Landfills	✓	✓	✓	✓	✓
	Airfields	✓	✓	✓	✓	✓
	Correctional Facilities	✓	✓	✓	✓	✓
Commercial and Industrial	Commercial (Fixed Location)	✓	✓	✓	✓	✓
	Sand and Gravel Mining	✓	✓	✓	✓	✓
	Industrial	✓	✓	✓	✓	✓
Residential/ Urban Development	Residential	✓	✓	✓	✓	✓

Anthropogenic Use/ Activity	Affiliated Activities	Altered Hydrology/ Sediment Transport	Direct Habitat/Species Loss	Edge Effects on Biological Resources	Introduction /Increase in Non-Native Species	Increased Fire Frequency
Construction	Construction (temporary activities)	✓	✓	✓	✓	✓
Agriculture	Agriculture	✓	✓	✓	✓	✓
Illegal Dumping/ Transient Encampments	Illegal Dumping	✓	✓	✓	✓	✓
	Transient Encampments	✓	✓	✓	✓	✓

For this reason, the discussion below does not restate many of the details about land use types and activities provided in Sections C.1 to C.7. Instead, the following discussion focuses on other key types of stressors on watershed health known or expected to occur as a result of anthropogenic use/activities or natural phenomena.

C.8.1 Other Anthropogenic Stressors

C.8.1.1 Altered Hydrology and Sediment Transport

There are several anthropogenic stressors to hydrology and sediment transport on the Otay River watershed. The first and most obvious is the impoundment of water behind Otay Dam. The Otay Dam and Reservoirs have governed the hydrology and altered the sediment transport regime of the lower part of the Otay River Main Stem for over a century. The dam and reservoirs distort the sediment equilibrium of the Otay River by retaining nearly all the bed sediment from the upper part of the watershed. This causes a sediment deficit for the lower reaches of the Otay River, which typically results in channel degradation. The lack of comparative historical data and the fact that the watershed has had such a long time to adjust to the dam make it unfruitful to discuss the complete mitigation of this particular watershed stressor. While it is important to recognize that the dam represents a significant stressor that constrains watershed health, especially downstream of the reservoir, it is more practical to assess watershed health from a baseline of post-dam, pre-modern-development conditions.

A second important anthropogenic stressor to the watershed, particularly with respect to sediment transport, is sand and gravel mining. Sand and gravel extraction on the Otay River has a history dating back to the 1910s, with most of the activity taking place between with I-5 and I-805 freeways. In-stream mining can degrade and destabilize a stream by causing headcutting, reduction in downstream sediment supply, erosion, degradation and damage to infrastructure. Off-stream mining can avoid many of these effects, but can have similar effects in the floodplain during large floods.

Historic materials extraction, especially when coupled with the construction of the Otay Dam, has significantly altered the hydrology and sediment transport regime of the Otay River mainstem. At present, most of the useful material has been depleted and there are currently no in-stream extraction activities on the Otay River. However, the effects of these activities are still manifest in the channel bed profile and altered sediment distribution (as foreign materials migrate into the area). Free-flowing river systems will tend to restore their sediment transport equilibrium over time. However, the lack of

consistent flow due to impoundment behind Otay Dam has made the altered sediment transport regime on the Otay River mainstem more persistent, if not permanent. These geomorphologic stressors also have implications on watershed health such as habitat and water quality.

Urbanization (municipal, commercial and industrial, residential/urban development, construction) represents the primary stressor to hydrology and sediment transport on the Otay River watershed, both upstream and downstream of the Otay Reservoirs. Agriculture and illegal dumping/transient encampments can increase sediment loading into surface waters. Properly implemented and maintained BMPs can mitigate the former, but there is little or no control of the latter.

Urbanization tends to increase the peak flow rates and runoff volume from the watershed during storm events. The increase in peak flow rate alters the flood regime and generally corresponds to increases in flow velocities, which can have significant implications for channel stability. Urbanization also tends to "perennialize" once ephemeral or intermittent streams and create a constant low flow. The Municipal Permit and resultant SUSMPs require all significant development or redevelopment projects to attenuate increases in peak flow and velocity, or demonstrate the lack of negative effects from an increase. This will help mitigate increases in peak flow, but does not address possible sediment depletion, and might exacerbate the input of sediment-starved water into the lower Otay River.

Human development has also had significant effects on the flood regime, in floodplain extent, inundation depth, and frequency. Most significantly, the Otay Reservoir and Dam have eliminated the natural flooding cycles on the Otay River Main Stem. Other parts of the watershed also experience flooding patterns that have been altered by human development, especially in the lower part of the watershed such as on Nestor Creek. National Flood Insurance Program eligibility rules require that municipal floodplain ordinances limit the effect of new development on flood depths. Therefore, newer development will have much less deleterious effect on floodplain hydraulics and inundation.

These types of hydrologic and sediment transport regimes have significant implications to the health of the watershed with respect to water quality, habitat, and other factors. Sections C.1 to C.7 detail the water quality and hydrologic/geomorphic stressors in this watershed, many of which are associated with various land uses and activities that commonly occur throughout the region. It is just as important to consider the effects of these stressors' alterations of hydrology and sediment supply on aquatic and surrounding habitats. For example, alterations of hydrology and sediment supply affect riparian habitats by altering the quantity and timing of flows (Scott et al., 1996; Poff et al., 1997; CBI, 2002). This, in turn, can affect numerous plant and animal species that are dependent on these habitats. Although riparian areas typically comprise less than 1 percent of the landscape, they tend to support a disproportionately high number of wildlife species (Fischer, 2001). Many of these species have evolved under specific hydrologic regimes and can be sensitive to changes in the magnitude, frequency, and duration of flows. There is increasing evidence that modifications of riverine hydrologic characteristics by urban development and irrigated agriculture can greatly affect the composition of the riparian and aquatic communities (Pederson and Perkins, 1986; Stromberg and Patten, 1992; Cooper, 1993; Stromberg, 1993; CRJC, 1998; Paul and Meyer, 2001; CBI, 2002). Pederson and Perkins (1986) found that the composition of macroinvertebrates in stream systems with greater than 75 percent development underwent a shift in macroinvertebrate community composition to species tolerant of changes in hydrology and geomorphology typical of an urbanized watershed. Rural watersheds where development had little influence on hydrology and geomorphology and riparian character were defined as having less than 15 percent development.

Additionally, altered hydrologic characteristics often favor non-native species at the expense of native species. For example, recent research by the USGS (Fisher, unpublished data) shows that historically

intermittent drainages that now have permanent base flow from irrigated landscaping or agriculture no longer support arroyo toads. This pattern has been attributed to the successful establishment of non-native aquatic species (e.g., bullfrogs, bass, and sunfish) that prey on or compete with larval toads. Permanent summer flow and scour of native in-stream vegetation can also encourage the establishment of non-native plant species, such as giant reed.

Alteration of watershed hydrology can affect other aquatic habitat types as well. A particularly sensitive habitat in this regard is vernal pools (Bauder, 1986; Hanes and Stromberg, 1996; Bauder, pers. comm.; McMillan, pers. comm.; Black, pers. comm, and Hecht, pers. comm.). Unfortunately, as of 1990, few research-level studies had been completed on vernal pool hydrology (Hanes and Stromberg, 1996). A conceptual model of the hydrologic processes affecting water levels in vernal pools was developed by Hanes, Hecht, and Stromberg (1990), which studied the significance of various hydrologic pathways supporting vernal pools. In general, vernal pool hydrology is a combination of direct precipitation, overland flow, subsurface inflow and outflow, and evapotranspiration. The contribution of each is dependent on topographic position, slope, geology, soil porosity, and vegetation cover. And each vernal pool or vernal pool complex has a specific set of physical conditions. Changes in the watershed supporting a vernal pool can result in changes in water depth, timing, and duration within the vernal pool. Vernal pool plant composition is particularly sensitive to these changes and can be converted by excessive watering to vernal marshes, supporting predominantly spike-rush (*Eleocharis* spp.), emergent marsh supporting predominantly cattails (*Typha* spp.) and bulrush (*Scirpus* spp.), or open-water wetlands. Changes in vernal pool hydrology by artificial impoundments also allows for the proliferation of exotic species, such as brome grasses (*Bromus* spp.), oats (*Avena* spp.), and thistles (*Centaurea* spp. and others) (Bauder, 1996). Therefore, vernal pool protection requires protecting its contributing watershed from changes that would generate unnatural levels or timing of water in the pool.

In the Otay River watershed, nearly all of the remaining vernal pools are in existing or planned preserves. This protection is addressed and afforded by key planning mechanisms such as the MSCP as implemented by the individual Subarea Plans and the Otay Ranch RMP (Phases 1 and 2). For the latter, a minimum of 95 percent of vernal pools are being preserved on the Otay Ranch, with 25 low-quality pools totaling 0.21 acre of vernal pool surface area over 14 acres of vernal pool habitat being directly affected by the implementation of the Otay Ranch GDP/SRP. A Vernal Pool Preserve of more than 330 acres of vernal pool landscape and species is being established on Otay Mesa south of the Otay River, with enhancement and restoration activities occurring in the pools and their watersheds. The Preserve Owner/Manager (City of Chula Vista and County of San Diego) is responsible for general management and monitoring of the Preserve, including inhibiting additional degradation (through fencing, elimination of cattle grazing, and access control); establishing protocols for the use of pools for research and education (e.g., who is permitted and what activities are allowed); development of specific monitoring strategies for determining changes in flora and fauna of the pools (e.g., when, why, who); and a minimal amount of general enhancement activities (e .g., trash removal). Outside of the Preserve, each pool and its surrounding watershed are being fenced and/or demarcated to minimize degradation.

Many of the land uses affecting water quality also affect hydrology and sediment supply. As with water quality, increases in impervious surface area affect hydrology and sediment supply (Center for Watershed Protection, 1999), particularly in intermittent and ephemeral streams. Southern California Coastal Water Research Project (SCCWRP, 2005) looked solely at intermittent and ephemeral streams because the majority of past research was completed on perennial streams in less arid climates. This study found that impervious cover of as little as 2-3 percent increased the rate of stream widening and downcutting in catchment drainage areas less than 5 square miles. While the area studied did not include the Otay River watershed and the results might not be directly applicable, these are regional

data that should be considered. Therefore, it is expected areas with land uses that increase impervious surfaces would be most at risk for alterations in hydrology and sediment supply. Smith's (2004) riparian ecosystem integrity assessment and the Otay Watershed Pollutant Loading results support that this is occurring for current land uses (Figures B.3-11 and C.6-1). In this watershed, these are primarily areas west of the Otay Reservoirs. While adverse effects are more limited in areas east of the Otay Reservoirs, future changes in hydrology or sediment supply upstream or in the vicinity of preserves and other sensitive habitats could adversely affect resources in those areas. Protecting these areas could be accomplished by restricting impervious cover in particular drainage areas, or implementing BMPs to either retain flows so they do not enter surface waters or detain them to minimize their effects on downstream and downslope areas.

C.8.1.2 Direct Habitat and Species Loss

Urbanization also has the obvious effect of directly eliminating habitat and species (upland and aquatic) in the developed areas. All types of anthropogenic use and activity result in habitat and species loss (Table C.8-1). However, even natural watershed stessors, such as naturally occurring erosion, drought, and fire, can result in direct habitat and species losses on a periodic basis.

Direct loss of habitat and species is the main stressor on the landscape. Nowhere is this more apparent than in California wetlands, which have suffered an estimated 91 percent loss in area (Salvesen, 1990, Dahl, 1991). Loss estimates for riparian habitat, which includes wetland and non-wetland riparian areas, range from 90 to 98 percent (Swift, 1984; Warner and Hendrix, 1985; Knopf et al., 1988; Faber et al., 1989; USDOI, 1994; Grupel and Elliott, 2001). As discussed in Section B.6, anthropogenic activities have also resulted in significant losses of upland communities (e.g., grasslands, coastal sage scrub, chaparral) and species in southern California. In fact, the past and anticipated loss of habitat and species in this region was the impetus to create the Multiple Species Conservation Program (MSCP), which conserves these natural resources while allowing for reasonable economic development to occur (City of San Diego, 1998). Also, concern about future impacts to aquatic resources is a major reason for developing the Otay River watershed SAMP.

Most of the natural resources (upland and aquatic) in this watershed are under the purview of the individual Subarea Plans prepared and implemented by the County of San Diego, City of Chula Vista, and City of San Diego in accordance with the MSCP (Figure B.6-10). As discussed in Section B, the intent of the MSCP and the individual Subarea Plans is to achieve a "workable balance" between conservation of a system of linked core habitat areas and reasonable economic development and other uses. While upland resources comprise the overwhelming majority of what is conserved in this semi-arid region, aquatic resources also occur in these areas, and wetlands are an important resource protected by the MSCP Subarea Plans (e.g., Wetlands Protection Program, Section 5.2.4 in the City of Chula Vista's MSCP Subarea Plan).

The habitat areas currently preserved or planned for preservation under the MSCP and other notable conservation programs are concentrated in the less developed eastern watershed and along the Otay River, including much of the area near the outlet used for salt extraction (e.g., Otay Ranch Preserve; CDFG's Rancho Jamul Ecological Preserve, Hollenbeck Canyon Wildlife Area, Otay Mountain Ecological Reserve; BLM's multiple holdings including Otay Mountain Wilderness Area; USFS Lyons Peak and Barber Mountain parcels; Caltrans' Johnson Canyon Preserve; City of San Diego's Dennery Canyon Vernal Pool Preserve; OVRP; USFWS's San Diego Bay NWR) (Figure B.6-9). Based on GIS analysis of data from the Corps' *Planning-Level Delineation and Geospatial Characterization of Aquatic Resources for the Otay Watershed* (Lichvar and Ericsson, 2003) and the locations of existing and planned preserve area data, approximately 70 percent of the aquatic resources in the Otay River

watershed are within existing or planned preserves. Also, Smith (2004) determined that the habitat, water quality, and hydrologic integrity of riparian habitat in the preserve and other undeveloped areas is usually higher than in more developed areas in the watershed (comparing Figure B.3-1 with Figures B.3-11 to B.3-13).

While areas in existing or planned preserves are protected from direct impacts, local, State,and federal controls protect many areas outside of existing or planned preserves from direct loss. Local regulatory mechanisms include the County of San Diego's RPO and BMO, the City of Chula Vista's Habitat Loss and Incidental Take Permit Ordinance, the Otay Ranch RMP, and the City of San Diego's Environmentally Sensitive Lands Regulations, which protect wetlands and other natural resources from direct loss. However, there are several exemptions in many of these local controls. For example, the RPO exempts single-family parcels, unless there is an application for a particular discretionary action and on-going existing agricultural operations. Federal and State programs provide additional aquatic habitat protection, including Clean Water Act Sections 401 and 404, Porter-Cologne Water Quality Control Act, and California Fish and Game Code 1600 et seq. The Coastal Zone Management Act and California Coastal Act protect resources within the coastal zone. The Federal and California Endangered Species Acts protect listed species and their habitats, as administered under the MSCP and the individual MSCP Subarea Plans in most of this watershed.

However, federal, State, and local controls do not prohibit all impacts to natural resources. For nearly all constructed projects, some loss of habitat and species has been authorized, is exempt, or occurs illegally. Therefore, additional direct losses of habitat and species are expected to occur in this watershed, subject to various federal, State, and local controls.

With the majority of the lands east of the Otay Reservoirs in existing or planned preserves, most future direct losses are expected to occur in unpreserved areas west and north of the Otay Reservoirs (compare Figures B.3-1 and B.3-9). However, lower-density development is planned for the eastern portion. The lower densities should allow for the most sensitive resources to be avoided, but there would still be some direct losses and there could be indirect effects on habitat and species downstream of and in proximity to the preserved areas. The expectation is that the various ordinances, programs, and policies, as mentioned above and described in more detail in Section B, would limit additional direct and indirect habitat and species losses within the watershed.

C.8.1.3 Edge Effects

Effects on biological resources due to land uses at the edge of biological areas are commonly known as edge effects. As noted in Table C.8-1, any type of anthropogenic land use can result in edge effects. Examples of disturbances that cause edge effects associated with residential development include noise and lighting impacts, increased erosion or sedimentation and siltation, increased human intrusion, exotic species invasion (plants and animals), and the disruption of the natural composition of native species (i.e., increasing human-adapted species at the expense of rarer and more sensitive species). Light, even at distances of several hundred feet, can inhibit mountain lion and other medium and large mammals from moving to adjacent habitat areas (Lyren, 2001). The construction of access roads and utilities to serve residential development can also cause a variety of edge effects. Edge effects can affect vegetation communities, thus altering wildlife habitat and affecting sensitive species. Edge effects extend the human footprint beyond the area of development; however, they are more difficult to quantify because they often are not manifested in a change in the visual landscape, and often result in gradual change over a longer period of time. Furthermore, the types of edge effects are diverse and their effects are variable.

The edge zone is the area in which land uses adjacent to open space areas have an impact on the biological value of the habitats. The edge zone varies greatly depending on the type of edge effect and the species or habitats potentially affected; therefore, it is not possible to identify a single edge zone distance for all species and habitats in all cases. As a general rule, however, the smaller an area of open space, the greater the proportion that will be affected by a given edge effect. Because some edge effects can extend for thousands of feet, there are few areas in the watershed that are not affected by at least one type of edge effect. The types of edge effects that are the most prevalent in the watershed include noise, outdoor lighting, introduction of non-native species (plants and animals, including pets), and disruption of the natural ecological community.

Development and other human uses can have a number of adverse edge effects on open space areas. Residential developments in close proximity to natural open space areas generally result in increased disturbances from foot, bicycle, and motorized vehicular traffic as well as an increase in trash. Illegal migrant worker encampments also contribute to trash and disturbance in riparian areas. Establishment of unauthorized trails is a large management issue in most open space areas in San Diego County, resulting in the loss of vegetation and the compaction and erosion of underlying soils. These trails are also routes for the invasion of non-native species. In some instances, these disturbances can produce severe, virtually permanent habitat degradation. Buildup of trash or litter in and adjacent to preserve areas can attract house rats and promote the abundance of mesopredators, such as raccoons and skunks. An unnaturally high abundance of mesopredators can affect nesting success of native birds.

In addition to noise and light impacts, roads can reduce or eliminate wildlife movement across affected areas, as well as increase the frequency of fires, alter the hydrologic regime of crossed streams, and as discussed in Section C.2, lead to water quality impairments. Sections B.6.2.2 and B.6.2.3 discuss habitat linkages and wildlife movement within the Otay River watershed and between this watershed and adjacent watersheds (Figure B.6-1). Roads and other urban development are the main threats to intra- and inter-watershed wildlife movement. For example, Otay Mesa Road (SR-905) is a significant constraint to wildlife movement between the Otay River watershed and the Tijuana River watershed. There are a number of approaches to mitigate the effects of roads on wildlife movement, such as installation of adequately sized undercrossings and overcrossings.

The MSCP Subarea Plans' assembly of a linked system of large, contiguous blocks of habitat tend to minimize edge effects, by maximizing the ratio of surface area to the perimeter of conserved areas. In addition, a variety of planning criteria are being applied in this watershed intended to minimize edge effects. For example, the City of Chula Vista's MSCP Subarea Plan includes Adjacency Management Guidelines that restrict uses adjacent to the Preserve and encourage enhancement in these adjacent areas. These guidelines focus on limiting particular activities and their effects (e.g., noise) adjacent to the Preserve. The MSCP Subarea Plans for the City of San Diego and the County of San Diego include similar guidelines that apply to land uses in areas adjacent to preserves. Furthermore, the County's BMO, which implements their MSCP Subarea Plan, includes preserve design criteria focused on minimizing edge effects (e.g., encourage larger blocks of habitat) and linkage and corridor design criteria to protect these features from barriers such as roads (e.g., length to width ratio less than 2 for wildlife underpasses, unless an underpass height is at least 30 feet). In addition, the Otay Ranch RMP includes policies, standards, and guidelines focused on protecting the Preserve from adjacent land uses, including the preparation of an "Edge Plan". The edge of the Preserve is defined as a 100-foot-wide strip of land, privately or publicly owned, that surrounds the perimeter of the Preserve. The Otay Ranch RMP also includes specific setback guidelines for different habitat types. For example, riparian woodlands should be provided with a setback minimum of 100 feet and a maximum of 200 feet between the woodland and development (commercial and residential). The OVRP Trail Guidelines (County of

San Diego et al., 2003) and WOVRP NRMP (City of San Diego, 2002a) include setbacks of 300 to 500 feet equestrian trails and staging areas from riparian habitat and coastal sage scrub. They also restrict activities within the 100-foot buffer zones surrounding sensitive biological resources to protect them.

With these approaches, the intent is to restrict uses near these sensitive areas so that their natural resources (habitat and species) are not degraded by near-by activities. Given the complexity of edge effects, it is not known whether the existing criteria are adequately protecting the natural resources in the sensitive areas. Clearly, areas west of the Otay Reservoirs are experiencing a variety of edge effects as a result of existing and ongoing urban activities. It is expected that the existing and planned preserves east of the Otay Reservoirs are experiencing fewer and less intense edge effects. However, because some edge effects can extend thousands of feet, there are probably natural resources even in preserve areas that are not fully protected against edge effects. Studies would be necessary to determine whether existing planning criteria adequately protect watershed resources; but the variety and complexity of edge effects can make such an evaluation difficult.

C.8.1.4 Introduction or Increases in Species Harmful to Native Flora and Fauna

Anthropogenic activities can also attract or introduce to an area wildlife that are potentially harmful to native species. As noted in Table C.8-1, any type of anthropogenic use can introduce or increase species harmful to native flora or fauna. For example, brown-headed cowbirds (*Molothrus ater*) can be particularly abundant in agricultural areas with livestock or areas of heavy equestrian use, and nest parasitism by this species has the potential to significantly reduce reproductive success of least Bell's vireo. Livestock can have other adverse effects, such as consumption of native vegetation and compaction of soils, which can destabilize streambanks and streambeds and lead to scouring of stream-associated habitat. Domestic animals that are allowed to roam can be predators of native species. House cats prey on riparian birds, and dogs can prey on birds, small mammals such as rabbits, and larger mammals such as coyote or bobcat. A variety of non-native animals or pets have been intentionally introduced or released into the wild. Many of these released pets are primary causes for the decline of native species with which they compete. For example, the release of the red-eared slider turtle (*Trachemys scripta elegans)* in California is one cause for the decline of the southwestern pond turtle (*Clemmys marmorata*). African clawed frogs (*Xenopus laevis*) are kept as pets and are used commonly in scientific research, but when released, this species threatens native amphibians and fish (Stebbins, 2003). This species is known to occur throughout southern California streams, including lower Sweetwater River. The USFWS reports that exotic wildlife species, particularly benthic or epibenthic marine species, are serious threats to the health of San Diego's coastal ecosystem (USFWS, 2005). Exotic marine species are transported into the bay environment on the exterior of ships, within ballast water that is discharged into the bay, and through illegal aquarium dumping. Some of the exotic species found in San Diego Bay include fishes such as sailfin mollies (*Poecilia latipinna*) and yellowfin goby (*Acanthogobius flavimanus*), which are believed to compete with native species for food and habitat. The Japanese mussel (*Musculista senhousia*) forms dense mats on substrata that alters sediment properties and may displace native bivalves. An exotic species that has invaded the salt marsh habitat of the Sweetwater Marsh Unit is the Australasian isopod *Sphaeroma quoyanum*. This organism burrows into the banks of the marsh's tidal channels and along marsh edge habitat often in very high densities, resulting in increased bank erosion and loss of salt marsh habitat (Talley et. al., 2001).

Historically, several non-native plants have been used in or adjacent to native landscapes for erosion control or wind breaks, such as salt cedar (*Tamarix* spp.) and giant reed (*Arundo donax*). Non-native plants also commonly escape landscape areas and backyards, such as pampas grass (*Cortaderia selloana*). Many are invasive species that quickly displace native cottonwoods and willows as well as adjacent upland plant communities, such as bunch grasses and sage scrub. These species can form

monocultures, lower the groundwater table where they grow densely, provide poor habitat for wildlife, and increase fire hazards.

Another plant pest released into the wild by humans includes invasive green algae, *Caulerpa taxifolia,* which was discovered in Agua Hedionda Lagoon in Carlsbad and in Huntington Harbor in June 2000 (SDRWQCB, 2005). It is thought to have been released from a saltwater aquarium. This species can become well-established and eliminate native seaweed, sea grasses, eelgrass beds, reefs, and other marine communities, as it has done by blanketing more than 11,000 acres of the northern Mediterranean coastline (NOAA, 2005). The species is banned in France, Spain, and Australia, and in 1999, the species was prohibited under the U.S. Federal Noxious Weed Act. The City of San Diego banned the sale and possession of the genus Caulerpa on July 23, 2001, and later, in September 2001, State Assembly Bill 1334 banned the sale, possession, and transport of *Caulerpa taxifolia* throughout California. Nonetheless, this species remains a high priority for the SWRCB and the National Oceanic & Atmospheric Administration (NOAA) because it spreads rapidly and vegetatively making prevention of spread and mechanical removal nearly impossible. The species was successfully treated in the Aqua Hedionda lagoon by covering it with a heavy plastic tarp and applying herbicides. The tarps remain in place and the sites are surveyed monthly. However, NOAA warns the public to not be lulled into a false sense of security due to the initial success in Carlsbad, because the probability of there being more infestations that have gone undetected, as well as the common occurrence of Caulerpa residing in American aquariums nearly ensures that the seaweed will continue to pose a threat to U.S. coastlines. The SDRWQCB formed the Southern California Caulerpa Action Team website http://caulerpa.cjb.net.

As documented in the Draft Habitat Restoration and Exotic/Non-Native Species Plant Removal Plan for the Otay Valley Regional Park (County of San Diego Department of Parks and Recreation, 2005) and the Corps'planning-level delineation of aquatic habitats (Lichvar and Ericsson, 2003), there are several non-native plant species in this watershed. More than 600 acres (approximately 7 percent) of exotic plants have been mapped within the 8,500-acre OVRP, with extends 13 miles from approximately 0.5 mile west of the I-5 upstream to and around the Otay Reservoirs. Approximately 97 percent of the giant reed in the OVRP occurs in its western third (i.e., west of Heritage Road), and more than 90 percent of the tamarisk occurs west of the Otay Reservoirs. While the OVRP is an important part of the watershed that includes the lower Otay River and the Otay Reservoirs, the Corps' planning-level delineation work and personal observations confirmed that exotic plants also occur in the remaining 84,000 acres of the watershed.

There are also several non-native faunal species in this watershed. The former are heavily concentrated downstream of Savage Dam on the Otay River and its tributaries, but pockets occur upstream or east of the reservoirs as well. The latter are also found primarily in the more urbanized areas west of the reservoirs, but they occur also in or near disturbed and artificially ponded areas. However, there really are no limits on where fauna could occur in this watershed, because they are independently mobile.

C.8.1.5 Anthropogenic Stressors Summary

While anthropogenic activities have adversely affected water quality (Figures B.3-12 and C.6-2 to C.6-11), they have also adversely affected the hydrology/sediment transport (Figures B.3-11 and C.6-1) and the habitat integrity (Figure B.3-13) of the riparian ecosystem in this watershed. The majority of the anthropogenic stressors are concentrated in the more urban western watershed, but stressors have affected particular areas in the eastern watershed as well. Going forward, greater consideration should be given to these less-developed areas, because many of them are preserved or in planned preserves and represent the highest-quality habitats in this watershed. Appendix 4 discusses and evaluates various non-structural and structural BMPs that could minimize adverse effects on the beneficial uses in the various

subbasins in the Otay River watershed. Modeling results indicate that non-structural BMPs with selected structural BMPs would be most effective at protecting water quality and minimizing hydromodification in the upper watershed, while structural BMPs would be most effective in the more urbanized lower watershed.

C.8.2 Natural Stressors

Southern California is a highly dynamic region in many respects, as described in Section B. It is a tectonically active area, which is prone to earthquakes and significant changes in topography spatially and temporally. The steep interior areas coupled with Mediterranean climate can create localized, intense rainfall in the winter and spring, which can lead to rapid geomorphological and biological changes and mudslides. This climate can also result in multi-year periods of drought, which affect habitat and species composition, abundance, and health. The climate and the typically poorly developed soils support coastal sage scrub, chaparral, and other communities that depend on fire for propagation, health, and persistence. Fire intensity has been particularly high in the eastern portion of the watershed, a trend which is expected to continue (Figure B.1-5).

The San Diego wildfires of 2003 provided a clear example of the scope and nature that fire and other natural stressors can have on the watershed (of course, this is not to suggest that human activities have not increased the frequency of fires in the region; anthropogenic ignition is becoming a more common source of fires in this region, associated with permanent and transient urban uses and activities). Approximately 28,000 acres were burned in the watershed, with most losses occurring from the Otay Reservoirs eastward (Section B.1.4). Since that time, rains have washed large quantities of sediment into streams and blocked culverts. Therefore, these natural stressors have resulted in major direct losses of habitat and species and altered the hydrology and sediment transport in the eastern watershed. Moreover, blockages along SR-94 could have an adverse effect on wildlife movement along the Hollenbeck Canyon/Rancho Jamul route. Because many of the habitat types and species are adapted to fire, the affected areas tend to recover quickly. However, the combination of anthropogenic and natural stressors on the landscape can delay or lead to incomplete recovery following these stochastic events; particularly if the frequency of the stressor is increased beyond the norm. Therefore, it is important to consider both natural and anthropogenic stressors when planning the management of watersheds.

C.9 STRATEGIES TO PROTECT, ENHANCE, RESTORE, AND MANAGE WATERSHED RESOURCES

Overview

This section presents 17 strategies *recommended* to protect, enhance, restore, and/or manage watershed resources in consideration of expected natural and anthropogenic stressors. Many of these strategies, if implemented, would support and build upon activities, practices, or projects that are in the planning stages or are already being implemented. It is understood that funding and other logistical considerations could limit whether particular strategies are implemented in full, in part, or not at all, and the actual sequence/timing of implementation.

Each strategy specifies activities, BMPs, or projects focused on achieving one or more of the stakeholder-identified ORWMP goals. For each identified strategy, information is provided in the following format:

- Target Goals
- Activities and Benefits
- Locations
- Expected Proponents
- Schedule
- Maintenance and Monitoring Considerations
- First-order Cost
- Potential Funding Sources

For each strategy, the **Target Goals** are specified from the list approved by consensus at the May 4, 2005 Working Group meeting. **Activities and Benefits** describe the actions, BMPs, or projects recommended and how they would protect, enhance, restore, and/or manage beneficial uses in the Otay River watershed. In some cases, the jurisdictions have similar measures or projects being implemented, which could reduce their burden, if a particular strategy is implemented. **Locations** are where these activities would occur or apply, whether at specific sites, streams, sub-basins, or in the larger watershed. Depending on the strategy, **Expected Proponents** could be the County of San Diego, the Cities of Chula Vista, San Diego, Imperial Beach, the San Diego Unified Port District, the Watershed Council or equivalent decision-making body (currently the ORWMP/SAMP Working Group, Policy Committee, and Executive Committee), non-government organizations (NGOs), regulatory or resource agencies, volunteers, or a collaborative effort. Each strategy's expected implementation time frame is noted as short-term (within 2 years), intermediate-term (3 to 5 years), or long-term (more than 5 years) under **Schedule**. **Maintenance and Monitoring Considerations** include aspects of the activities, BMPs, or projects beyond their actual implementation. **First-order Costs** are order-of-magnitude estimates (i.e., less than $10,000, $10,000 to less than $100,000, $100,000 to less than $1 million, $ 1 million to less than $10 million, $10 million to $100 million), unless more specific cost estimates can be provided. These are total cost estimates that could be reduced if similar effective measures are already in place or particular activities or projects are occurring. **Potential Funding Sources** include various local, State, or federal opportunities, such as proposition money, County or City funds, and local fees, which could be used to implement strategies and monitor their effectiveness. A more comprehensive matrix of funding sources, which includes which strategies could qualify, is provided as Appendix 5.

This information is intended to provide stakeholders and decision-makers with key considerations for the initial evaluation of each strategy. Stakeholders would need to consider what practices, activities, or projects are in effect or are being implemented. If stakeholders and decision-makers determine that a strategy would provide additional benefits to the watershed, it can be further investigated to fully evaluate its feasibility and expected benefits, and the specifics of how it would be implemented.

The strategies have been preliminarily assigned to categories of high (Section C.9.1), medium (Section C.9.2), or low (Section C.9.3) priority, but they are not ordered by priority within each category (Table C.9-1). This initial prioritization is based on their expected watershed benefits and their capacity to build upon other beneficial efforts being planned or already underway. This prioritization did not consider cost, but cost is clearly an important factor in determining feasibility and could necessitate reprioritization of the strategies. Also, other logistical considerations, such as securing access, completing environmental review, and obtaining permits, could necessitate lower priority strategies beginning before higher priority strategies. This is an initial list, which can be easily modified or reprioritized based on stakeholder input or additional data. Summaries of key considerations of these strategies, including recommended timing of implementation, are provided in Tables C.9-2 and C.9-3 in Section C.9.4.

More details on monitoring, evaluation, and management approaches are provided in Section D. The remainder of Section C and Section D provide a flexible, adaptive framework for protecting, enhancing, restoring, and managing the variety of beneficial uses in the Otay River watershed during the short and long terms.

Table C.9-1 List of Strategies by Priority

Priority	Strategy	See Page Number
High	• Eradicate Non-Native Flora and Fauna and Prevent Reinfestation and New Introductions	C-77
	• Protect, Enhance, and Restore Habitat Linkages and Wildlife Movement	C-84
	• Restore the Lower Otay River Floodplain to Enhance the Quality of Water Entering San Diego Bay	C-88
	• Implement Setbacks or Buffers Around Aquatic Resources for New Developments	C-91
	• Limit Future and Remove Existing Trash and Debris	C-106
	• Protect Drinking Water Quality in the Otay Reservoirs	C-109
	• Limit Impervious Surface Area	C-111
	• Implement a Watershed-Wide Education Program to Improve Public Awareness and Stewardship	C-120
	• Form a Watershed Council or Equivalent to Implement and Update the Watershed Management Plan	C-125
Medium	• Retrofit Existing Developments as Necessary to Protect Aquatic Resources	C-129
	• Restore Urban Creeks	C-131
	• Implement Comprehensive Agricultural Land Practices to Protect Aquatic Resources	C-141
	• Improve Existing and Create New Recreational Facilities Within the Watershed	C-145
	• Manage Tecate Cypress Forest and Oak Woodlands	C-153
	• Achieve Consistency in Regulations in Conjunction with the SAMP	C-160
Low	• Preserve, Enhance, and Restore Additional Floodplain Parcels Within the Otay River Watershed	C-162
	• Protect, Enhance, and Restore Cultural Resources	C-164

C.9.1 High-Priority Strategies for Watershed Protection, Enhancement, Restoration, and Management

The following strategies, in no particular order, are considered high priority for the Otay River watershed, based on their expected large benefits to the watershed and their capacity to build upon other efforts being planned or underway:

- Eradicate Non-Native Flora and Fauna and Prevent Reinfestation and New Introductions
- Maintain, Enhance, and Restore Habitat Linkages and Wildlife Movement
- Restore the Lower Otay River Floodplain to Enhance the Quality of Water Entering San Diego Bay
- Implement Setbacks or Buffers Around Aquatic Resources for New Developments
- Limit Future and Remove Existing Trash and Debris
- Protect Drinking Water Quality in the Reservoirs
- Limit Impervious Surface Area
- Implement a Watershed-Wide Education Program to Improve Public Awareness and Stewardship
- Form a Watershed Council or Equivalent to Implement and Update the Watershed Management Plan.

C.9.1.1 Eradicate Non-Native Flora and Fauna and Prevent Reinfestation and New Introductions

Target Goals

This strategy is intended to address the following goals of the ORWMP:

Goal 1. Protect, Enhance, and Restore Watershed Resources

Goal 5. Maximize Integration of Existing Programs and Plans that Affect the Resources of this Watershed

Activities and Benefits

As discussed in the *Draft Habitat Restoration and Exotic/Non-Native Species Plant Removal Plan for the Otay Valley Regional Park* (County of San Diego Department of Parks and Recreation, 2005), there are numerous invasive, non-native species in this watershed, including giant reed (*Arundo donax*), tamarisk or salt cedar (*Tamarix ramosissima*), pampas grass (*Cortaderia selloana*), and castor bean (*Ricinus communis*). This draft plan offers a coordinated approach for reducing and controlling, if not eliminating, the populations of exotic plant species within the Otay Valley Regional Park (OVRP), the boundaries of which are shown in Figure B.3-17. Non-native fauna were not addressed in this plan. More than 600 acres (approximately 7 percent) of exotic plants occupy the OVRP (between Otay Reservoirs Vicinity and the park's western-most boundary approximately 0.5 mile west of I-5). During their planning-level delineation of aquatic resources in this watershed, the U.S. Army Corps of Engineers (Corps) observed and mapped several invasive, non-native species, particularly downstream of Savage Dam (Lichvar and Ericsson, 2003), as shown in Figure C.9-1. This delineation did not comprehensively identify non-native plant species in this watershed or their extents, nor did it identify or map non-native fauna.

The most detrimental of the non-native plant species in the region and this watershed are giant reed (*Arundo donax)* and salt cedar/tamarisk (*Tamarix* sp.). These species directly impair habitat-support functions and values and indirectly affect hydrologic and biogeochemical functions performed by aquatic ecosystems. Eradicating non-native species enhances habitat functions and values and protects habitats within the watershed from future infestations. Similarly, non-native fauna, including non-native turtles, frogs, crayfish, and brown-headed cowbirds, prey on or compete with native wildlife within the watershed. Therefore, their control or eradication would assist native wildlife in maintaining healthy populations. Furthermore, their removal could aid in the recovery of sensitive wildlife species, such as southwestern arroyo toad and least Bell's vireo, which occur in the watershed.

For this strategy to be effective, it will be necessary to identify the location and extent of non-native plant and animal species in the watershed. The mapping recently completed for the OVRP sufficiently identifies exotic plant species infestations in the OVRP area. However, this effort did not include assessments of exotic fauna nor did it extend into the remainder of the watershed outside of the OVRP. Therefore, qualified biologists are needed to identify exotic flora and fauna throughout the watershed with the exception of exotic flora inside the OVRP area. All exotics should be mapped (e.g., using a Geographic Information System) to identify locations and infestation levels.

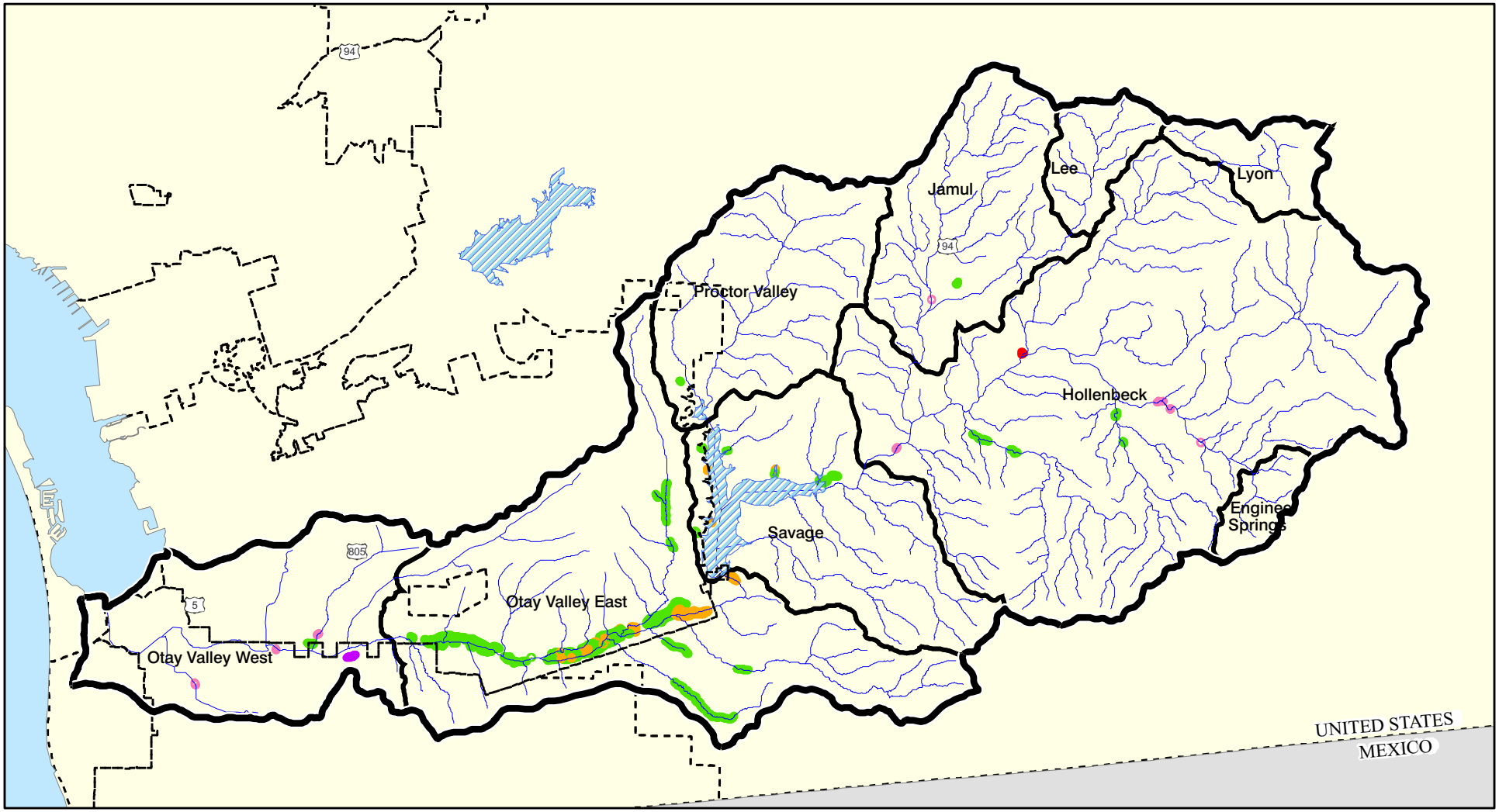
In addition, it would be important to know which areas in the watershed are already being treated or will be treated, either because of a mitigation obligation or because of volunteer efforts. For example, the MSCP Subarea Plans include provisions for eradicating non-native species in and adjacent to the preserve areas. In areas undergoing or slated for treatment as a mitigation obligation, the funding and eradication activities would be the responsibility of the land owner or manager. In theory, this would

reduce the total costs to the watershed-wide program (i.e., certain areas are the financial responsibility of another party); unless the land owner or manager does not fulfill the mitigation requirements and is not forced to do so, or the mitigation requirements are insufficient to eradicate non-native species in the treated area. It is also important to know where the treatment areas are relative to infested (i.e., potential source) areas. This is important because areas being treated could become reinfested once the treatment ends if the treated areas are downstream or downwind of non-native species (although proximity is usually more important for non-native wildlife). Also, areas not used as mitigation could be potentially available for mitigation, either through an in-lieu fee program (see below), mitigation bank, or directly with the landowner or manager to satisfy mitigation obligations, which could further reduce the public costs of the watershed-wide program. Areas not available as mitigation would still be important to consider and, as necessary, treat, to ensure the watershed-wide eradication goals are achieved.

Therefore, the following steps will be necessary to successfully implement this strategy:

- Retain qualified biologists to identify and map the locations and extent of non-native plant and animal species in this watershed, considering existing data (e.g., OVRP non-native plant information) and noting which areas are already being treated or will be treated as mitigation obligations or because of volunteer efforts (incorporate spatial data into the watershed GIS).
- Have the experts prioritize species types and locations according to the California Exotic Pest Plant Council (CalEPPC) List A. The *Draft Habitat Restoration and Exotic/Non-Native Species Plant Removal Plan for the Otay Valley Regional Park* (County of San Diego Department of Parks and Recreation, 2005) offers an approach for prioritizing eradication efforts focused on non-native plants.
- Use these experts to identify the appropriate eradication methods (e.g., mechanical removal, direct herbicide application, cut-and-paint, trapping – will vary by target species, location in the watershed, timing of treatment, proximity of sensitive flora and fauna, and other factors).
- Identify affected property owners to educate them about the problem and to reach formal agreement on gaining access for eradication activities (initial and long-term treatments).
- Secure all necessary funding to undertake these activities (i.e., necessary funding includes money needed to retain experts to collect the initial baseline information and to complete all other listed steps).
- Complete the environmental documentation (CEQA and NEPA) and obtain the approvals (U.S. Army Corps of Engineers [Clean Water Act Section 404 permit], California Department of Fish and Game [Fish and Game Code Section 1602 or Section 1605 Streambed/Lake Alteration Agreement], San Diego Regional Water Quality Control Board [Clean Water Act Section 401 Water Quality Certification/Porter-Cologne Water Quality Control Act Waste Discharge Requirements], State Water Resources Control Board [Clean Water Act Section 402 NPDES permit], U.S. Fish and Wildlife Service [Endangered Species Act Section 7 consultation – typically addressed through the Corps' permitting process], State Historic Preservation Officer [National Historic Preservation Act Section 106 consultation – typically addressed through the Corps' permitting process], and local [encroachment] permits).
- Hire a licensed contractor to implement the eradication program (see maintenance and monitoring considerations, below).

In general, non-native plant eradication is most successful if started within and adjacent to the uppermost stream reaches (headwaters) and continued methodically downstream to avoid re-infestation by upstream sources. This is particularly important for species that reproduce vegetatively and primarily spread by conveyance of fragments in surface water (e.g., giant reed). However, several species (e.g., tamarisk) can produce large quantities of highly mobile seed, which can be spread by wind, animals, water, and other means. For these species, eliminating headwater occurrences may not substantially reduce the transport of propagules if a major seed source is located upwind, if an



Legend

- ARUNDO
- BERMUDA GRASS
- DOWNY BROME
- TAMARIX
- TREE TOBACCO

Basemap Legend

- Otay River Watershed Boundary
- City Boundary
- Lakes

N

0 2.5 5

Scale in Miles

Source: Lichvar and Ericsson, 2003.

Otay River Watershed Management Plan

Figure C.9-1

USACE-Mapped Exotic Plant Species Locations in the Otay River Watershed

Aspen Environmental Group

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eradication site is frequently disturbed, or if seed vectors enter an exotic-free area. Therefore, it is important to consider reproductive mechanisms among other factors in developing and implementing an effective eradication program.

The Corps, the CDFG, and potentially the SDRWQCB could authorize the watershed-wide eradication program under the SAMP. However, regulated activities occurring before completion of the SAMP would have to be authorized separately. The SAMP would include establishing/authorizing an aquatic resource conservation and restoration program. Exotic species eradication could be a key component of that program.

For long-term effectiveness, it is imperative that this strategy also implement education and land management components to prevent reinfestations as well as introductions of new pests. One component is preparing and distributing to watershed residents a free pamphlet containing a list of non-native plants to avoid or that are prohibited in this watershed (e.g., giant reed, salt cedar, pampas grass, fountain grass, castor bean, iceplant, pepper trees, jacaranda) and alternative native plants to use for meeting particular needs, such as erosion control. The jurisdictions could work collaboratively with the Working Group to develop this list and pamphlet. Similarly, it is important to provide written notification of this eradication strategy to nurseries within and adjacent to the watershed, including a formal request that they not sell species on this list or contained within the CalEPPC List A. While it is not illegal for nurseries to sell many of these exotic species, regular education and political pressure could effectively reduce if not eliminate the sale of listed exotic plants in this watershed. Proponents of this strategy could also prepare a more complete guidebook with the prohibited plant list and brief descriptions of the benefits of native and non-invasive landscapes, planting techniques, water conservation, and natural alternatives to fertilizers and pesticides (see high-priority strategy: Implement a Watershed-Wide Education Program to Improve Public Awareness and Stewardship). These educational materials should also advise residents and users about the importance of properly managing any exotic wildlife in their possession (e.g., bullfrogs and crayfish should not be released into the ecosystem).

The County and cities in the watershed should prohibit developers from using or allowing future residents to use plants on the prohibited plant list as a condition for project approval. Jurisdictions need to require that this list is included in the Covenants, Codes, and Restrictions (CC&Rs) and Homeowner's Association (HOA) Rules and Regulations to ensure residents do not use them in their landscaping. The prohibited plant list should be updated as new pest species emerge (see frequent publications from CalEPPC) or once every 3 years at a minimum. It would also be beneficial, perhaps through CC&Rs and HOA Rules and Regulations, to discourage residents and users from releasing non-native or domestic wildlife into the watershed.

Locations

It is expected that the majority of non-native plant species are concentrated west of the Otay Reservoirs (in the more urbanized areas of this watershed); although pockets have been observed in Hollenbeck Canyon, Proctor Valley Creek, Jamul Creek, Dulzura Creek, Poggi Canyon, Nestor Channel, other tributaries to the Otay River, and the Otay Reservoirs. While they have not been mapped comprehensively (with the exception of the California Department of Fish and Game's Rancho Jamul Ecological Reserve), it is anticipated that non-native fauna, including bullfrogs, crayfish, and brown-headed cowbirds, are also concentrated west of the Reservoirs, in proximity to artificial ponds and urban areas. For example, brown-headed cowbirds are known to occur along the lower Otay River. Trapping programs have been successful in controlling this species to benefit the least Bell's vireo.

Expected Proponents

Because non-native species in this watershed occur in multiple jurisdictions, the Watershed Council/equivalent should work with the County of San Diego, the Cities of Chula Vista, San Diego, and Imperial Beach, and the Unified Port District of San Diego to implement this strategy system-wide. Moreover, it would be critical to coordinate activities and secure access from the various property owners/managers in the watershed, so that non-native eradication activities proceed in an organized, methodical, and effective fashion. It is likely the Corps and the CDFG would consider this type of program to be an important component of the SAMP's aquatic resource conservation and restoration program. If desired, a separate entity could be established and funded by these jurisdictions to execute this strategy. Moreover, the jurisdictions might find it helpful to enlist the aid of a conservation entity to complete the eradication activities. For example, the Mission Resource Conservation District (MRCD) has been highly successful in removing giant reed and other non-native plant species in parts of the Santa Margarita River and San Luis Rey River watersheds. For these efforts, they worked with the regulatory and resource agencies to establish an in-lieu fee mitigation program, whereby they collected mitigation fees from parties seeking to impact aquatic resources (and as approved by the regulatory agencies), and the MRCD used these funds to eradicate non-native species. The Otay River watershed is within the Greater San Diego County RCD service area. While they do not currently have an exotics removal program, this RCD might be interested in establishing a similar program in the Otay River watershed given its abundant and varied sensitive habitats and species, many of which are in preserves. Whatever the chosen course of action, the arrangement among proponents could be formalized by a Joint Exercise of Powers Agreement (JEPA) or similar agreement.

In this watershed, a large-scale non-native eradication and native revegetation effort is already in the planning stages focused on the OVRP (County of San Diego Department of Parks and Recreation, 2005). This effort could provide an important pilot project for other eradication efforts in this watershed. Pilot eradication projects can be useful for:

- Determining which eradication techniques work best in the watershed;
- Getting local interest groups (e.g., NGOs) and residents and/or volunteers involved and educated about the need for eradication throughout the watershed; and
- Demonstrating to grant funding agencies the commitment to eradication in the watershed and that their funding can assist in realizing watershed-wide eradication goals.

Pilot projects can provide a strong base of understanding, funding, and trained and committed personnel for treating the rest of the watershed. Therefore, proponents of this strategy should leverage the success and lessons of the OVRP eradication effort as they implement treatments in other infested areas.

Schedule

Sustainable removal of non-native plant species requires a minimum of 5 years, with 7-10 years often necessary to ensure full eradication. Because they are mobile, it is improbable that non-native fauna would be fully eradicated in this watershed. Non-native fauna and flora can be controlled, but some level of ongoing maintenance and monitoring would probably be required within this watershed, except for the most remote or isolated locations. It could also take 6 to 12 months to complete the required environmental documentation and to acquire the necessary federal, State, and local permits, particularly if (as expected) formal consultation with the U.S. Fish and Wildlife were required. Therefore, non-native species eradication in this watershed is a long-term project. Initial education and management components of this strategy could be implemented over the short term (within 2 years), but watershed-wide changes in attitudes and behavior would require much longer.

Maintenance and Monitoring Considerations

Eradication of non-native species requires extensive follow-up treatments typically over the course of several years. To ensure success, a monitoring program would be required to track the eradication progress and to determine whether approaches should be modified to increase effectiveness. As discussed, full eradication of non-native fauna would not be expected, except in isolated watershed areas. Long-term monitoring of treated areas would be required by the regulatory agencies if mitigation fees were used to partially or fully fund eradication activities.

First-Order Cost

Because the full extent of infestation is unknown, the cost of this effort cannot be determined at this time. Estimates of non-native species eradication activities in this region range from $5,000-$60,000 per acre, depending on the intensity of infestation, the type of infestation (including the number of retreatments necessary), and assuming property acquisition or easements are not necessary. Replanting with native species tends to increase cost toward the higher end of the range in the short term, but can assist the recovery of treated areas, increase their resistance against reinfestation, and reduce long-term management (including retreatment) costs. Use of volunteers could reduce costs, but some training will be required as will full-time oversight by licensed professionals. Assuming a conservative estimate of 1,000 acres infested in this watershed, the cost of eradicating non-native plant species would range from $5 million to $60 million. Eradication of non-native fauna could occur concurrently, but as noted, would probably need to continue indefinitely.

The costs associated with distributing a prohibited plant list or a guidebook of prohibited plants and native alternatives, and notifying nurseries of these pests could be kept well under $100,000. The costs for the jurisdictions to update their plan review and approval processes are not known, but would not be expected to exceed $100,000.

Potential Funding Sources

As discussed (under Expected Proponents), an in-lieu fee program could provide an important funding source for exotic species eradication. Typically, a conservation entity manages the collection of mitigation funds, the eradication of non-native species, and the follow-up maintenance, monitoring, and agency reporting. A more formal mitigation bank is also an option, in which the banking entity undertakes the eradication activities and sells the credits to parties impacting wetlands/waters and needing mitigation, to pay off their investment. These banks require the development of a mitigation banking instrument, including agreements with the U.S. Army Corps of Engineers and other water resource agencies, and the oversight of a multi-agency Mitigation Bank Review Team. Mitigation banks are less popular because of the time and resource commitments needed for approval. As discussed (Activities and Benefits), areas being used or slated to be used for mitigation are the financial responsibility of the responsible land owners or managers, so these areas should reduce the total cost of the watershed-wide program (i.e., these costs are being borne by other parties). Other potential funding sources include grant funding, bond money (such as Propositions 40 and 50), federal agency money (e.g., National Fish and Wildlife Foundation Pulling Together Initiative–specifically for removing noxious plant species), State money (e.g., California State Coastal Conservancy Watershed Enhancement Program and the Wetlands Recovery Project Work Plan), and local money.

C.9.1.2 Protect, Enhance, and Restore Habitat Linkages and Wildlife Movement

Target Goals

This strategy in intended to address the following goals of the ORWMP:

Goal 1. Protect, Enhance, and Restore Watershed Resources

Goal 5. Maximize Integration of Existing Programs and Plans that Affect the Resources of this Watershed

Activities and Benefits

As shown in Figure B.6-1, there are several known habitat linkages that connect the Otay River watershed with open space of adjacent watersheds and provide wildlife movement opportunities. Several sources of data were considered to develop this figure, including the County of San Diego, City of San Diego, and City of Chula Vista's MSCP Subarea Plans and the Otay Ranch RMP. Wildlife movement is an important landscape-level function that facilitates connectivity, population dynamics, gene flow, and helps maintain regional ecological integrity. Therefore, it is critical to protect, and if possible, enhance existing and restore historic habitat linkages. Protecting habitat linkages may initially begin with acquiring land or easements and expand to include long-term monitoring, enhancement, and/or restoration activities. Enhancing or restoring corridors may consist of eradicating non-native plant species; planting native vegetation; establishing cover; removing or redirecting lighting, noise, and other disturbance factors; or adding or modifying structures that aid in safe wildlife passage, such as appropriately designed culverts or tunnels, overcrossings, and associated wildlife fencing.

Proponents of this strategy would need to perform several tasks:

- Establish a wildlife corridor and linkages inventory for the entire watershed using existing inventories and publications.
- Retain wildlife movement experts to evaluate the current condition of known and potential habitat linkages (use strategies currently being developed by the County of San Diego Department of Public Works), including developing criteria and choosing target species for identifying functional wildlife corridors.
- Prioritize and protect habitat linkages, and conduct movement studies to assist in the protection, enhancement, and/or restoration of viable movement corridors, using input from the available experts.
- Develop specific protection, management, enhancement, and/or restoration protocols for each linkage, beginning with the highest priority linkages.
- Contact and reach formal agreement with willing property owners to manage their properties or to allow for the preservation of connectivity, enhancement or restoration that would benefit habitat linkages over the long-term (note that the strategy could still be effective if specific property owners are uncooperative, but reprioritization of projects might be required; without further investigation, it is not known which property owners would be involved and which ones would be cooperative).
- Secure all necessary funding to undertake these activities (i.e., necessary funding includes money needed to retain experts to establish the inventory and to complete all other listed steps).
- Complete any required environmental documentation (NEPA and CEQA) and obtain federal, State, and local approvals for feasible projects.
- Hire any needed contractors to implement the activities (see maintenance and monitoring considerations, below).

Locations

As shown in Figure B.6-1, the two main linkages facilitating regional wildlife movement between the Otay River watershed and adjacent areas are: (1) the Otay River Valley, linking the San Diego Bay and Otay Mountain; and (2) Otay Mountain, linking the Otay River watershed to the Tijuana River watershed (Penrod, 2001). The Otay River Valley linkage is well protected by a series of wildlife movement corridors or linkages in public ownership. Conversely, Otay Mesa Road/SR 905 may have reduced or eliminated the Otay Mountain Linkage at Dennery Canyon. This area needs intensive study to see if anything can be done to preserve movement in the area. Other key linkages that should be targeted for protection, enhancement, and/or restoration activities include:

- *San Miguel Mountains/Proctor Valley/Otay Ranch*. Prior to the October 2003 fires, San Miguel Mountain supported coastal sage scrub, chamise chaparral, southern mixed chaparral, native grasslands, vernal pools, and alkali meadow (City of Chula Vista, 1993c). A significant portion of the Mountain is within the Otay Ranch Preserve. At this time, the area functions as a wildlife linkage and is currently not constrained. The Otay Ranch Resource Management Plan determined this area to be a wildlife linkage between San Miguel Mountain and the Sweetwater Reservoir and River, located to the north and northeast, respectively. In addition, the area may facilitate movement from Proctor Valley to the south and Jamul Creek to the east, connecting the Jamul Mountains with the San Ysidro Mountains.
- *Sweetwater River/McGinty Mountain/Hollenbeck Canyon*. Implementation of the Sweetwater-Loveland Open Space and Habitat Management Plan provided a linkage from Sweetwater Reservoir through to the McGinty Mountain area at the northeastern end of the Otay River watershed. The McGinty Mountain area encompasses large tracts of undeveloped land, including an existing Nature Conservancy Preserve and adjacent high quality native plant and wildlife habitat.
- *Jamul Mountains/Lower Otay Reservoir*. Prior to the October 2003 fires, Jamul Mountain, a large topographic feature northeast of Lower Otay Reservoir, supported coastal sage scrub, chamise chaparral, and live oak woodland. The oak woodlands provide unconstricted wildlife movement across these lands, although future development plans are unclear at this time. Monitoring locations are recommended as part of the MSCP regional wildlife movement monitoring program (CBI, 2003a).
- *Jamul Mountains/San Ysidro Mountains*. Much of this area is conserved as part of the MSCP, and wildlife movement across this region is facilitated by a multitude of canyons (e.g., Little Cedar and Cedar canyons) that are administered by the BLM. However, there is some uncertainty regarding future development in the major amendment area on the East Otay Mesa. Nevertheless, open space preservation of the East Otay Mesa hills in the San Diego County Subarea may contribute to wildlife movement from the Tijuana River watershed to the Otay River watershed through this area.
- *Spring Canyon/Dennery Canyon /West Otay Mesa*. Although Spring Canyon is located on top of the mesa south of the Otay River Valley, this isolated canyon drains into the Tijuana River Valley. The only connection between the Spring Canyon and Dennery Canyon open spaces to the Otay River Valley is through a culvert under Otay Mesa Road/State Route 905 (CBI, 2003b), near Heritage Road. The culvert is known to be used by coyotes and gray foxes, but also seems to provide restricted crossing opportunities for bobcat and mountain lion. Mule deer were not found during transect surveys in this area. Perhaps a larger culvert could be installed to increase wildlife movement. The Spring Canyon area is becoming more isolated by surrounding development and is losing its value as a wildlife corridor.
- *Johnson Canyon/O'Neal Canyon/Otay River Valley*. This area functions as a linkage between the Otay Lakes, the Otay River Valley, Otay Mountain, and adjoining open space (CBI, 2003a). Wildlife movement is adequately facilitated through the Otay River Valley and adjoining canyons connecting the mesa with the valley. Wildlife movement through O'Neil Canyon, which supports gnatcatcher-occupied coastal sage scrub, probably functions as a part of the regional wildlife corridor to Otay Mesa and beyond, as well as the local wildlife corridor to the Otay River Valley. Wildlife culverts and tunnels allow for movement through a constriction point under Alta Road, which appears to be used by wildlife (as evidenced by game trails and coyote scat). In addition, the MSCP planned preserve design took "unconstricted" wildlife movement in this

area into consideration. A large part of this linkage will be preserved as mitigation for the Otay Ranch development project and Caltrans' SR-125 project, and habitat management and restoration for the Johnson Canyon Preserve will be provided to facilitate wildlife movement (EDAW, 2003). However, a third border crossing between Mexico and the United States is proposed within the vicinity of State Route 905. The effects of this crossing are unknown at this time, but should be closely studied with respect to wildlife movement. The protection of this corridor is critical as it is the western-most corridor in the Otay River watershed that adequately supports wildlife movement. Farther west is Spring Canyon/Dennery Canyon/West Otay Mesa as shown on Figure B.6-1, but that wildlife corridor is extremely restricted and is rapidly losing is value.

- *Salt Creek/Otay Valley*. Salt Creek used to be a regional wildlife corridor for Quino checkerspot butterfly, cactus wren, and California gnatcatchers (Ogden, 1992). However, development of the Eastlake communities and Otay Ranch have fragmented the upper creek. While large mammal movement may have never occurred in this area, restoration and preservation of Salt Creek may continue to provide important dispersal habitat for these species.
- *Hollenbeck Canyon/Rancho Jamul*. The Hollenbeck Canyon Wildlife Area and Ranch Jamul Ecological Reserve open spaces managed by the California Department of Fish and Game comprise a large block of wildlife movement corridors and linkage in the County (CBI, 2003b), linking the Otay Ranch Preserve to lands in the east. Both open space preserves are separated by State Route-94. While culverts appear to facilitate wildlife movement underneath this highway in three to five locations, the 2003 fires and subsequent watershed runoff have partially blocked these passage routes. Wildlife movement target species across this swath of land include coyote, gray fox, bobcat, mule deer, and mountain lion. The CDFG is currently preparing land management plans for these open spaces, including provisions and management assisting wildlife movement (USGS, 2002; TAIC, in progress).
- *Poggi Canyon/Wolf Canyon/Otay River Valley*. Key biological resources within Poggi Canyon, Wolf Canyon, and Otay River Valley may also offer restricted linkages between the three areas as identified in the Otay Ranch Resource Management Plan (City of Chula Vista, 1993c). Poggi Canyon does not function as a terrestrial wildlife movement corridor due to constrictions from the Olympic Parkway straightening and the installation of rock check-dams throughout. The canyon may continue to have value as a bird dispersal area (CBI, 2003a). Wolf Canyon is contiguous with Otay River Valley via a narrow linkage west of Rock Mountain. This linkage may act primarily for bird dispersal, but may also facilitate small mammal movement. Wolf Canyon should be considered in future analysis to identify potential management, enhancement, or restoration opportunities.
- *Hollenbeck Canyon/Lyons Valley/Lee Valley*. One of the potential future corridors identified by the MSCP is in the vicinity of Lyon Canyon, linking the northeastern portion of the watershed with U.S. Forest Service Land (i.e., Cleveland National Forest) to the east. This potential future corridor is within the County of San Diego's "Pre-Approved Mitigation Area", and as with other MSCP Planned Preserve areas, it should be a priority for land acquisition and enhancement.

Expected Proponents

The Watershed Council/equivalent could work with the individual jurisdictions to lead the protection, enhancement, and restoration efforts within their municipal boundaries. The County of San Diego would be responsible for most of these activities, because the majority of the known linkages occur within the unincorporated portions of the watershed. However, linkages extend across jurisdictions and watershed boundaries, and it would be more effective for the jurisdictions to work collaboratively. Moreover, it would be beneficial to involve the preserve owner/managers and resource agencies because many of the preserves were established in consideration of maintaining habitat linkages and wildlife movement. A JEPA could formalize the jurisdictions' intent to protect and improve habitat linkages both within this watershed and to adjacent watersheds.

Schedule

Protecting habitat linkages could involve providing wildlife crossings on a project level, potentially combined with habitat acquisition, public easements, or working with property owners to maintain contiguous wildlife movement corridors. Several factors will dictate how quickly these activities can occur, such as jurisdictional priorities, property owner willingness to sell or manage their properties for the benefit of wildlife movement, and funding. It might be possible to acquire key parcels over the short-term, but an effective program focused on protecting, enhancing, restoring, and managing habitat linkages and wildlife movement corridors would involve a long-term commitment to studies, before and after implementation, as well as actual implementation and follow-up actions.

Maintenance and Monitoring Considerations

Maintenance and monitoring would be critical to the success of any activities or projects focused on benefiting wildlife movement. For example, long-term, intensive studies would be required to ensure a new road undercrossing is facilitating wildlife passage. Limited usage would suggest that the undercrossing requires modification (e.g., larger undercrossing, more wildlife fencing) or that additional features (e.g., additional undercrossings) are needed. Monitoring is also needed on preserve or protected properties to evaluate their usage by wildlife and to determine if habitat enhancement or restoration is warranted. Furthermore, it is critical that structures used for wildlife movement are maintained and monitored, particularly after significant watershed events. This need was clearly demonstrated by the clogging of culverts under SR-94 by sediment conveyed to watershed streams following the San Diego wildfires of 2003.

First-Order Cost

Because this strategy could include several different types of activities and projects, the cost is not known at this time. To develop a realistic cost estimate, it would be necessary to specify what would occur, which would depend on evaluating linkage conditions, prioritizing activities, and the other factors specified above. Property acquisition in southern California is extremely costly ($100,000 per acre is not unusual), and any enhancement or restoration activities and long-term maintenance and monitoring would increase the cost further (averaging $30,000-$80,000 per acre, depending on the habitat type and the level of effort). For a particular activity or project, costs would obviously be lower if property acquisition is not required or it could occur within existing public right-of-way (e.g., State Route 94 or 905).

Potential Funding Sources

Adding or modifying structural features related to State transportation facilities, such as culverts and bridges and associated wildlife fencing (e.g., State Routes 94 and 905), could be funded by the California Resources Agency State Gasoline Tax Environmental Enhancement and Mitigation Program. The National Fish and Wildlife Foundation and NOAA Challenge Grants could be used for wildlife corridor and movement enhancements, because they are specifically set aside for projects that promote fish and wildlife conservation in which movement is a key component to maintaining viable populations. There are many funding sources available to acquire, enhance, and restore native habitat. These include California Department of Parks and Recreation Habitat Conservation Fund, Wetlands Recovery Project Work Plan, and bond money distributed by the SWRCB under Propositions 40 and 50.

C.9.1.3 Restore the Lower Otay River Floodplain to Enhance the Quality of Water Entering San Diego Bay

Target Goals

This strategy in intended to address the following goals of the ORWMP:

Goal 1. Protect, Enhance, and Restore Watershed Resources

Goal 4. Ensure Public Health and Safety

Goal 5. Maximize Integration of Existing Programs and Plans that Affect the Resources of this Watershed

Activities and Benefits

The health of San Diego Bay is dependent on the quality of the water entering it, which includes surface and groundwater from the Otay River watershed. Therefore, any activity, BMP, or project that improves the quality of surface or groundwater in the Otay River, particularly downstream of Savage Dam (which hydrologically disconnects the upper and lower watershed, except during extreme storm events), will improve the quality of water entering the San Diego Bay. In the *San Diego Integrated Natural Resources Management Plan* (SDUPD, 2000), sponsored by the U.S. Navy and the Unified Port District of San Diego and developed by numerous stakeholders, restoration of the lower Otay River including the salt pond area and the historic floodplain were identified as key actions for improving Bay water quality.

Currently, a substantial portion of the lower Otay River is levied/bermed, particularly downstream of I-5. Several floodplain restrictions also occur between I-5 and I-805 (e.g., Hollister Street dip crossing and the Hanson Spancrete Pacific Gravel Processing Plant in the river bottom). These impacts limit the Otay River's floodplain's capacity to provide a full range of riparian functions; as indicated by low (generally less than 0.5, out of a maximum of 1) Hydrologic, Water Quality, and Habitat Integrity Index scores calculated by Smith (2004) for this portion of the Otay River (Figures B.3-11 to B.3-13). In addition to storage of flood waters and supporting riparian habitat, floodplains are critical to providing numerous biogeochemical functions such as nutrient cycling and the detention and transformation of contaminants. The latter functions are dependent on the area of the floodplain available to store and treat flows and the duration of water-soil and water-vegetation contact. Therefore, if the levees/berms and other floodplain restrictions are removed or modified, as being contemplated for the area west of I-5 under the San Diego Bay National Wildlife Refuge (NWR) Draft Comprehensive Conservation Plan (CCP)/Environmental Impact Statement (EIS), there will be an increased potential for these functions to occur over a greater area and at a higher frequency, which will filter excess nutrients and contaminants and improve the quality of the water entering San Diego Bay. In addition, the floodplain will provide better filtration if it is regraded to provide macro- and micro-topographic features (e.g., pits, secondary channels, hummocks) and it develops a well-developed riparian community.

To be most effective, this strategy will require the completion of the following steps:

- Retain restoration ecologists, fluvial geomorphologists, or experts with similar training to evaluate the existing floodplain impediments/constraints and opportunities for restoration. Candidate impediments/ constraints to remove or relocate out of the historic 100-year floodplain include:
  - The earthen levees/berms downstream of I-5 (see note below)

  - The pipelines and other utility infrastructure (e.g., sewage pump station, power poles downstream of I-5; although San Diego Gas & Electric does not have any plans to remove or relocate existing power poles out of the 100-year floodplain)
  - The Otay River low-water concrete crossing at Saturn Boulevard and other roadway fills within the 100-year floodplain (e.g., Hollister Street)
  - The Hanson Spancrete Pacific Gravel Processing Plant and its associated access roads (off Hollister Street and 7th Avenue) and infrastructure immediately upstream of Hollister Street and the San Diego Trolley Bridge.

- Coordinate with the USFWS and the OVRP proponents regarding their planned restoration activities along the lower Otay River to determine what remains to be completed.
- Have the experts prioritize the impediments/constraints not planned for removal and evaluate other restoration opportunities (in consideration of the *Draft Habitat Restoration and Exotic/Non-Native Species Plant Removal Plan for the OVRP* [County of San Diego Department of Parks and Recreation, 2005], the Western OVRP NRMP [City of San Diego, 2002], the restoration work under the San Diego Bay NWR, any other restoration efforts for the lower Otay River, and local opportunities and constraints).
- Contact and reach formal agreements with the property owners to determine which impediments/constraints can be removed and what other restoration opportunities can be realized (note that this strategy can still be effective if specific property owners are uncooperative, but reprioritization of activities might be required; without further investigation, it is not known which property owners would need to be involved and which ones would be cooperative).
- Secure the necessary project funding to remove as many impediments/constraints and restore as much of the lower Otay River floodplain as possible (i.e., necessary funding includes money needed to retain experts to collect the initial baseline information on impediments/constraints/opportunities and to complete all other listed steps).
- Prepare formal restoration plans, including project design and specifications.
- Complete the necessary environmental documentation (NEPA and CEQA) and secure the required federal (including a LOMR/CLOMR from the Federal Emergency Management Agency if levees are removed or relocated; see note below), State, and local permits to complete these activities.
- Hire contractors as needed to complete these activities (also see maintenance and monitoring considerations, below).

While removal of the levees/berms could greatly increase restoration potential, it is important to note that this activity would require coordination with the Federal Emergency Management Agency through their Letter of Map Revision/Conditional Letter of Map Revision (LOMR/CLOMR) process as well as the applicable flood control departments (e.g., City of San Diego). Moreover, it will be important that flooding into the urban margin does not occur, which could otherwise increase contaminant concentrations and reduce water quality benefits.

The overall goal should be to minimize the amount of grading required to maximize the reconnection of the Otay River to its historic floodplain, at an affordable cost and with minimal disturbance to sensitive wildlife and vegetation in the area. It might be sufficient to remove impediments, allow the Otay River to reestablish a more natural course during the next wet season, and follow-up with regular exotics removal, as-needed grading to increase floodplain engagement and topography, and targeted native plantings to expedite reestablishment of a well-developed, self-sustaining riparian community.

Restoration efforts should also include removing/relocating salt pond berms to restore salt marsh, brackish marsh, mudflat, and eelgrass habitats. The San Diego Bay NWR Comprehensive Plan Process has been focusing on restoration of these habitat types near the salt works.

Locations

This strategy would focus on identifying, prioritizing, and implementing restoration actions along the lower Otay River, downstream of Savage Dam (and primarily downstream of I-805). Some of this restoration is expected to occur in the next several years as part of the development of the OVRP and the fuller implementation of the San Diego Bay NWR. Lower Otay River areas not restored under either program should still be restored to maximize the area of floodplain available to provide aquatic functions that benefit water quality and wildlife.

Expected Proponents

The County of San Diego and the Cities of Chula Vista and San Diego have been working with the OVRP Advisory Bodies to develop the OVRP, which will restore some of the floodplain along the lower Otay River. The *Draft Habitat Restoration and Exotic/Non-Native Species Plant Removal Plan for the Otay Valley Regional Park* (County of San Diego Department of Parks and Recreation, 2005) provides an initial approach to these restoration activities, which are mainly focused on removing exotic plant species and planting natives. The U.S. Fish and Wildlife Service is working with stakeholders on the San Diego Bay NWR restoration work along the lower Otay River, which is expected to involve removal/relocation of some levee sections. The Watershed Council/equivalent should work with these entities, the City of Imperial Beach, and the San Diego Unified Port District on coordinating these and additional restoration activities, because they all have an interest in the health of the lower Otay River and the San Diego Bay. A JEPA or similar agreement could formalize their intent to implement this strategy.

Schedule

Restoration activities in this area are in their planning phases, and actual restoration activities and follow-up maintenance and monitoring will take several years to accomplish. Therefore, restoration activities along the lower Otay River are long-term (more than 5 years) activities.

Maintenance and Monitoring Considerations

Habitat restoration involves a substantial commitment to follow-up maintenance and monitoring. Physically disturbed areas, such as graded areas, are susceptible to infestation by invasive, non-native species, of which there are currently several in this watershed. In fact, the July 2005 draft report identified more than 600 acres of exotic plants in the OVRP (i.e., 7 percent of the OVRP). In addition, it is important to monitor the effectiveness of revegatation efforts and to take appropriate remedial actions as necessary, to ensure successful establishment of self-sustaining native habitat. With the focus of this strategy on the quality of the water entering the Bay from this watershed, monitoring should include the analysis of a range of constituents (including those specified in the San Diego Basin Plan). A useful monitoring approach, referred to as a BACI (Before-After/Control-Impact) design (see Section D.9), is the analysis of water entering (considered the control site) and leaving (considered the impact site) the restored areas both before and after activities have started. In this way, the benefits to water quality can be tracked and, if necessary, remedial actions can be undertaken to maximize these benefits while still providing a full array of habitat-related benefits.

First-Order Cost

Restoration of habitat can cost in excess of $75,000 per acre, which includes implementation, maintenance, and monitoring, including reporting to the regulatory agencies. This cost can easily double or triple if land acquisition is necessary. Costs can be significantly higher if, for example, it is

necessary to replace a low-water crossing (e.g., Hollister Street) with a bridge. Therefore, significant floodplain restoration along the lower Otay River is expected to cost well in excess of $10 million.

Potential Funding Sources

There are several funding sources available for restoration of habitat, particularly floodplains and projects that would benefit water quality. The U.S. Fish and Wildlife Service may implement significant restoration work for the San Diego Bay NWR (South San Diego Bay Unit), as will the County and other participants to develop the OVRP. Funding for these and other restoration activities could come from many sources, including Propositions 40 and 50. The California State Coastal Conservancy, using a variety of funding sources, has been a key player in undertaking several river parkway restoration projects in southern California. Another potential source is Section 206 of the Water Resources Development Act of 1996, as amended (P.L. 99-662), which authorizes the Corps to implement aquatic resource restoration and protection if the project would improve the quality of the environment, is in the public interest, and is cost effective. This funding source is limited to $5 million without specific authorization by Congress. As required of all Corps Civil Works projects, a non-federal co-sponsor must cost-share the project. For Section 206, the non-federal cost-share requirement is 35 percent.

C.9.1.4 Implement Setbacks or Buffers Around Aquatic Resources for New Developments

Target Goals

This strategy in intended to address the following goals of the ORWMP:

Goal 1. Protect, Enhance, and Restore Watershed Resources

Goal 2. Ensure Reasonable, Sustainable, and Compatible Economic Development

Goal 5. Maximize Integration of Existing Programs and Plans that Affect the Resources of this Watershed

Activities and Benefits

Background

In this case, setbacks are defined as the distance measured from the rear lot line or edge of developed area to a natural feature, such as a stream or vernal pool. In general, the County or cities can require setbacks to avoid hazards, avoid conflicts, or minimize impacts. Buffers in this case are biological and physical landforms that protect the ecological functions of a natural feature, such as a stream or vernal pool. Establishing setbacks or buffers around aquatic resources provides physical separation and habitat transition between sensitive natural resources and habitats (e.g., streams, riparian habitats, vernal pools) and urbanized areas that could potentially threaten these natural areas through predation by domestic animals, noise, lighting, trampling, urban runoff, etc. The San Diego Region Municipal Permit and County and city storm water ordinances identify setbacks as an important BMP for protecting natural resources. These intervening areas, if managed in a natural state, can protect channel stability, protect the quality of receiving waters, minimize intrusion by humans and non-native wildlife and plants, and dampen noise and light that might otherwise adversely affect wildlife using aquatic resources or adjoining transitional habitat. To maximize protection of aquatic resources, the vegetation community in the intervening area must consist of native plant species to avoid habitat degradation over time and enhance wildlife habitats. In cases where it is not practicable to exclude all non-native species

in the setback or buffer area, at a minimum, the County and cities in the watershed should ensure, as a condition of project approval, that none of the species on the prohibited plant list (see high-priority strategy: Eradicate Non-Native Flora and Fauna and Prevent Reinfestation and New Introductions) would be planted within this area. In addition, it will be important to restrict residents from accessing these buffer areas to minimize adverse effects to vegetation communities and wildlife. Restrictions could include installation of fences, planting of discouraging vegetation (e.g., nettles, thorny species), or erecting educational or "No Trespassing" signs. Moreover, the jurisdictions should modify their project approval processes to require developers to include CC&Rs, HOA Rules and Regulations, or similar means to specify nearby natural resource areas that should be avoided by residents, visitors, and their pets and domestic animals. Provisions should include appropriate (i.e., found in the area) native plantings on private properties, including HOA common areas, adjacent to or included in these buffer areas.

It is important to note that there is new construction in the watershed that is not avoiding or setting back from all aquatic resources (e.g., driveways across streams to access single lots in the eastern watershed, detention basins on and crossings of Salt Creek in Otay Ranch); and there might be particular cases in the future where it will be necessary to impact aquatic resources. In these situations, the construction is and will still be subject to federal and State regulations and permit requirements, which require avoidance and minimization of impacts and compensation for unavoidable impacts.

The federal and State regulatory agencies are increasingly requiring the protection of buffer areas as well as the aquatic resources under their purview (Corps Regulatory Guidance Letters 01-1 and 02-2; Corps Los Angeles District Regulatory Branch's Mitigation Guidelines and Monitoring Requirements; CDFG Fish and Game Commission Policies). In some cases, the regulatory agencies give credit for these buffers as mitigation (although typically less than the credit they give for wetlands or another regulated aquatic resource) or reduce the required mitigation ratio. For these reasons, it is prudent to include buffers in project designs.

The County is currently in the process of formulating criteria for required wetland buffer setbacks ranging from 25 feet to 200 feet, depending on a number of different factors. These factors include the existence of hydrophytic vegetation, condition of the existing wetland, whether the wetland/buffer serves as a wildlife corridor, existence of sensitive species, and the connectivity and condition of the wetland upstream and downstream. However, it is currently unknown what new criteria would be approved by the County Board of Supervisors. Currently, the County does require a 100-foot buffer between any development and new or proposed open space.

Moreover, at the County level, there are three ordinances that require or encourage buffers or setbacks from various aquatic resources, such as wetlands, streams, and vernal pools, in the unincorporated areas. These are the Resource Protection Ordinance (RPO), the Biological Mitigation Ordinance (BMO), and the Watershed Protection, Storm Water Management, and Discharge Control Ordinance (WPO). The RPO includes provisions to protect wetlands and wetland buffers. The Cities of Chula Vista, San Diego, and Imperial Beach have similar Best Management Practices in their storm water ordinances, but buffers or setbacks are one of many options that can be implemented.

The City of Chula Vista also has Adjacency Management Guidelines in their MSCP Subarea Plan, which restrict uses adjacent to the Preserve, including wetlands, and encourage enhancement in these adjacent areas. Instead of specifying buffer widths, most of the focus is on limiting particular activities and effects (e.g., noise) adjacent to the Preserve. An exception is the specification as high priority the locating of staging areas for equestrian use at a sufficient distance (e.g., 300 to 500 feet) from areas with riparian and coastal sage scrub habitats to ensure that the biological values of the Preserve are not

impaired. This distance is consistent with what has been specified in the OVRP planning documents (OVRPCP, OVRP Trail Guidelines, WOVRP NRMP); the OVRP documents also restrict what uses occur within the 100 foot buffer zone surrounding sensitive biological resources. The City of San Diego's and County of San Diego's MSCP Subarea Plans also include land use guidelines that apply to areas adjacent to preserves.

Similarly, the Otay Ranch RMP includes policies, standards, and guidelines focused on protecting the Preserve from adjacent land uses, including the preparation of an "Edge Plan". The edge of the Preserve is defined as a 100-foot-wide strip of land, privately or publicly owned, that surrounds the perimeter of the Preserve. The following setback Guidelines are also followed adjacent to Preserve aquatic habitats:

- Vernal pool setbacks must include the watershed and a minimum of an additional 100 feet, depending on the adjacent land use.
- Mulefat scrub should be provided with a setback that is a minimum of 50 feet and a maximum of 100 feet wide, depending upon the quality of the habitat and its function within the matrix of the surrounding vegetation (e.g., corridor, foraging habitat, etc.), and the specific type of adjacent development.
- Riparian woodlands should be provided with a setback minimum of 100 feet and a maximum of 200 feet between the woodland and development (commercial and residential).
- Oak woodlands should be provided with a setback of a minimum of 50 feet and a maximum of 100 feet between the woodland and development (commercial and residential).

The City of Chula Vista, County of San Diego, and the Preserve Owner/Manager are responsible for ensuring these controls are implemented adjacent to the Otay Ranch Preserve.

Development in the City of San Diego is subject to this jurisdiction's environmentally sensitive lands regulations, which include standards that assist in the implementation of the City of San Diego's MSCP Subarea Plan. These regulations require developments, both inside and outside the Multi-Habitat Planning Area, to maintain a sufficient buffer to protect the wetland's (includes vernal pools) functions and values. A minimum 100-foot wetland buffer is required for projects in the Coastal Overlay Zone unless the resource agencies determine a lesser buffer is sufficient to protect the resource.

The Strategy in the Otay River Watershed

To be most effective, the following set of steps or actions should be completed by proponents of this strategy:

- Retain qualified fluvial geomorphologists/hydrologists, water quality specialists, and conservation biologists to evaluate the buffer criteria in effect in this watershed and their effectiveness watershed-wide in protecting aquatic resources (habitat and species)
- Have the qualified specialists develop a comprehensive watershed-specific plan that would protect aquatic resources (habitat and species)
- Have jurisdictions and other regulatory agencies work collaboratively to determine whether the buffer criteria recommended by the plan are reasonable and what specific changes should be made to the buffer criteria jurisdictions implement within their respective portions of the watershed
- Update project review and approval processes to ensure changes in buffer criteria are formalized.

A comprehensive watershed-specific plan should be developed that considers the buffer criteria used by the County of San Diego, the City Chula Vista, and the City of San Diego, the findings of the *Otay River Watershed Special Area Management Plan Draft Planning Principles Report* (Jones and Stokes, 2005), the *Source Water Protection Guidelines for New Development* (City of San Diego Water

Department, 2004), the *Otay Watershed Pollutant Loading Tool: Development and Application* (Appendix 3), and the *Storm Water Management BMPs for the Otay River Watershed* (Appendix 4).

It is expected that setbacks/buffers would need to be greater for:

- Vernal pools
- Higher-order streams (i.e., with larger floodplains)
- Sensitive habitat areas
- Areas supporting sensitive species
- Areas where the wetland/buffer serves as a wildlife corridor
- Areas with high connectivity and good condition of aquatic habitat upstream and downstream
- Areas proximate to existing or planned preserves or locations upstream of existing or planned preserves
- Areas of better infiltrating (group A or group B) soils, or
- Areas sensitive to sediment loading.

These buffer criteria would not apply to existing development, unless new construction within existing tracts would occur closer to aquatic resources. In these cases, the jurisdictions would need to determine whether new or existing criteria could be applied or whether the new construction has already been approved.

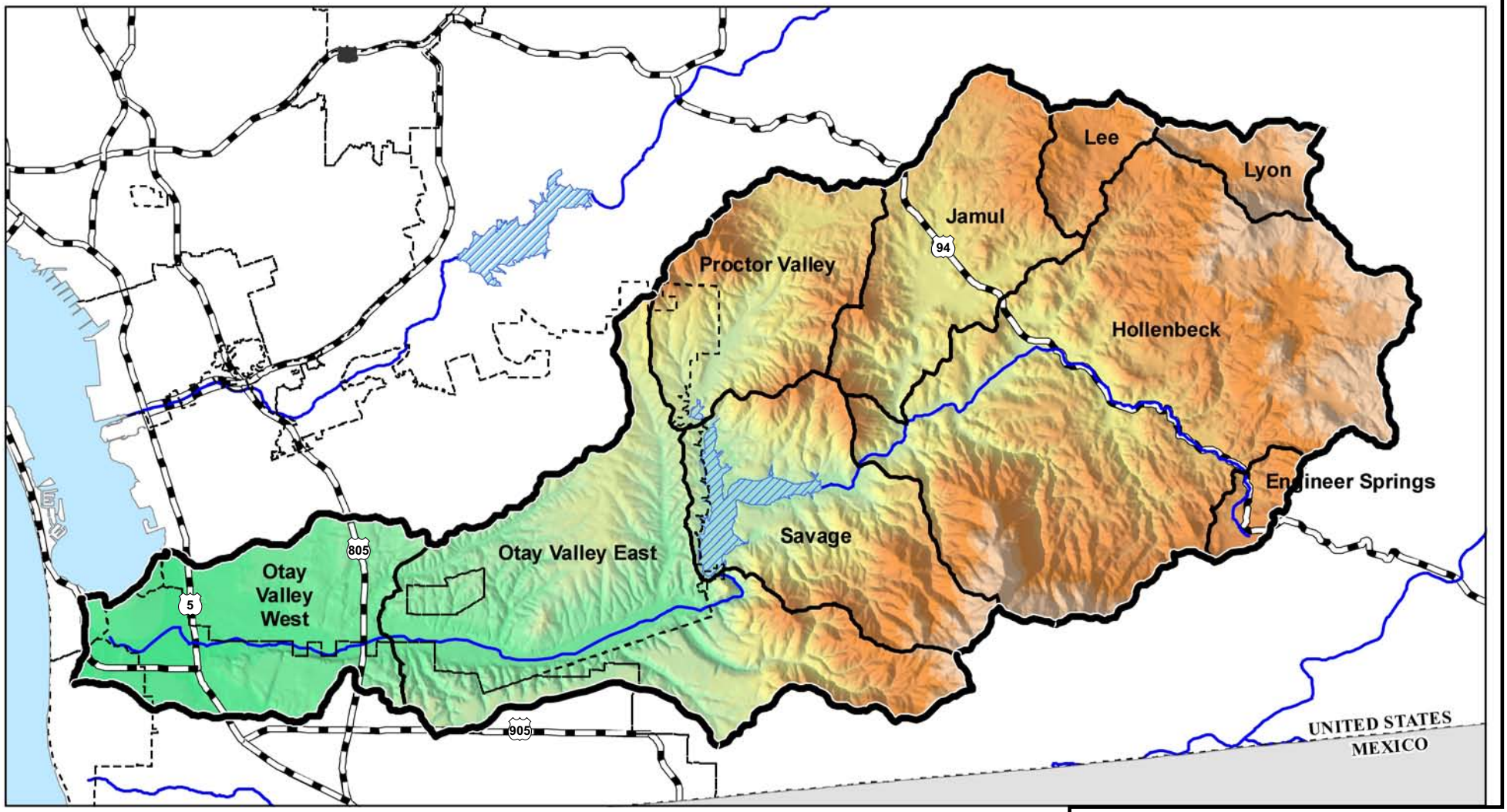
There also might be cases where new development could not avoid all aquatic resources. The jurisdictions would need to determine how to address these situations at the local level. These impacts would still be subject to federal (Corps) and State (SWRCB and SDRWQCB; CDFG; and if in the coastal zone, the California Coastal Commission) regulations.

Regarding federal and State requirements, it is possible that buffer criteria would be a component of the Aquatic Resource Conservation and Restoration Program developed under the SAMP. For this reason, the Corps and CDFG should be included in the formulation of new buffer criteria.

Locations

These BMP requirements should be implemented to the extent practicable throughout the watershed to protect aquatic resources. However, the open space and preserve areas east, south, and north of the Otay Reservoirs, along Otay Mesa, and in proximity to Wolf Canyon, are particularly at risk from future urbanization, as detailed in the *Otay River Watershed Special Area Management Plan Draft Planning Principles Report* (Jones and Stokes, 2005). Inadequate buffers or setbacks in one portion of the watershed can adversely affect the functions and values of downstream resources through increased erosion, sedimentation, and intrusion by invasive species, inputs of nutrients or contaminants, or other anthropogenic impacts.

Figures C.9-2 to C.9-11 illustrate the relationship between the various aquatic resources relative to land use in the nine different sub-basins comprising this watershed. The boundaries for these nine sub-basins were originally delineated in the *Otay River Watershed Special Area Management Plan Draft Planning Principles Report* (Jones and Stokes, 2005). In these figures, land use is differentiated as existing/planned preserves and existing/planned development. Clearly, in the eastern watershed, many of the aquatic features are within preserve areas or areas that will be preserved. Nevertheless, many aquatic resources at the boundaries of these protected areas are at risk; as are areas outside of the



Legend

Sea Level — 3,700 Feet

N

0 2.5 5
Scale in Miles

Basemap Legend

- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes

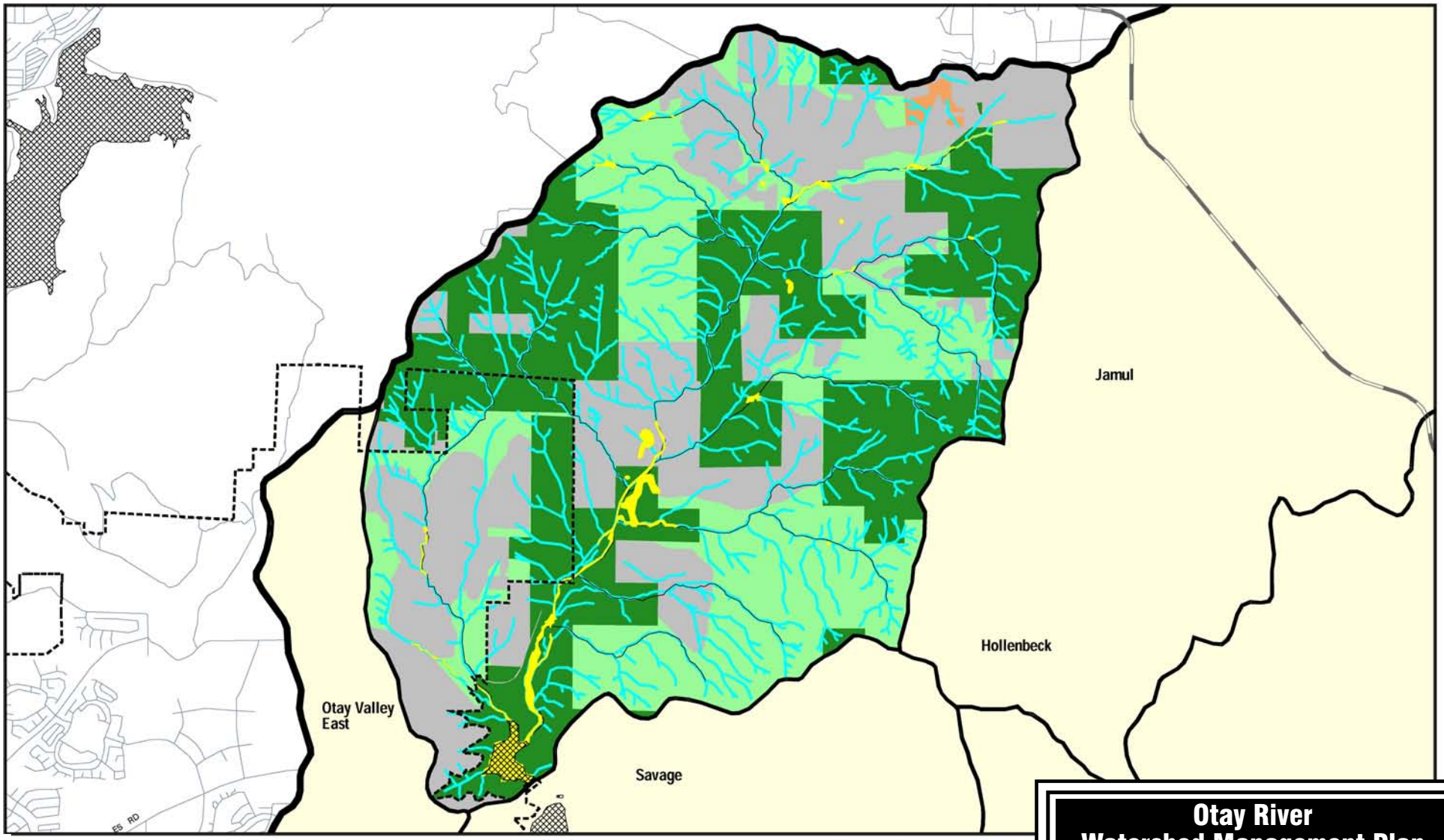
Source: TAIC, 2005

Otay River Watershed Management Plan

Figure C.9-2

Shaded Relief and Sub-Basin Boundaries

Aspen Environmental Group



Legend
- Acquired Preserve
- MSCP Planned Preserve
- County of San Diego Pre-Approved Mitigation Area
- Existing and Potential Development Areas
- Aquatic Resources and Vernal Pool/Complex
- Wash Channels
- Streams

N

0 4500 9000
Scale in Feet

Base Map Legend
- Watershed Boundary
- Hydrologic Sub-Basin Boundary
- Jurisdictional Boundary
- Freeway/Highway
- Roads
- Lake / Reservoir

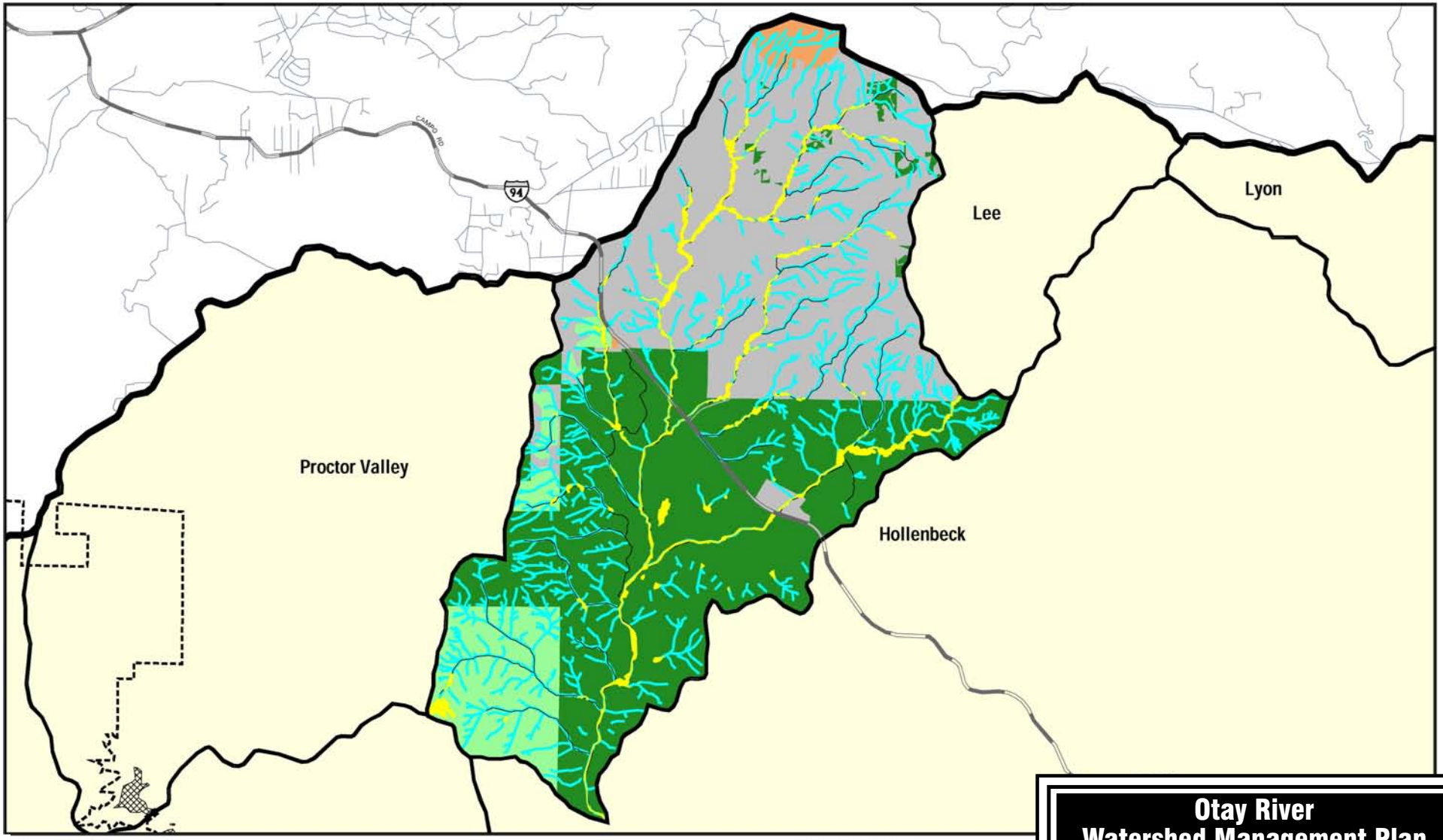
Source: TAIC, 2005

Otay River Watershed Management Plan

Figure C.9-3

Distribution of Aquatic Resources Relative to Existing and Proposed Conservation Areas in the Proctor Valley Sub-Basin

Aspen Environmental Group



Legend

- Acquired Preserve
- MSCP Planned Preserve
- County of San Diego Pre-Approved Mitigation Area
- Existing and Potential Development Areas
- Aquatic Resources and Vernal Pool/Complex
- Wash Channels
- Streams

N

0 6000 12000

Scale in Feet

Base Map Legend

- Watershed Boundary
- Hydrologic Sub-Basin Boundary
- Jurisdictional Boundary
- Freeway/Highway
- Roads
- Lake / Reservoir

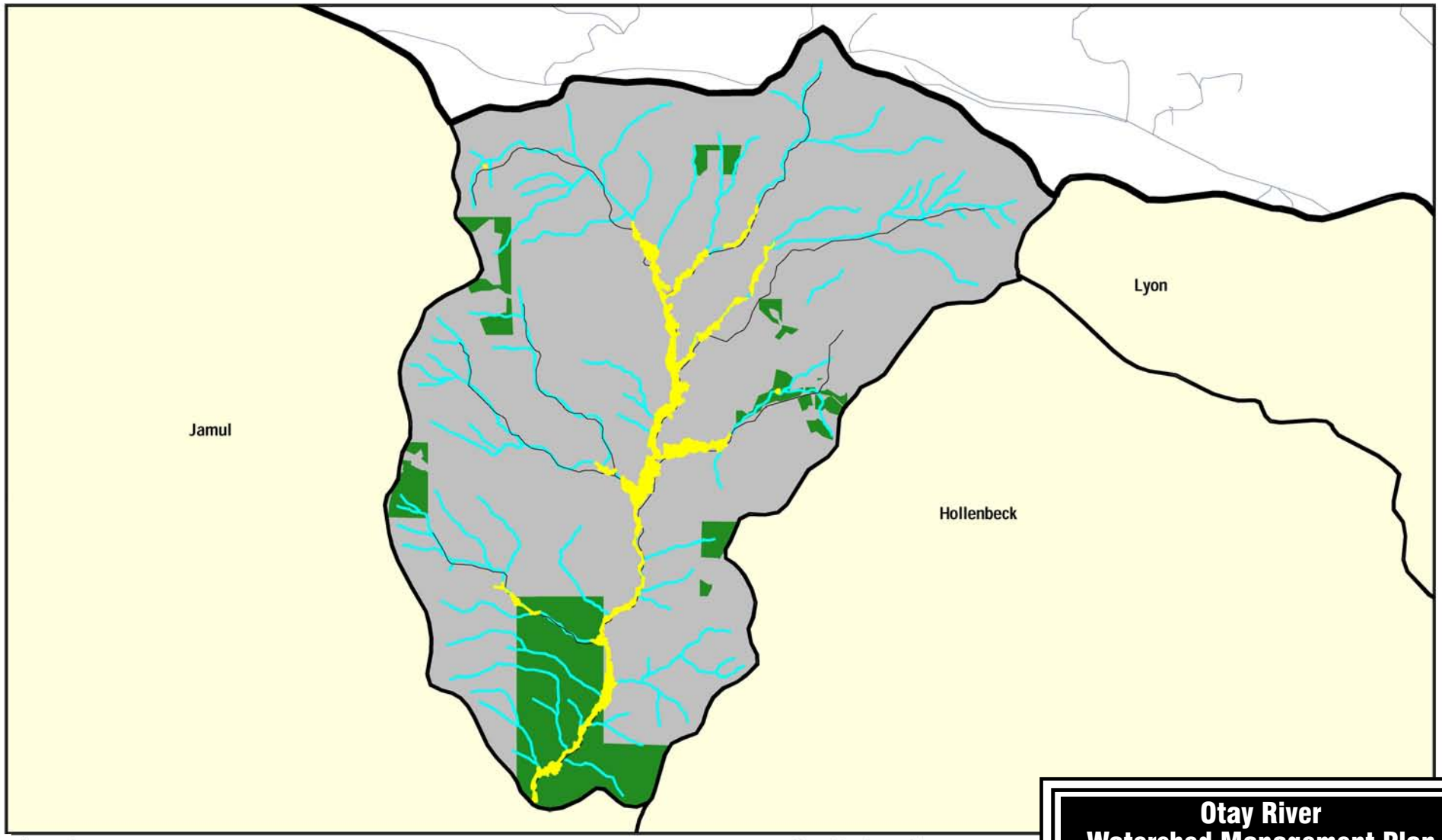
Source: TAIC, 2005

Otay River Watershed Management Plan

Figure C.9-4

Distribution of Aquatic Resources Relative to Existing and Proposed Conservation Areas in the Jamul Sub-Basin

Aspen Environmental Group



Legend
- Acquired Preserve
- MSCP Planned Preserve
- County of San Diego Pre-Approved Mitigation Area
- Existing and Potential Development Areas
- Aquatic Resources and Vernal Pool/Complex
- Wash Channels
- Streams

N

0 2500 5000
Scale in Feet

Base Map Legend
- Watershed Boundary
- Hydrologic Sub-Basin Boundary
- Jurisdictional Boundary
- Freeway/Highway
- Roads
- Lake / Reservoir

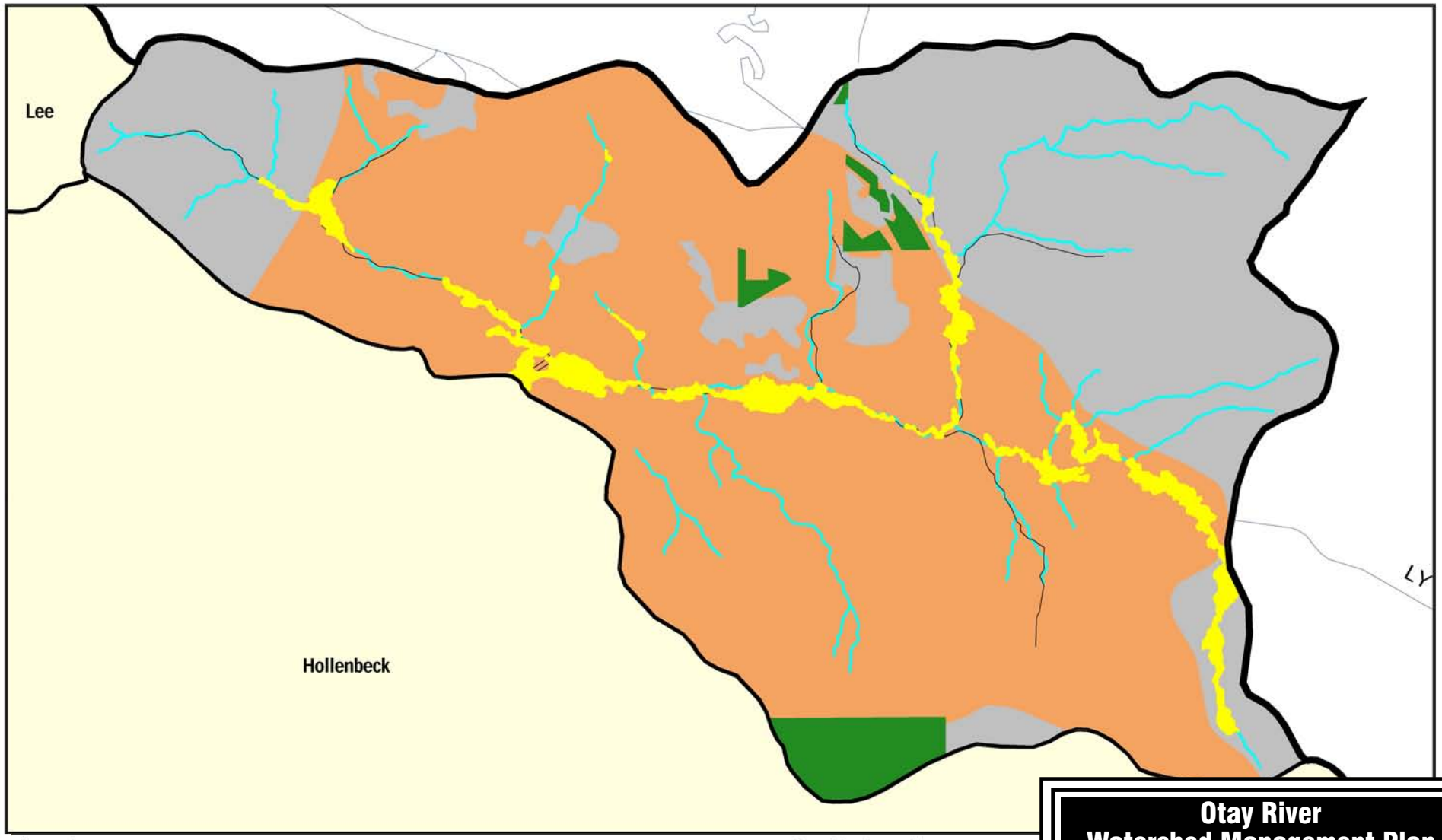
Source: TAIC, 2005

Otay River Watershed Management Plan

Figure C.9-5

Distribution of Aquatic Resources Relative to Existing and Proposed Conservation Areas in the Lee Sub-Basin

Aspen Environmental Group



Legend
- Acquired Preserve
- MSCP Planned Preserve
- County of San Diego Pre-Approved Mitigation Area
- Existing and Potential Development Areas
- Aquatic Resources and Vernal Pool/Complex
- Wash Channels
- Streams

N

0 1800 3600
Scale in Feet

Base Map Legend
- Watershed Boundary
- Hydrologic Sub-Basin Boundary
- Jurisdictional Boundary
- Freeway/Highway
- Roads
- Lake / Reservoir

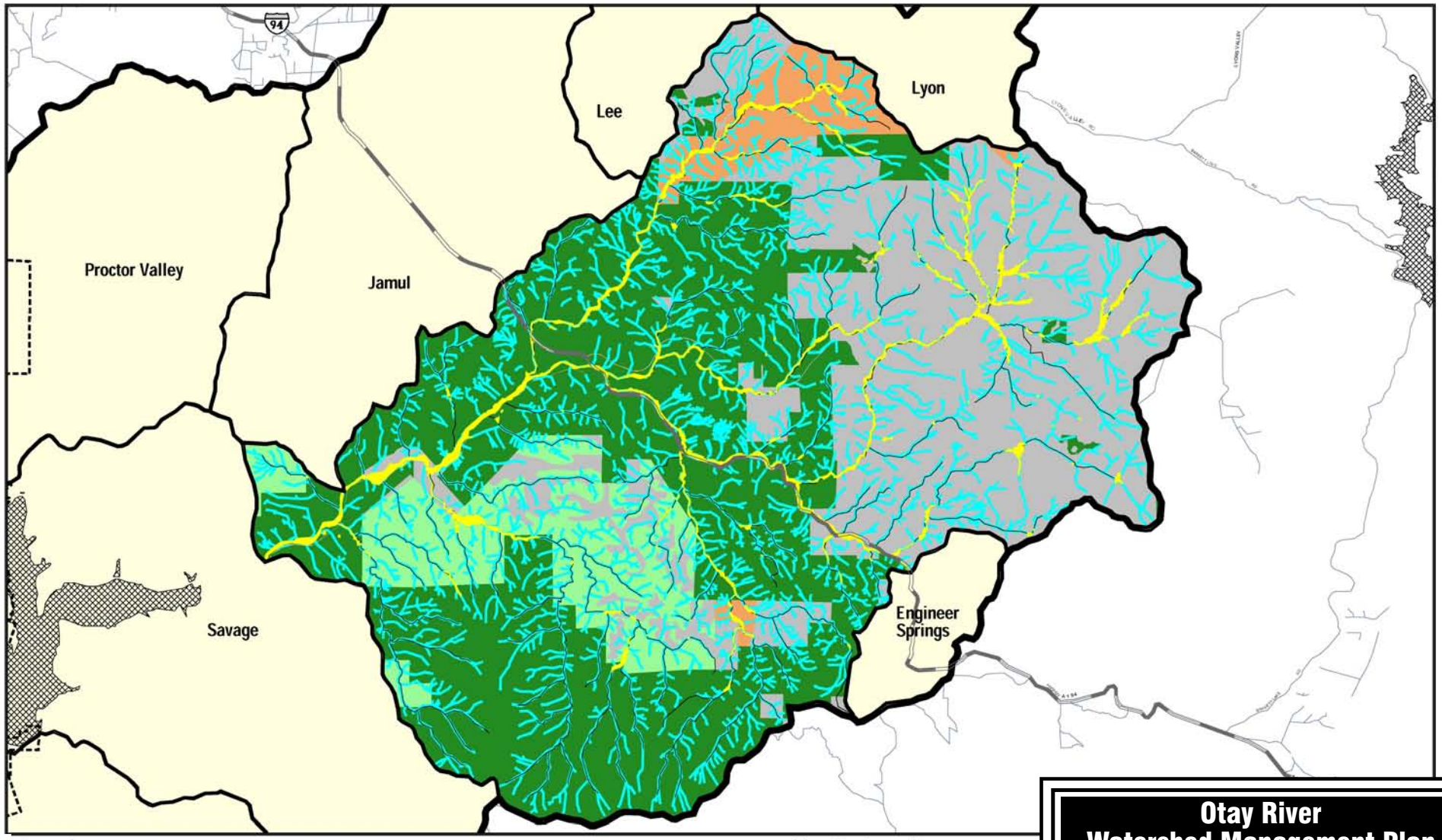
Source: TAIC, 2005

Otay River Watershed Management Plan

Figure C.9-6

Distribution of Aquatic Resources Relative to Existing and Proposed Conservation Areas in the Lyon Sub-Basin

Aspen Environmental Group



Legend
- Acquired Preserve
- MSCP Planned Preserve
- County of San Diego Pre-Approved Mitigation Area
- Existing and Potential Development Areas
- Aquatic Resources and Vernal Pool/Complex
- Wash Channels
- Streams

N

0 8100 16200
Scale in Feet

Base Map Legend
- Watershed Boundary
- Hydrologic Sub-Basin Boundary
- Jurisdictional Boundary
- Freeway/Highway
- Roads
- Lake / Reservoir

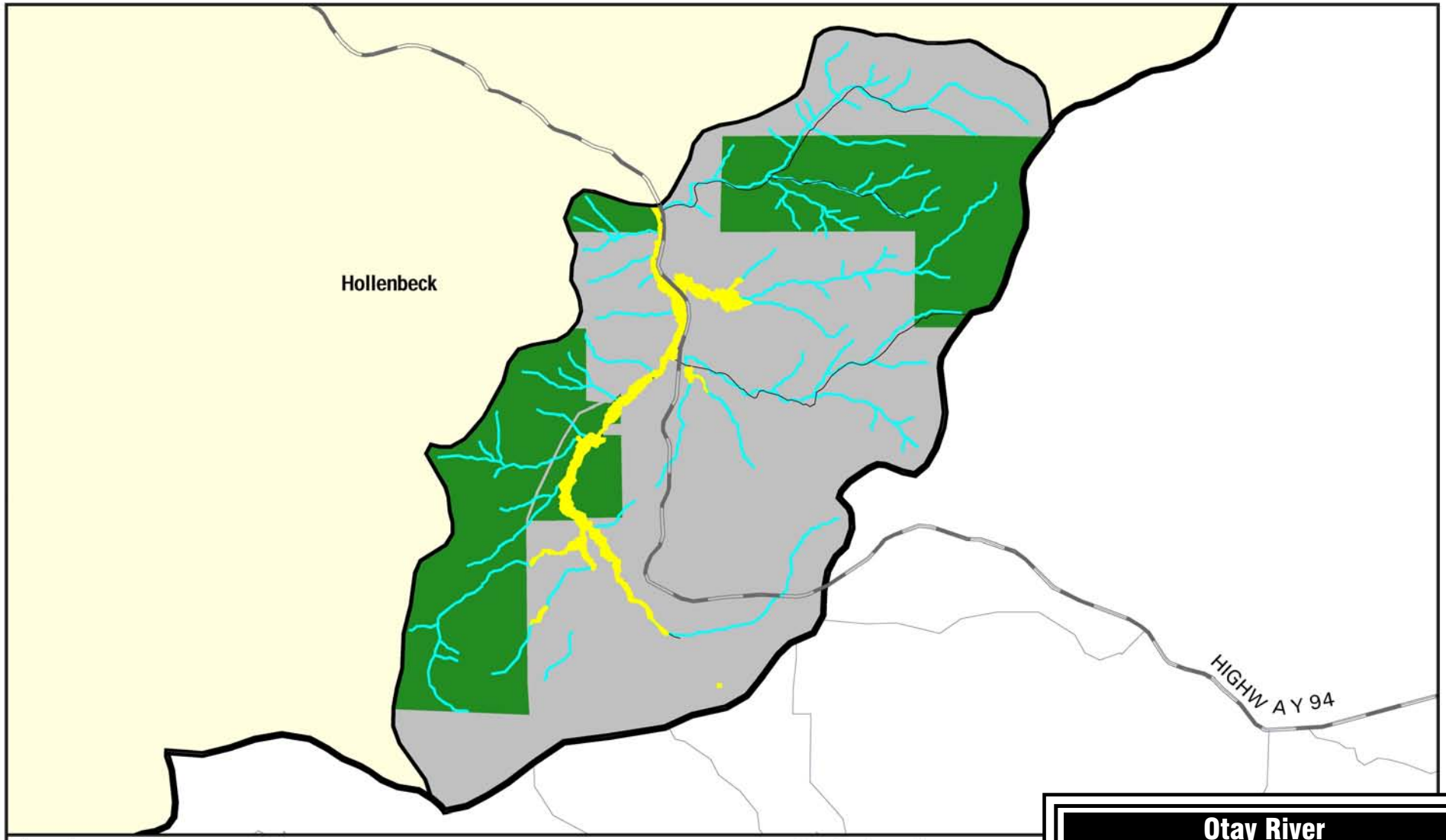
Source: TAIC, 2005

Otay River Watershed Management Plan

Figure C.9-7

Distribution of Aquatic Resources Relative to Existing and Proposed Conservation Areas in the Hollenbeck Sub-Basin

Aspen Environmental Group



Legend
- Acquired Preserve
- MSCP Planned Preserve
- County of San Diego Pre-Approved Mitigation Area
- Existing and Potential Development Areas
- Aquatic Resources and Vernal Pool/Complex
- Wash Channels
- Streams

N

0 2000 4000
Scale in Feet

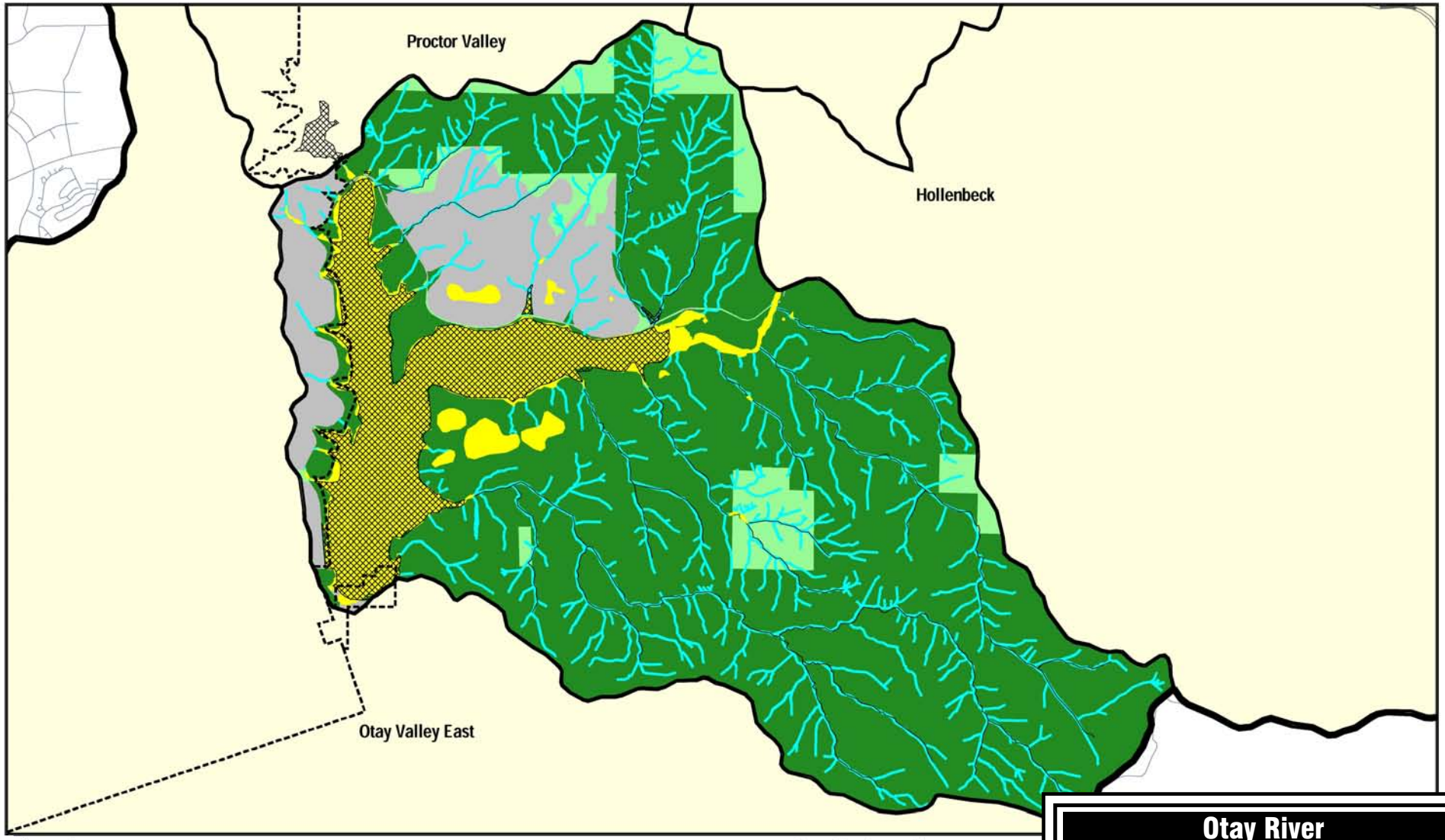
Base Map Legend
- Watershed Boundary
- Hydrologic Sub-Basin Boundary
- Jurisdictional Boundary
- Freeway/Highway
- Roads
- Lake / Reservoir

Source: TAIC, 2005

Otay River Watershed Management Plan

Figure C.9-8
Distribution of Aquatic Resources Relative to Existing and Proposed Conservation Areas in the Engineer Springs Sub-Basin

Aspen Environmental Group



Legend

- Acquired Preserve
- MSCP Planned Preserve
- County of San Diego Pre-Approved Mitigation Area
- Existing and Potential Development Areas
- Aquatic Resources and Vernal Pool/Complex
- Wash Channels
- Streams

N

Base Map Legend

- Watershed Boundary
- Hydrologic Sub-Basin Boundary
- Jurisdictional Boundary
- Freeway/Highway
- Roads
- Lake / Reservoir

0 4800 9600

Scale in Feet

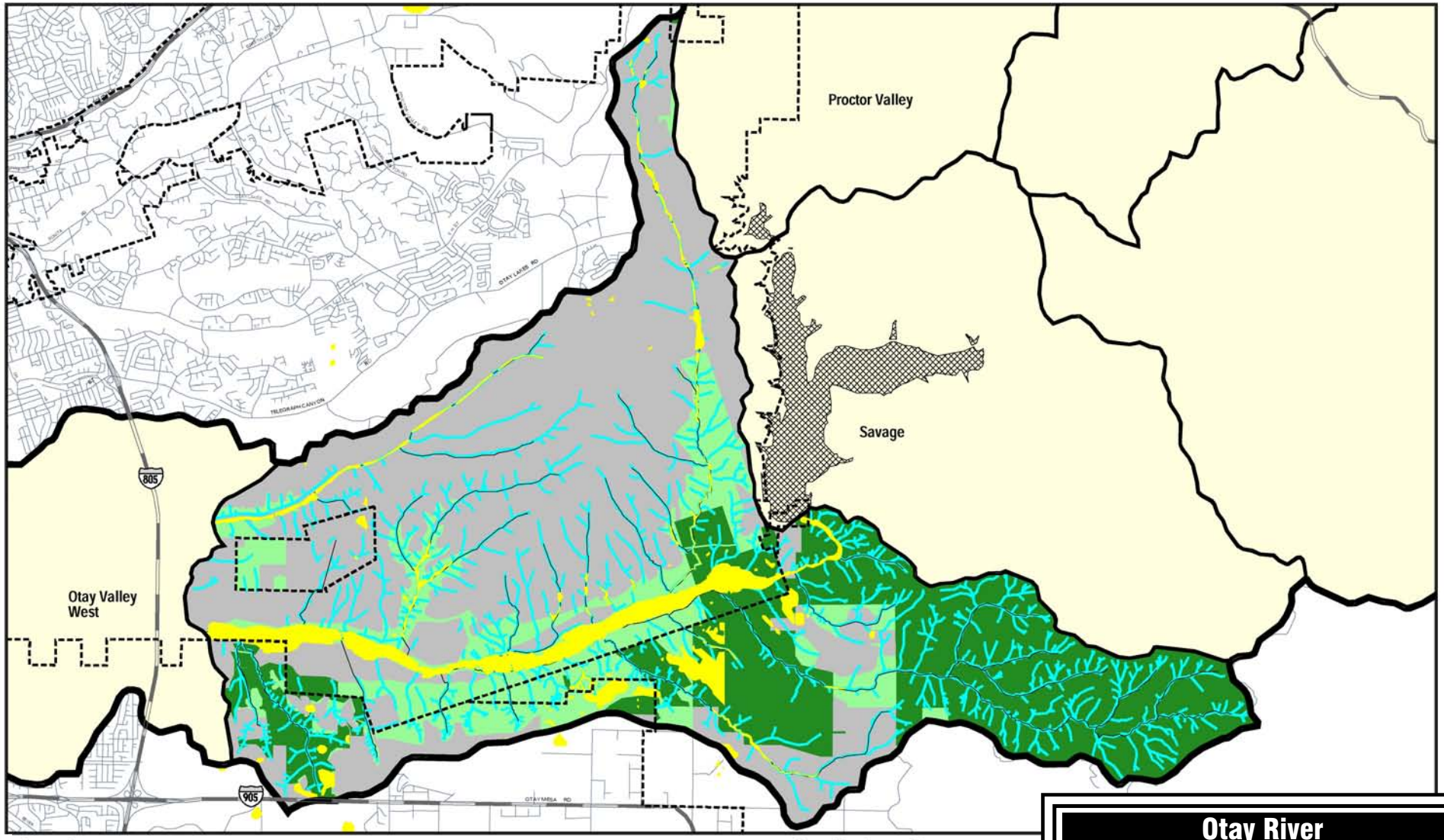
Source: TAIC, 2005

Otay River Watershed Management Plan

Figure C.9-9

Distribution of Aquatic Resources Relative to Existing and Proposed Conservation Areas in the Savage Sub-Basin

Aspen Environmental Group



Legend
- Acquired Preserve
- MSCP Planned Preserve
- County of San Diego Pre-Approved Mitigation Area
- Existing and Potential Development Areas
- Aquatic Resources and Vernal Pool/Complex
- Wash Channels
- Streams

N

Base Map Legend
- Watershed Boundary
- Hydrologic Sub-Basin Boundary
- Jurisdictional Boundary
- Freeway/Highway
- Roads
- Lake / Reservoir

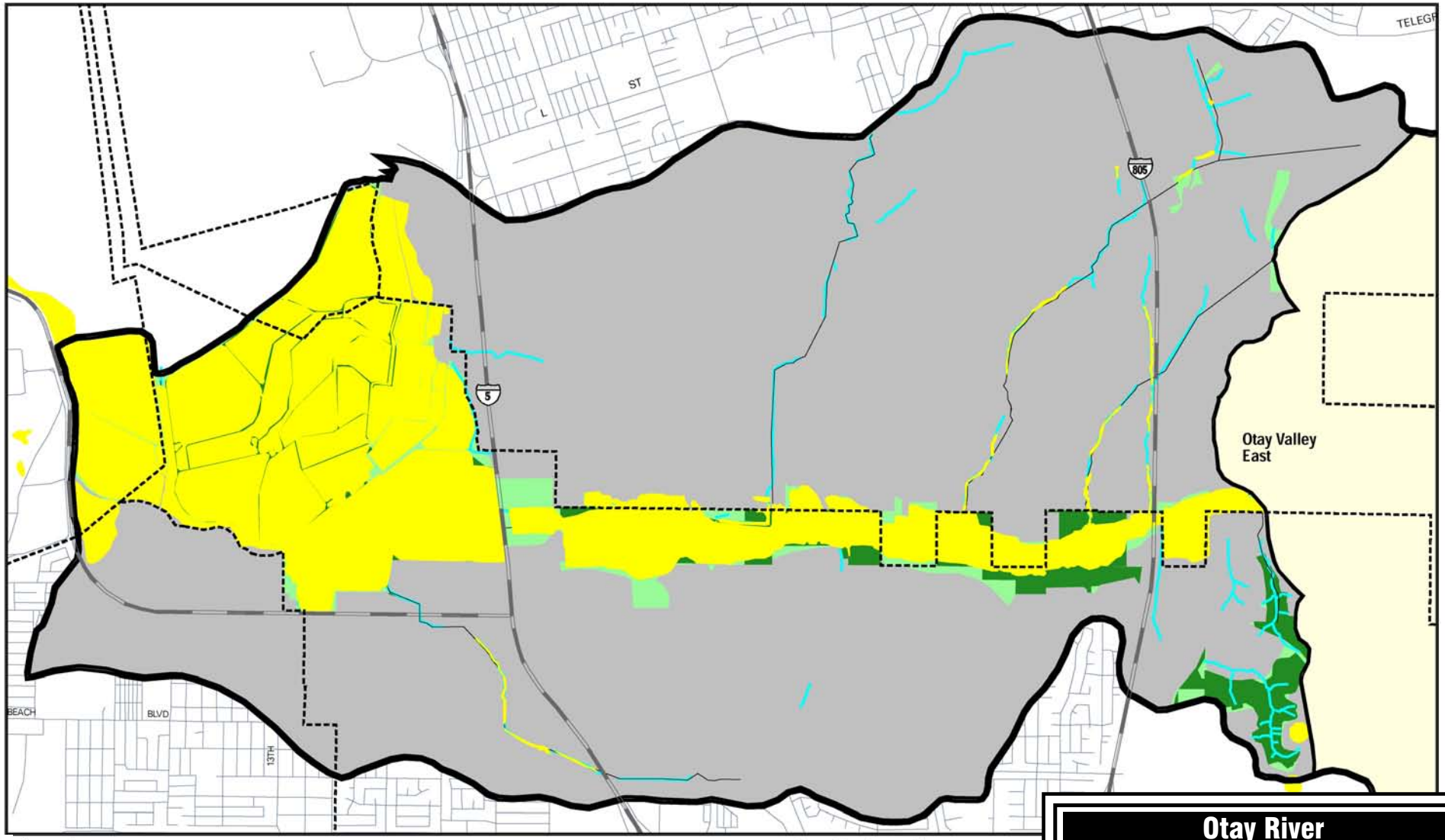
0 7500 15000
Scale in Feet

Source: TAIC, 2005

Otay River Watershed Management Plan

Figure C.9-10
Distribution of Aquatic Resources Relative to Existing and Proposed Conservation Areas in the Otay Valley East Sub-Basin

Aspen Environmental Group



Legend

- Acquired Preserve
- MSCP Planned Preserve
- County of San Diego Pre-Approved Mitigation Area
- Existing and Potential Development Areas
- Aquatic Resources and Vernal Pool/Complex
- Wash Channels
- Streams

N

0 3500 7000

Scale in Feet

Base Map Legend

- Watershed Boundary
- Hydrologic Sub-Basin Boundary
- Jurisdictional Boundary
- Freeway/Highway
- Roads
- Lake / Reservoir

Source: TAIC, 2005

Otay River Watershed Management Plan

Figure C.9-11

Distribution of Aquatic Resources Relative to Existing and Proposed Conservation Areas in the Otay Valley West Sub-Basin

Aspen Environmental Group

MSCP or other preserves (although local, State, and federal laws and regulations afford them some protection). In addition, impacts to streams and other aquatic resources upstream of these preserve areas could be translated downstream and adversely affect these protected areas. Therefore, great attention should be given to implementing adequate setbacks in proximity to and upstream of existing or planned preserve areas.

In contrast, many of the aquatic habitats downstream of Savage Dam have been adversely affected by urbanization (e.g., Poggi Canyon, Nestor Channel, portions of the Otay River). Notable exceptions (at least for significant direct impacts) include Wolf Canyon, O'Neal Canyon, Johnson Canyon, and Dennery Canyon. However, some development is planned or already under construction in these areas, and effective setbacks will be a key means of protecting these streams and any adjoining aquatic habitats such as vernal pools. In the lower watershed, potential vernal pool complexes at risk include those in the vicinity of Wolf Canyon near Otay Landfill and upper Johnson Canyon. Vernal pools fringing upper Dennery Canyon are already protected by fencing and setbacks.

Expected Proponents

The County and cities in this watershed would be in the best position to ensure that this strategy is implemented in their portions of this watershed. They could formalize their commitment to implement this strategy watershed-wide through a JEPA or similar agreement (assuming their existing buffer criteria need some revisions to ensure protection of aquatic resources throughout this watershed).

Through their respective plan approval processes, the jurisdictions should require that project applicants in this watershed incorporate setbacks/buffers into their project plans (i.e., Site Design BMP). As noted above, jurisdictions could also require developers to add CC&Rs, HOA Rules and Regulations, or similar instruments focused on minimizing incursions of non-native species into aquatic resource and setback or buffer areas. The development of such requirements is currently being evaluated by the County. As noted (Activities and Benefits), the County and the Cities of Chula Vista and San Diego have buffer criteria applicable in their respective jurisdictions.

It is also expected that the regulatory and resource agencies and other interest groups would be highly supportive of developing watershed-wide buffer criteria. In particular, it is expected that Corps, CDFG, and, if they participate in developing the SAMP, the SDRWQCB would seek to include watershed-focused buffer criteria in the implementation of the SAMP.

Schedule

The preparation of the plan and the updates to the jurisdictions' plan review and approval processes could occur within the short-term (within 2 years). Implementation could take longer if there is insufficient support by the jurisdictions or the strategy becomes controversial.

Maintenance and Monitoring Considerations

To ensure the identified setback distances or buffers are effectively protecting aquatic resources, there should be monitoring of aquatic resources in the different sub-basins by geomorphic setting, land use type, and other factors identified above. Resource monitoring is already required for the MSCP preserve areas and there is monitoring associated with other preserve areas (e.g., Rancho Jamul Ecological Reserve), so there could be some savings in using other data sources. Parties engaged in these other monitoring efforts might be willing to revise their protocols somewhat if other data types are needed to evaluate the effectiveness of setbacks/buffers.

The additional monitoring could be conducted by the implementing jurisdiction, an entity established or approved to undertake these activities, or a coordinated effort agreed to by a JEPA or similar agreement. If necessary, the setback distance in a particular sub-basin or portion of a sub-basin could be increased to ensure full protection. Conversely, monitoring might indicate that the setback distance in a particular sub-basin or portion of a sub-basin could be reduced and still protect the resources.

First-Order Cost

The costs to evaluate the watershed-level effectiveness of the current buffer criteria and prepare the plan, have each jurisdiction modify their project review and approval process, and to monitor the setback/buffer effectiveness could well exceed $100,000, depending on the scope and duration of monitoring implemented. If the strategy is incorporated into the SAMP Aquatic Resource Conservation and Restoration Program, this cost is more appropriately considered a SAMP cost instead of an ORWMP cost.

It is possible that applicants could realize less project revenue in having to design or redesign projects to avoid and setback from aquatic resources. However, on balance, such revenue losses to the development community would be expected to be low, given the current ordinances in place (e.g., RPO and WPO), criteria specified in the MSCP Subarea Plans and Otay Ranch RMP, and other land use controls, which require protection of aquatic (e.g., streams, floodplains, vernal pools, other wetlands, wetland buffers) and other natural resources. This type of BMP was also included in the 2001 Municipal Permit and the WPO. Furthermore, existing buffer criteria could be sufficient to protect aquatic resources in portions of the watershed, which would keep implementation and monitoring costs lower.

Potential Funding Sources

The jurisdictions could charge developers fees in cases where they cannot avoid aquatic resources or implement adequate setbacks to protect these resources. These funds could help offset the costs of updating the jurisdictions' project approval process and managing the strategy/program. To accomplish this, each jurisdiction would need to adopt a fee ordinance that establishes fair-share fees in accordance with the Mitigation Fee Act. The Act (Government Code section 66000, et seq.) requires that when a development impact fee is established the agency imposing the fee must identify the purpose of the fee and the use to which it will be put. The nexus between the impact of the development project and the use of the fee must be specified, and the agency imposing the fee must demonstrate that the fee amount being collected roughly matches the cost for offsetting the impact. In addition, the jurisdictions could fund this program. Bond money might also be available; although wide-scale implementation of a BMP providing indirect benefits to aquatic resources might not be viewed by grant agencies as high of a priority as projects that directly protect, enhance, or restore aquatic resources.

C.9.1.5 Limit Future and Remove Existing Trash and Debris

Target Goals

This strategy in intended to address the following goals of the ORWMP:

Goal 1. Protect, Enhance, and Restore Watershed Resources

Goal 4. Ensure Public Health and Safety

Goal 5. Maximize Integration of Existing Programs and Plans that Affect the Resources of this Watershed

Activities and Benefits

This strategy is intended to: (1) ensure adequate source and treatment controls are in place to limit introduction of trash and debris into the system; and (2) build upon the extensive on-going actions by the OVRP Citizens Advisory Committee (CAC) to clean up trash (non-structural treatment control BMP) along the lower Otay River, around the Otay Reservoirs, and into Proctor Valley. Regarding the latter, the CAC has overseen the collection and disposal of more than 1,300 tons of trash during the last several years (John Willett, personal communication). Trash is a source of contaminants that can adversely affect aquatic resources, as well as diminish the aesthetics of the watershed. Trash and debris dumping is a known problem along Proctor Valley Road in the upper watershed. The concern of trash-related adverse effects to beneficial uses is significant enough that Proctor Valley Creek in the Proctor Valley Hydrologic Subarea (910.32) is on the SWRCB's Monitoring List, which means it is considered high priority to evaluate whether it will be listed on subsequent Section 303(d) and/or Total Maximum Daily Load (TMDL) lists.

A more formal program should be established to ensure adequate trash and debris-focused source and treatment controls are in place and to coordinate the current and on-going clean-up efforts. To be successful, this strategy would require several actions:

- Coordinate with the OVRP Citizens Advisory Committee to evaluate activities that have occurred, those planned, other watershed areas that should be targeted for trash and debris removal or for further study (i.e., reconnaissance-level survey), as well as information on techniques and resources available (see expected proponents, below).
- Enter the information on these activities into the watershed GIS (update annually or more frequently).
- Prepare a priority list of areas that require additional clean up and new areas to target.
- Contact property owners and reach formal agreements for access to complete the clean-up activities (lack of access could necessitate reprioritization of activities).
- Obtain funding as necessary to complete all of these steps and the listed activities.
- Complete the necessary environmental documentation (NEPA and CEQA) and obtain the required federal, State, and local approvals to continue these activities over the long-term.
- Maximize use of volunteers and other free/inexpensive labor (e.g., prisoners), and use contractors as-needed to complete listed activities.
- For new development projects in this watershed, require the use of trash- and debris-related Best Management Practices, such as those described by the City of San Diego Water Department in their *Source Water Protection Guidelines for New Development* (January 2004). The jurisdictions could make this a requirement of the project approval process. In addition, the jurisdictions could require applicants to prepare specific CC&Rs, HOA Rules and Regulations, or similar means to educate and impose restrictions on residents and prescribe penalties on those who dump trash or debris into stormdrains, detention basins, natural waterways, or other aquatic features.
- Identify existing developments in the watershed that are a major source of trash and debris (e.g., no, ineffective, or improperly maintained trash- and debris-related BMPs) and work with land owners/HOAs/ residents to reduce these sources through BMP modifications or retrofitting (e.g., installation of trash racks, screens, nets, booms).

Locations

The lower Otay River is known to have a trash and debris problem, as are several of the Otay River's culverted or development-adjacent tributaries (e.g., Nestor Channel, Poggi Canyon, the unnamed tributary through Loma Verde Park). There are many sources for these inputs, including transient encampments in the river bottom. The OVRP CAC has made great strides in remedying the trash and debris problem, but more clean-up is needed as are efforts to minimize future sources. It is well known that trash and debris dumping also occur in the upper watershed along Proctor Valley Road. Trash and debris is likely a problem in other parts of the watershed as well and should be comprehensively identified, with the assistance of the CAC and as-needed reconnaissance-level surveys, as the first step in maximizing implementation of this strategy.

Expected Proponents

The Watershed Council/equivalent should work with the County, Cities, SDUPD, the OVRP Advisory Bodies, and the major land owners/managers (USFWS, CDFG, BLM, and the U.S. Forest Service) to develop the watershed-wide trash and debris cleanup and prevention program. A JEPA or similar cooperative agreement could define the roles and responsibilities of each entity. Each party could develop a trash and debris management plan that specifies protocols for removing and disposing of trash and debris in their areas of responsibility or control, or they could give the OVRP Advisory Bodies primary responsibility for directing these activities watershed-wide. Other NGOs and volunteers could participate in the planning and implementation as well. The jurisdictions would need to be more active in cases involving land owner or resident coordination and changes in BMPs. The jurisdictions should also take the lead in educating watershed residents in their areas of responsibility about the adverse effects of trash and debris on the natural resources (e.g., yearly inclusion of a flyer on the issue in the water bill) (see also high-priority strategy: Implement a Watershed-Wide Education Program to Improve Public Awareness and Stewardship). Whichever party leads this program should coordinate with the appropriate County and City departments to relocate any transients out of the Otay River, streams, and other open space areas. While the ORWMP is not the appropriate vehicle for providing alternative housing to transients, it is appropriate for the ORWMP to recognize that transient occupation of open space areas (particularly aquatic areas) has adverse effects on the natural resources on this watershed; and that this is a stressor the jurisdictions need to better address at the local level. This lead party would also need to ensure that encampments are removed and disposed of at approved upland locations.

Schedule

Trash and debris removal activities have been underway for the last several years and are making great progress in this watershed. However, other degraded areas within the watershed remain. If the jurisdictions work with property owners, land managers, the CAC, and volunteers, much of the trash and debris clean-up could occur within 2 years (short-term activity). The education process can also begin immediately, but attitudes, cultural, and behavioral changes can take much longer to achieve. Structural improvements, such as trash booms, trash racks, in-line separation units, or pipe controls can take longer to get approved, designed, and constructed (particularly if on private property). These latter efforts would be expected to require an intermediate-term (3-5 year) or perhaps long-term (more than 5 years) horizon.

Maintenance and Monitoring Considerations

Trash and debris removal will be an on-going activity, especially if educational programs are not effective in minimizing future introductions. If structural improvements are incorporated, follow-up maintenance and monitoring will be necessary to ensure they are effective and functioning properly.

First-Order Cost

If stakeholders and others are willing to volunteer their time and disposal costs are waved, the trash removal process itself can be of minimal cost on an annual basis. To date, disposal costs for collected debris and trash have been waived. Program costs would be kept lower if there continue to be no or minimal disposal costs. However, there are other costs to consider. For example, there would be smaller costs associated with producing and distributing educational materials within the watershed. Use of paid crews would greatly increase costs. Construction and maintenance of structural controls could be much more expensive (hundreds of thousands or millions of dollars).

Overall, annual costs for this strategy would be expected to exceed $10,000, and total costs could well exceed $1 million if structural BMPs are incorporated in existing infrastructure. The cost of including structural BMPs in new developments would be the responsibility of land developers/builders, and the long-term maintenance would probably be the responsibility of the governing jurisdiction or individual HOAs. The costs associated with modifying BMPs or, where practicable, retrofitting existing developments (e.g., installation of trash racks, screens, nets, booms) could be borne by the jurisdiction or landowner/developer/HOA/residents, depending on the circumstances. In particular cases, the jurisdictions might be able to have the developers/property owners/HOAs pay for part or all of the new or modified BMP; if, for example, there were water quality standards they were required to meet and their existing facilities or practices are inadequate. This is an option the jurisdictions could consider. Clearly, coordination would be critical between the jurisdictions and the affected property owner/manager to determine what would be practicable, effective, and fair. Fortunately, BMPs are available for capturing trash and debris that do not require much additional space or effort to install (e.g., nets, booms). They do, however, require regular maintenance.

Potential Funding Sources

Efforts to-date have been mainly orchestrated by the CAC and volunteers. There are grant funding sources available for non-profit, grass-roots, and community-based groups and volunteer efforts, such as the Wetlands Recovery Project Small Grants Program, the California Department of Fish and Game's Habitat Conservation Fund, Land and Water Conservation Fund, and the Recreational Trails Program, as well as the NOAA Community Based Habitat Restoration National and Regional Partnership Grant and Community-Based Restoration program. Bond money from Proposition 40 and 50 can also be used for these activities through the Murray-Hayden Urban Parks and Youth Services Program. Also, it might be possible to evaluate the primary contributors of trash in this watershed and impose a fee-based system to fund future clean-up.

C.9.1.6 Protect Drinking Water Quality in the Otay Reservoirs

Target Goals

This strategy in intended to address the following goals of the ORWMP:

Goal 1. Protect, Enhance, and Restore Watershed Resources

Goal 2. Ensure Reasonable, Sustainable, and Compatible Economic Development

Goal 5. Maximize Integration of Existing Programs and Plans that Affect the Resources of this Watershed

Activities and Benefits

The City of San Diego Water Department developed *Source Water Protection Guidelines for New Development* (January 2004) to protect their drinking water reservoirs from future development in the portions of the San Diego County watersheds draining into them. The focus of this strategy is to implement these Guidelines so that all new development contributing runoff to the Otay Reservoirs adequately protects the quality of the water both within and draining into the Otay Reservoirs. The most effective means of implementing this strategy is for the responsible jurisdictions (i.e., the County of San Diego, the City of Chula Vista, and the City of San Diego) to require that all new projects in these upper watershed areas draining to the Reservoirs adhere to these Guidelines through implementation of appropriate BMPs. Implementation of these BMPs will undoubtedly protect other natural resources in the upper watershed as well, such as streams and wetlands. These Guidelines include Project Design BMPs, such as minimizing paved/impervious areas, incorporating zero-discharge features (e.g., ponds, vegetated depressions to route runoff through), and maximizing natural spaces and landscaping. They also include Source Control BMPs, such as minimizing dry weather or low flows, sheltering stored materials from washoff, minimizing excessive irrigation (e.g., using drip irrigation, containing irrigation water onsite), and using drought-tolerant and native plant species requiring less irrigation. Moreover, they include Treatment BMPs, such as extended detention basins, check dams, gabions, baffle boxes, trash racks, booms, settling basins, and sand filters, which can include vegetation. In some cases, BMPs in series or "treatment trains" can be more effective. Urban runoff is viewed as a resource that can be captured and treated with infiltration techniques (for recharge, which is particularly important in the upper watershed).

It is important to note that these Guidelines do not address water quality concerns during construction activities, which are instead left to the storm water programs administered by the SWRCB and the SDRWQCB (e.g., the Municipal Permit) and the jurisdictions' implementing storm water and grading ordinances.

Locations

The location would be the entire developable portion of the upper Otay River watershed that drains into the Otay Reservoirs (approximately 60 percent of the watershed's area) (i.e., the Proctor Valley, Lee, Savage, Engineer Springs, Jamul, Lyon, and Hollenbeck Hydrologic Sub-Areas). Most of this area is within the County's jurisdiction, but portions are within the jurisdiction of the City of Chula Vista and the City of San Diego.

Expected Proponents

The City of San Diego has developed these Guidelines and is an obvious proponent, with a vested interest in protecting the quality of the water in the Otay Reservoirs. As discussed above, the County of San Diego and the City of Chula Vista should also implement these Guidelines in those portions of the watershed in their respective jurisdictions that drain into the Upper or Lower Otay Reservoirs; especially because this stored drinking water is distributed to many of their residents.

Schedule

It is expected that incorporating the Guidelines into the jurisdictions' project approval process for projects in the upper watershed would be a short-term activity (within 2 years). Actual BMP implementation, particularly Treatment BMPs, could take several more years to achieve.

Maintenance and Monitoring Considerations

The County and the Cities of Chula Vista and San Diego would need to conduct monitoring to ensure that the Project Design, Source Control, and Treatment BMPs identified are effectively protecting water quality within the Otay Reservoirs. The City of San Diego already monitors water quality in the Otay Reservoirs and a few of the drainages in this watershed. The other jurisdictions also have staff conducting construction and post-construction monitoring to ensure protection of water quality. The County and Cities would need to determine if additional monitoring is required, in additional streams, for more constituents, or on projects that represent particular types/classes of development and BMPs. The current Guidelines include standards for a dozen constituents (based on the San Diego Region Basin Plan and the latest information), which if met over time, should protect water quality in the Otay Reservoirs and other beneficial uses.

Because they have been collecting water quality data in the upper watershed for several years and have historical data against which to compare, it might be more efficient to have the City of San Diego continue with the monitoring in the entire upper watershed. Regardless, the other jurisdictions should participate in the decision-making regarding what else is monitored. If the City of San Diego does lead this monitoring effort, the other jurisdictions should provide their fair shares of the funding. Shares could be calculated based on each jurisdiction's fraction of the total land area or population within areas draining into the reservoirs, some combination of these two factors, or another mutually agreeable cost-sharing approach.

First-Order Cost

The total cost of the jurisdictions updating their project approval processes is unknown but is probably less than $100,000. The monitoring program to track the effectiveness of the identified BMPs is expected to be more costly (more than $100,000 but probably less than $1 million). Monitoring costs would be higher if the program continues for several years or in-perpetuity. The City of San Diego currently monitors the quality of the water in the reservoir and would likely continue that effort. As noted, the other jurisdictions should participate in determining whether additional monitoring should occur and provide their fair shares of the funding.

Potential Funding Sources

The jurisdictions could require developers in the upper watershed to pay a fee to help fund the BMP-effectiveness monitoring. The jurisdictions could also fund the monitoring themselves. Because this strategy would implement a large-scale water quality protection program, it would probably be eligible for Propositions 40 and 50 money. Other sources of funding include the Nonpoint Source Implementation Grant Program by the SWRCB.

C.9.1.7 Limit Impervious Surface Area

Target Goals

This strategy in intended to address the following goals of the ORWMP:

Goal 1. Protect, Enhance, and Restore Watershed Resources

Goal 2. Ensure Reasonable, Sustainable, and Compatible Economic Development

Goal 4. Ensure Public Health and Safety

Goal 5. Maximize Integration of Existing Programs and Plans that Affect the Resources of this Watershed

Activities and Benefits

Background on Impervious Cover as an Indicator

Urbanization of watersheds tends to increase the areal extent of impervious surfaces (e.g., roads, houses, schools). This increase results in several hydrologic and water quality impacts, including: reduced vegetative interception of precipitation, reduced infiltration and soil moisture recharge, increased surface water runoff, decreased lag time from precipitation to stream runoff, increased peak flows, increased channel erosivity, increased downstream discharge, and reduced local groundwater recharge. As discussed in Section B.3.1, research has demonstrated that even modest (i.e., 10 percent) increases in impervious surfaces on the landscape can lead to increases in surface runoff and degradation of water quality for downstream receiving waters, such as creeks, wetlands, and bays (Scheuler, 1994; Center for Watershed Protection, 1999). This research also indicates that impervious cover above 25 percent can adversely affect streams in the drainage area to such a degree that they are no longer suitable candidates for restoration (also referred to as "non-supporting streams"). Limiting impervious surface area or disconnecting runoff from impervious surface areas from entering surface drainage features (e.g., by routing runoff through infiltration features such as basins or by directing it to the sanitary sewer system) could protect aquatic resources from further degradation.

The primary goal should be to limit increases in impervious surfaces, and secondarily, to disconnect or minimize runoff from areas covered by impervious surfaces from entering surface waters. The intent of limiting impervious surfaces is not to reduce the intensity of development (i.e., number of units, square footage of commercial, etc.), but rather to reduce hardscaping in the watershed as much as practicable through clustering and other efficient planning techniques. A primary focus on limiting impervious surfaces is important because adding impervious surfaces eliminates important landscape functions such as infiltration and recharge, and there are often limits to how much runoff from impervious surfaces can be kept out of surface waters. However, development will continue to add impervious surfaces in the watershed, and it will be important to minimize the adverse effects of the additional hardscaping on surface waters. The *Source Water Protection Guidelines for New Development* (City of San Diego Water Department, 2004) provide several approaches to disconnect runoff from impervious areas from entering surface waters.

It is important to note that care must be taken in interpreting and applying impervious surface area percentages to a watershed, because physical and biological conditions vary across the landscape and can affect how streams, subbasins, and the larger watershed respond in terms of infiltration, surface water runoff, and stream erodibility. As discussed in Section B.7, key factors to consider are the area's geomorphic setting, geology, soils, and vegetation. For example, higher percentages of impervious surface area might have less effect on a given area and downstream receiving waters if the area has little slope, lower infiltrating soils (e.g., Group C or D), and plenty of vegetation. In contrast, lower percentages of impervious surface area could have more effect on a given area and downstream receiving waters if the area is steeply sloped, has higher infiltrating soils (e.g., Group A or B), and has little vegetation. Therefore, the specific physical and biological conditions in different subbasins are

essential to consider when predicting watershed response or in developing and applying impervious cover limitations.

Imperviousness can be evaluated for a drainage area (e.g., watershed, sub-watershed, catchment), based on the land uses within it. Uncompacted, native habitat has the lowest impervious surface cover (i.e., nearly 0 percent), whereas concrete has the highest imperviousness (i.e., 100 percent). While correlations have not been firmly established for the arid southwest, in many regions of the country, an impervious surface percentage of as little as 10 percent measurably degrades streams, with more severe degradation occurring as impervious cover increases (Schueler, 1994). While the results might not apply to the Otay River watershed, the Southern California Coastal Water Research Project found that impervious surface cover of as little as 2-3 percent can degrade ephemeral and intermittent streams in smaller (less than 5 square miles) basins in southern California (SCCWRP, 2005). Recent research by the County of San Diego has suggested protecting areas with 15 percent or less cover to limit further degradation (by minimizing increases in percent impervious cover in these areas above 15 percent) and redeveloping in areas with more than 40 percent impervious cover (County of San Diego DPLU, 2003). The County also recommends clustering development as opposed to the "urban sprawl" approach, which requires construction of more infrastructure to support and, therefore, increases imperviousness on larger scales. They further recommend the establishment of development districts in each watershed (and sub-watershed) in the County, each of which would have different management prescriptions. It should be noted that the County and City of Chula Vista collaborated on the land use planning for the 23,000-acre Otay Ranch master planned community which resulted in both agencies adopting the Otay Ranch GDP/SRP in 1993. This plan concentrated higher intensities of urban development west of the Otay Reservoirs while preserving more than 11,000-acres of open space, the majority of which is located east of the reservoirs. The plan also includes further clustering of development into village cores. Opportunities to further cluster development within remaining undeveloped areas of the Otay Ranch, west of the reservoirs, may be limited given existing development entitlements, development agreements, adopted implementation plans and the adopted GDP/SRP. The use of BMPs for new development in this area may be the most effective strategy remaining.

The Strategy in the Otay River Watershed

Using the County of San Diego's land use-impervious surface assumptions and impervious surface assumptions for parks and open space agreed to by the jurisdictions in the Otay River watershed, all of the Hydrologic Sub-Areas (HSAs) in this watershed are below 15 percent impervious cover (Figure B.3-10 and Table B.3-11). Only the western portion of the Otay Valley Hydrologic Area (roughly west of I-805) exceeds this threshold (49 percent). The eastern portion of the Otay Valley Hydrologic Area is rapidly developing and will greatly exceed this threshold in the near future (Figure B.3-14 and Table B.3-12). Moreover, as planned, Lee and Lyons HSAs are expected to exceed the County's suggested threshold as is the overall watershed. However, these are preliminary values, and additional research should be conducted in the Otay River watershed, to ensure the percentages of impervious surface area (including what is directly connected) in the different Hydrologic Sub-Areas (similar to sub-watersheds) are reasonably accurate.

Based on the preliminary values, there is a real opportunity to minimize the adverse effects associated with increasing impervious surface cover in this watershed; particularly in the Proctor Valley, Jamul, Lee, Lyon, Hollenbeck, Engineer Springs, and Savage Hydrologic Sub-Areas, which are where most of the preserve areas are located. There is less opportunity in the Otay Valley Hydrologic Area and especially within planned development areas on the Otay Ranch, but, to the extent practicable, efforts could focus on disconnecting impervious surface cover in the eastern portion of this area to decrease adverse effects.

As proposed, the jurisdictions would implement this strategy by tracking and placing specific limits on a new project's contribution to impervious surface area, depending on its proposed location within the Otay River watershed. This would require that applicants calculate the impervious surface area of their project and how much would be directly connected to surface water, and for the applicable jurisdiction to determine whether the project could occur as proposed (i.e., proposed location, overall impervious surface area, amount of directly connected impervious surface area).

The goal of the program would be to have applicants concentrate impervious surfaces in one or a few locations in the proposed development area and to leave the remainder in a more natural (i.e., little or no impervious surfaces) state. Clustering development in this way usually results in less impervious surface cover over a given area than does less dense, spread-out development connected by roads and other infrastructure. In the unincorporated areas in the eastern portion of this watershed, however, there are restrictions on clustering development due to potential effects on groundwater upon which these areas depend. For example, studies are required to demonstrate that there would not be an adverse effect on groundwater for projects proposing a density greater than 1 dwelling unit per 8 acres. Moreover, there are many individual legal lots in the unincorporated portions of the eastern watershed. There could be less ability to limit impervious cover on many of them; nor would it be beneficial to encourage developers to construct lower-density, linked development spread out over multiple lots in a common drainage area. Therefore, for this strategy to be most effective, it would be critical for the jurisdictions to establish a fair and flexible program that encourages more efficient clustering development and limits new impervious surfaces, while recognizing exceptions and allowing for use of other BMPs to limit adverse effects. In cases where impervious cover occurs or is added, the focus should shift to disconnecting or minimizing surface runoff from impervious surface areas from entering surface waters. Moreover, there should be enough flexibility that jurisdictions could allow higher impervious surface cover at the project level if it would provide a net impervious surface benefit to the larger HSA.

What follows are the County of San Diego's initial suggested thresholds for addressing imperviousness in regional watersheds based on their existing conditions, including the establishment of sub-watershed development districts. As noted by the County in their White Paper, these thresholds would be subject to change based on input from other jurisdictions and additional research. As discussed, there are also locations in this watershed (e.g., groundwater ordinance restrictions relevant in the eastern watershed) or circumstances that could restrict how the program is implemented in those locations.

Preservation Areas

Preservation Areas would be designed to protect streams of existing good water quality and have the following characteristics:

- Relatively high percentages of wooded land and open space (>30 percent)
- Relatively low percentages of urban/suburban land uses with low amounts of impervious cover (<15 percent)
- Relatively few contaminated sources such as hazardous waste sites and wastewater discharges
- Relatively good water quality, which supports the beneficial uses.

Development occurring within these Preservation Watershed Districts would not exceed 15 percent impervious cover per project.

Restoration Areas

Restoration Areas would be designed to restore poor stream water quality and have the following characteristics:

- Relatively low percentages of wooded land and open space (<30 percent)
- Relatively high percentages of urban/suburban land uses with low amounts of impervious cover (>15 percent)
- Relatively high densities of contaminant sources such as wastewater discharges
- Relatively poor water quality, which is impaired.

Development occurring within these Restoration Watershed District would not exceed 50 percent impervious cover per project. Opportunities to retrofit existing developments would be evaluated to enhance or restore water quality.

Figure C.9-12 shows which HSAs in the Otay River watershed are considered Preservation Areas (less than 10 percent impervious surface cover) and Restoration Areas, the latter of which consist of impacted (11-25 percent impervious cover) and degraded/non-supporting (more than 25 percent impervious cover) districts, using criteria applied in other parts of the country (Center for Watershed Protection, 1999).

The White Paper also recommends further establishing Sub-Watershed Development Districts to establish "specialized" impervious cover factors unique to these smaller hydrologic areas. For example, some sub-watersheds could already exceed the 50 percent impervious cover limitation for restoration areas or are significantly below the 15 percent impervious cover limitation for preservation areas. The following parameters (or "zones") could be followed when establishing impervious cover factors for these focused areas:

Urban Growth and redevelopment would be concentrated and focused in the already developed watersheds where the impervious surface coverage exceeds 40 percent. The focus is to enact development policies that encourage retrofitting to restore water quality, and incentives are provided to focus redevelopment and storm water retrofitting along urban waterways.

Suburban Growth would be applied in the watersheds with 16 to 40 percent impervious coverage. The focus, again, is to enact development policies that encourage retrofitting to restore water quality. Suburban growth areas would be prioritized to acquire and protect the remaining undeveloped lands where not in conflict with adopted General Plans. Suburban growth would be directed toward the watershed with existing impervious coverage of 16 to 40 percent provided that rooftop and pavement area of the development does not exceed this threshold.

Open Space acquisition and conservation would be applied within the relatively undeveloped watersheds where the impervious surface coverage is below 15 percent. These "green" open space watersheds would have low intensity development designed to protect the existing good water quality. Pursuant to this "zone," new development would be permitted in the watershed identified for open space preservation provided the gross impervious coverage at build out does not exceed 10 to 15 percent.

A GIS database could be used to track the gross impervious cover based upon accumulations in developed land uses in a particular "zone" (urban growth, suburban growth, open space). This strategy could be implemented at two levels (APA, 2002). At the watershed level, implementation could proceed through updates to zoning, general plans, and other long-range planning mechanisms. At the

project level, it could be implemented during the project review and approval process. At the watershed level, if development in one zone is approaching a threshold, additional development could be directed to another zone that can tolerate the additional impervious surface area. It would be imperative for jurisdictions implementing the strategy to determine fair and effective approaches and circumstances for redirecting development (e.g., adopting Transferable Development Rights program, offering land use incentives for more efficient or clustered development).

To assist in compliance, the implemented strategy/program could provide guidance on various techniques that can be used to minimize impervious cover in new and retrofitted developments, such as narrower residential streets, smaller turn-around and cul-de-sac radii, smaller parking demand ratios, angles one-way parking, smaller front yard setbacks, shorter road lengths, permeable paving for parking areas, smaller parking stalls, clustered subdivisions, and shared parking and driveways.

To provide flexible development options, the program could also contain storm water credits that permit the impervious cover thresholds to be increased at no more than 5 percent for successful incorporation of certain techniques, such as:

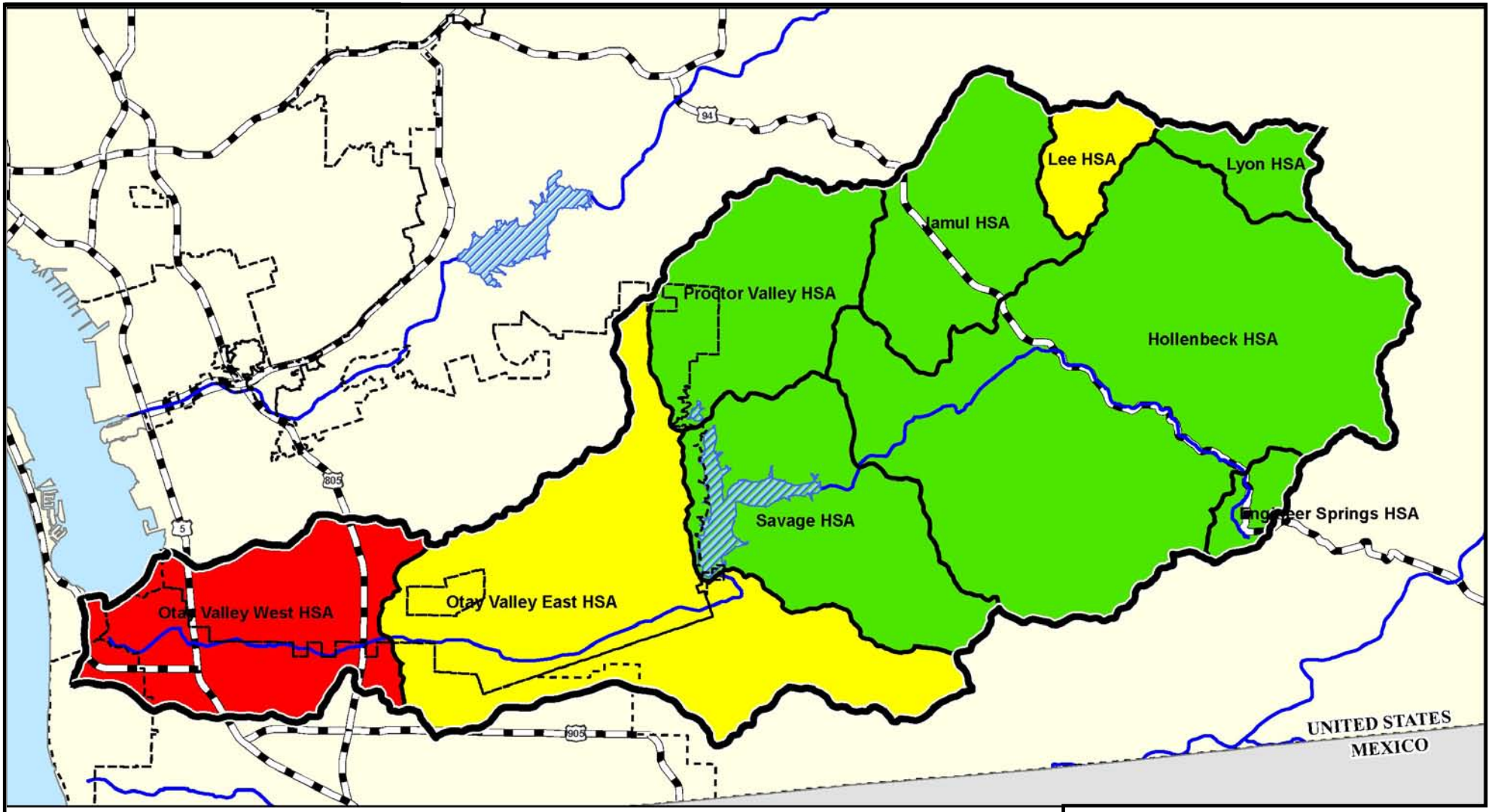
- Disconnection of rooftop runoff splash onto lawns or infiltrate into the groundwater table
- Revegetation of disturbed areas along riparian stream corridors
- Removal of impervious surfaces from onsite or from other watersheds
- Acquisition and protection of open space offsite through conservation easements.

Locations

The entire watershed would be targeted by this strategy. Given that the majority of preserve and open space areas are east of the I-805 (and the lowest percentages of impervious surfaces), this strategy would provide the most benefit to these areas (Figure B.6-9). West of I-805, efforts should focus on disconnecting impervious surface area associated with existing development from surface waters. Disconnecting impervious cover can be accomplished by routing storm water runoff from areas with impervious cover directly to the sewer or into a detention/infiltration feature. The goal is to reduce or eliminate increases in runoff, which can result as impervious cover increases. The practicability of disconnecting impervious cover will not be known until area-specific studies are conducted. For example, space for a detention/infiltration facility could be limited in a particular area, and the capture and routing of storm water runoff to the sewer might not be practicable either.

Expected Proponents

The County of San Diego Department of Planning & Land Use's Watershed Planning Program has conducted research and prepared a White Paper addressing impervious surface area, including how impervious surface area could be used for differential planning approaches in County watersheds and subwatersheds (County of San Diego DPLU, 2003). Also, most of the land within this watershed is unincorporated County land. Therefore, the County of San Diego is ideally suited to lead this effort; although, as addressed in their White Paper, they would need to work with the other jurisdictions, perhaps through a JEPA, to successfully implement this strategy watershed-wide. Ultimately, each jurisdiction would be responsible for determining how land development proceeds within its own boundaries. At the discretion of the jurisdictions, NGOs conducting research on impervious cover or developing programs limiting impervious cover in other watersheds could participate in the research and development of a program for this watershed.



Legend

- Preservation (10 Percent or Less Impervious Cover)
- Impacted (11-25 Percent Impervious Cover)
- Degraded (Greater than 25 Percent Impervious Cover)

Basemap Legend

- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes

0 3500 7000
Scale in Feet

N

Source: TAIC, 2005

Otay River Watershed Management Plan

Figure C.9-12
Otay River Watershed Development Districts

Aspen Environmental Group

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Schedule

The County of San Diego has already conducted substantial study of this issue. Given the importance of controlling impervious surface area in watersheds and the implications for where and how future development would proceed, the County would probably want to conduct additional studies; perhaps in collaboration with the other jurisdictions. In fact, additional modeling and mapping studies were recommended in the County's 2003 White Paper; and it is recommended that additional study occur to more accurately map the impervious surface areas in the different parts of this watershed, including how much is directly connected to surface waters. More time would be needed to adopt the establishment of the development districts and to update the jursidictions' project approval processes to ensure impervious surface controls are implemented. Implementation could occur over the intermediate term (3-5 years), but could take longer depending on what additional studies are deemed necessary and how quickly the jurisdictions adopt this strategy.

Maintenance and Monitoring Considerations

Because the relationships between percent impervious surface area and effects on aquatic resources have not been well established for the arid southwest, it would be critical to monitor the actual effects associated with future urbanization in the watershed. Also, as noted above, the effects of adding impervious surfaces can vary depending on factors such as soil type and vegetative cover. If monitoring suggests that the threshold percentages for development districts are not protecting natural resources (it is worth noting that they are higher than used in other parts of the country), the percentages or parameters might need to be changed.

First-Order Cost

Placing limits on impervious surface area associated with development projects is not expected to substantially increase development costs. Implementation of this strategy could result in redistribution of development from a more natural zone to a more urbanized one (which could save infrastructure costs) and/or could involve directing runoff from developments into infiltration areas or to the sanitary sewer system to limit or preclude it from entering the storm water conveyance system. Progress is already being made in the redistribution of development from more natural to more urban areas, as reflected in the Otay Ranch GDP/SRP and many of the jurisdictions' General Plans. Similar BMPs are included in the Municipal Permit, the jurisdictions' storm water ordinances, and are discussed in the San Diego Region's Model SUSMP, so this is not a new design concept. The main change would be adhering to specific impervious cover limits, depending on HSA. It is expected that there would be costs associated with funding whatever additional studies the jurisdictions determine are necessary as well as undertaking formal adoption and project approval update processes. These costs could well exceed $100,000, depending on the level of effort. There would also be costs associated with resource monitoring, the scope of which would depend on the type, frequency, and duration of monitoring.

Potential Funding Sources

The jurisdictions could require developers to pay a storm water fee depending on their increase in impervious surface area or how much directly impervious surface area their projects would contribute to the development districts in which they occur. The fees could be used to manage the program, including the follow-up monitoring. The jurisdictions could also provide funding, as they have done for the initial studies. If benefits to water quality can be shown, proposition money could also assist this effort, such as Propositions 40 and 50.

C.9.1.8 Implement a Watershed-Wide Education Program to Improve Public Awareness and Stewardship

Target Goals

This strategy in intended to address the following goals of the ORWMP:

Goal 1. Protect, Enhance, and Restore Watershed Resources

Goal 3. Provide Educational and Recreational Opportunities

Goal 4. Ensure Public Health and Safety

Activities and Benefits

This strategy is essential to the long-term protection and enhancement of natural resources and water quality within the Otay River watershed and the effective implementation of the ORWMP. By raising awareness and gaining the participation of residents and users, it is possible to change the behaviors that lead to the majority of the watershed stressors. Nevertheless, some stressors stem from social impairments, such as the transient population in the Otay River, and require specialized efforts beyond education.

This strategy focuses primarily on developing and distributing educational materials and curricula, and conducting workshops, tours, and enhancement/restoration events designed to inform residents and users on the dynamics of the watershed and the benefits of living responsibly within this watershed. While education is critical, it is equally important to involve residents and users in the enhancement and restoration activities. Participation in trash removal, weed removal, and native species planting builds a sense of stewardship in the watershed community. What follows is a four-phase approach to implement this strategy:

(1) *Stakeholder Outreach*. This component is already underway, beginning with the formation and participation of the Working Group in the ORWMP-development process. The Working Group currently has representatives from six different interest groups (i.e., Recreation, OVRP Citizens Advisory Committee, Environmental, Regulatory, Property Owners and Business Owners), and it is strongly recommended that a new interest group be formed comprised of educators and others focused on Watershed Education.

- Continue to invite residents, other users, educators, regulators, and resource managers to participate in Working Group meetings.
- Form an interest group for Watershed Education.
- Facilitate the meetings to determine the priorities and goals for Watershed Education, and include in the ORWMP goals.
- Facilitate the remaining phases of implementing this strategy pursuant to the actions described below or formulate an alternative implementation approach.
- Amend the program on a regular basis to best reflect the changing watershed and the interests of students, teachers, residents, and other watershed users.

(2) *Program Integration and Coordination*

- Identify existing programs that can be utilized as models to efficiently develop the Otay River Watershed Educational Program. An initial list of organizations with environmental education programs include the following.

- County of San Diego MSCP Outreach and Education
- County of San Diego Project Clean Water
- The San Diego Unified Port District Education Program, which includes both youth (classroom and field) and adult programs.
- California Regional Environmental Education Community (CREEC)
- U.S. Environmental Protection Agency – Adopt Your Watershed
- U.S. Fish and Wildlife Service – Education for Conservation
- U.S. Fish and Wildlife Service – NWR Complex
- North American Association for Environmental Education (EElink)
- San Diego Natural History Museum

– Identify out-door classroom opportunities operated by land managers, rangers, or docents who are willing and able to assist in regular education events. Begin with the preserves, parks, and open space areas within the watershed and the adjacent Sweetwater and Tijuana watersheds. An initial list of possible outdoor classrooms and/or field trip locations include the following.

- USFWS San Diego NWR Complex
  - Sweetwater Marsh - Chula Vista Nature Center
  - South San Diego Bay Unit – Habitat Heroes Program
  - Tijuana Slough NWR – Tiujuana Estuary Visitor Center and Nature Trails
- Bureau of Land Management Otay Mountain Wilderness Area
  - Otay Truck Trail and Minnewawa Truck Trail
- CDFG Rancho Jamul Ecological Reserve
  - Educational facilities located in the headquarters building; parking lot; limited trails for passive recreation, including hiking, birdwatching, scientific research, etc. (outdoor classrooms currently exist at this reserve, including several nature watching field trips organized by the San Diego Natural History Museum)
- OVRP
  - Current facilities include nature trails and limited parking areas, future opportunities will include staging areas, kiosks, water fountains, and parking lots.

(3) *Develop Educational Materials, Design Programs and Curricula, and Distribute to the Public.*

– Develop a general watershed guidebook to living responsibly in the watershed and include references and contact information to specific resources and educational materials. An excellent example of this type of guidebook is *Living Lightly in Our Watersheds, A Guide for Residents of the Malibu Creek Watershed and Adjoining Watersheds* available at http://www.malibuwatershed.org (Malibu Creek Watershed Advisory Council).

– Develop more specific educational materials to supplement the general watershed guidebook. Suggested topics for educational materials include:

- Watershed and stream ecology
- Sensitive resources in the Otay River watershed
- Invasive flora and fauna and their adverse effects
- Native alternatives to non-native plant use in meeting particular needs (e.g., erosion protection, windbreaks)
- Trash and debris – proper disposal methods and locations

- Native, native cultivars, and drought tolerant landscaping
- Alternatives to traditional fertilizers, herbicides, and pesticides
- Water conservation practices in the arid southwest
- Responsible pet ownership and domestic animal management
- Household pollutant control
- Storm water pollution prevention
- The importance of reduction, reuse, and recycling

– Form small teams of individuals or consultants to focus on developing materials for the topics listed above. For example, a small team of two or more individuals with knowledge, experience, or interest in native plants could draft a native landscape handbook for the Otay River watershed. For consistency, handbook developers should consult the Western OVRP NRMP restoration guidelines. The handbook would be reviewed, amended, and finalized by the larger Watershed Education interest group and/or Working Group. In this way, materials focused on various topics can be drafted simultaneously.

– Design educational programs for a suite of media including E-mail, video (VHS and DVD), class curricula (handouts, workbooks, projects), newspapers, flyers, pamphlets, guidebooks/handbooks, tours, field trips, signs, and kiosks.

– Seek peer review of the materials from the HOAs, school districts, reserve managers, and others not directly involved with the Working Group.

– Post all information on the Project Clean Water website or other websites such that the material can be obtained easily and inexpensively.

(4) *Implementation*

– Provide training to educators about environmental and watershed-related curricula.

– Coordinate watershed tours and field trips to natural areas led by educators, docents, or resource managers with experience in the dynamics, locally native flora and fauna and other natural resources, and stressors in the watershed.

– Facilitate community involvement through watershed-improvement activities. Suggested activities include:

- Trash clean-up days
- Trail and fence maintenance
- Weed removal and replanting
- Water quality monitoring (e.g., assisting the San Diego Stream Team)
- Wildlife monitoring and vegetation mapping

– Facilitate community education through regular workshops and presentations. Suggested topics include:

- Landscaping with natives, focusing on the benefits of using native species and native cultivars over non-native species
- Water quality monitoring
- Environmentally friendly pet ownership and domestic animal management
- Living responsibly with the resources in the watershed (e.g., properly disposing of trash and debris, implementing water conservation practices, the importance of reduction/reuse/recycling).
- Easy steps residents and other users can take to protect the watershed from pesticides, herbicides, detergents, and other potential household contaminants, such as sweeping instead of washing down

driveways, taking cars to a car washes that recycle and filter water instead of washing cars at home, using biodegradable soaps and detergents, and natural alternative to pesticides.

- Upcoming opportunities for participating in watershed enhancement or restoration projects

– Ensure that individual jurisdictions serve as community models in implementing the educational materials being distributed to the residents and users ("teach by example"):

  - Use natives, native cultivars, or drought-tolerant landscaping practices when planting new or renovated streetscapes and street medians.
  - To the extent practicable, use biotechnical approaches to solving erosion or flood control problems.
  - Ensure that maintenance contractors are monitoring irrigation lines and watering times, particularly in the winter, such that residents do not observe overwatering and waste by the cities or the County.
  - Ensure best available technology or RWQCB-approved storm water management practices are implemented and maintained.
  - Reinforce responsible pet ownership and management by installing bag dispensers and trash receptacles with spring-loaded lids at convenient locations along trails and parks and by redistributing educational materials prior to the rainy season.

– Implement key development requirements in the local plan approval process.

  - Add or amend CC&Rs or HOA Rules and Regulations to include educational materials and impose restrictions and penalties on residents to control household pollutants and limit actions that can adversely affect the community, as well as the watershed as a whole. For example, the HOA Rules and Regulations could include educational material regarding the adverse effects of washing down driveways instead of sweeping. The rules could restrict this activity under specific circumstances and impose a penalty. Another example could be to distribute educational material regarding the adverse effects of trash and pet waste on the community as well as the downstream natural resources. The HOA Rules and Regulations could prohibit residents from littering in common areas, and require that they pick up waste from their pets, and dispose of trash and debris in provided trash receptacles. The HOA's justification for imposing these restrictions is that by disposing of trash and pet waste properly, the cleanliness of neighborhood schools, parks, and other common areas is protected, HOA fees are kept low, and the value of homes in the community is maintained.
  - For new development, use only natives, native cultivars, or drought-tolerant landscaping for streetscapes, common areas, front yard planters, and buffer areas around parks.
  - For new development, if sufficient reclaimed water sources are available, install reclaimed water irrigation systems for common areas, parks, and schools.

Locations

This strategy would target the entire Otay River watershed, but the types of materials and activities planned should be specific to the particular needs and issues of concern in the area (could be sub-area or jurisdiction specific).

Expected Proponents

The County of San Diego's Project Clean Water program includes an Educational Technical Advisory Committee that coordinates activities between non-profit organizations, private institutions, and governmental agencies, which provide environmental and water quality education. Monthly meetings provide a forum for educators, trainers, and public information officers to collaborate, share methods and materials, and seek policy-level support and direction. The County of San Diego MSCP also has an Outreach and Education component. Because of these programs, as well as their lead role in organizing and managing the ORWMP Working Group, the County of San Diego is ideally suited to lead the effort

of implementing this strategy in the Otay River watershed. If a Watershed Education interest group is formed, it should lead the development of watershed-specific educational materials, but it should coordinate closely with Project Clean Water and the MSCP to maximize efficiency in implementing the program. In addition, it is important that all the jurisdictions share in developing educational materials because they will ultimately be responsible for plan-checking new and renovated developments proposed within their jurisdictions for compliance with the ORWMP. Whenever the Watershed Council or equivalent decision-making body is established, this permanent body could take over the lead role in implementing this strategy.

In addition to jurisdiction-based organizations within this watershed (e.g., City of Chula Vista Science Resource Teacher/Nature Center Liaison), it is recommended that the County seek partnerships with regulators and non-profit groups, such as the California Native Plant Society, the Audubon Society, and San Diego Stream Team, to develop specific programs and field trips for the Otay River watershed. Several of these organizations have education programs, training, and materials available that can be utilized to initiate the program in the short term. The existing materials can also be used as templates for developing watershed-specific programs. For example, the California Coastal Commission and the SWRCB have Education and Public Outreach Programs that include educational materials for businesses, teachers, and residents in subjects such as respecting living things, restoration, waves and watersheds, and sustainable living. The San Diego Stream Team trains volunteers on water quality monitoring techniques and indicator macrofauna. The San Diego Chapter of the California Native Plant Society completed demonstration gardens at five elementary schools in San Diego in 2004, donating plants and expertise to teach school children about native plants and planting techniques. The preserve owners/managers in this watershed are also expected to have valuable educational materials and could probably provide tours of their resource-rich areas.

Schedule

Developing an interest group for Watershed Education could be completed at any one of the monthly Working Group meetings, and invitations to specific organizations such as the San Diego Chapter of the California Native Plant Society and the San Diego Stream Team can be sent immediately. The Project Clean Water or MSCP Outreach and Education websites have place holders for links to educational materials for teachers, students, residents, and businesses. These links could initially be filled with existing materials offered by other organizations as described above. Developing specific educational materials for the Otay River watershed to replace the regional versions and distributing them to residents could be completed in the short term (within 2 years). Organizing school presentations, tours and field trips, restoration or enhancement events, and other activities are likely short-term to intermediate-term activities (3-5 years). Over the long-term, the educational program would need to adapt as the watershed changes and as the ORWMP, the Otay River watershed Special Area Management Plan, the MSCP, and other planning or regulatory efforts are implemented and updated.

Maintenance and Monitoring Considerations

The efficacy of this strategy will depend on how the residents and users embrace the educational materials and participate in the watershed improvement projects. While it would be difficult to quantify, surveys of residents and users could gauge their attitudes about the watershed's resources and their role in reducing stressors (see Section D.8.3). As with the other strategies, there are some uncertainties with what will be most effective, and the components of this strategy are likely to be updated over time. Feedback on the educational materials, the degree of participation in watershed improvement projects, the level of assistance in monitoring programs, and community surveys can all be useful in evaluating whether changes to the strategy are necessary.

First-Order Cost

There would be costs associated with developing educational materials (guidebooks, videos etc.), installing kiosks and waste receptacles at trail heads, conducting public outreach at schools, and organizing and coordinating field trips. These costs could collectively exceed $100,000 over the short-term, depending on the level of effort, but volunteer labor and donated materials would likely reduce this estimate. Over the intermediate and long term, there would be additional costs to evaluate the progress of the programs and update them as needed.

Potential Funding Sources

Developing individual videos, pamphlets, and guidebooks are fairly low cost items, less than $10,000 for each topic, particularly when "templates" from other organizations are utilized. Installing kiosks at trail heads is also considered a low-cost action (less than $10,000). However, the long-term updating and reproduction of these materials and the maintenance of kiosks, gutter stenciling, etc. would be more costly and would need to be included in annual program costs. Because many of the topics are directly and indirectly related to improving water quality, proposition money could assist this effort, such as Propositions 40 and 50. In addition, there are multiple grants available for specific environmental education programs for schools and government agencies. The California Department of Education Environmental Education Grant Program provides mini-grants of up to $3,000 to schools to help implement *A Child's Place in the Environment*. Grants funds up to $10,000 are available for larger, district or county-wide projects. The California Coastal Commission's Whale Tail Grants Program distributes funds from sales of the Whale Tail License Plate. These grants support programs that teach California's children and the general public to value and take action to improve the health of the State's marine and coastal resources. Adopt-A-Beach programs, as well as other beach maintenance and coastal habitat restoration projects that have an educational component, are also eligible for these California Coastal Commission grants.

There are specific grants and awards available for developing brochures and interpretative displays (e.g., The Conservation Fund and Eastman Kodak Company Kodak American Greenways Award Program), designing and coordinating community restoration groups (NOAA-Office of Habitat Conservation Community Based Restoration Program), as well as other environmental education and restoration activities (Wetlands Recovery Project Small Grants Program). There are numerous other funding opportunities under Proposition 40 and 40 and other bond moneys that require an educational component to every project.

C.9.1.9 Form a Watershed Council or Equivalent to Implement and Update the Watershed Management Plan

Target Goals

This strategy in intended to address the following goals of the ORWMP:

Goal 2. Ensure Reasonable, Sustainable, and Compatible Economic Development

Goal 5. Maximize Integration of Existing Programs and Plans that Affect the Resources of this Watershed

Activities and Benefits

To maximize the implementation and utility of the ORWMP, it is imperative that a Watershed Council or similar oversight and decision-making body be established and remain in place over the long-term. An active and persisting entity is required to implement and update the ORWMP as-needed to best reflect stakeholder goals and to ensure strategies are effective in reducing impairments and protecting, enhancing, and restoring beneficial uses in this watershed. This body could be an extension of the Otay River Watershed Working Group, which includes representatives from each interest group (Environmental, Recreation, OVRP Citizens Advisory Committee, Regulatory, Property Owners and Business Owners), the Executive Steering Committee, or the Policy Committee. To be most effective, this body needs to include decision-makers from each jurisdiction, such as a County Supervisor and a council member from each city. The inclusion of elected officials representing each jurisdiction will be essential to ensure that the ORWMP strategies or updates are actually implemented. In some cases, changes could be significant enough that the governing body for each jurisdiction would have to collectively consider and decide on an issue. For example, additional funding will be required to update GIS databases and supporting documents, which could require action by the individual jurisdictions. In these cases, it is expected that follow-up meetings by the Watershed Council would be necessary to fully address these issues. Overall, this group would be responsible for (directly or through delegation):

- Prioritizing and implementing strategies
- Reviewing and updating goals as necessary to best reflect current interests
- Reviewing and updating GIS databases and supporting documents on watershed conditions
- Reviewing strategies implemented and not implemented to determine which should be retained, eliminated, or modified, as well as reprioritizing strategies to be implemented
- Modifying strategies (including monitoring protocols and evaluation criteria) based on lessons learned or changing conditions
- Developing new strategies based on changing conditions and technology.

Over the long-term, at a minimum, this group should meet to formally update the ORWMP every 3 to 5 years. However, during the first several years, the group should meet more frequently (monthly, quarterly, semi-annually, annually) as necessary to maximize the implementation and effectiveness of strategies, and to ensure the ORWMP best reflects stakeholder interests and the watershed conditions. For most of the recommended strategies, the first action/step would be to acquire and evaluate baseline data to determine what if any additional action is warranted. This step would typically involve obtaining and reviewing existing sources of information, such as existing plans and reports, and supplementing this information as necessary with the most current data. For example, the first step or action in implementing a watershed-wide non-native species eradication program (Strategy C.9.1.1) would be to obtain information on non-native species distribution in this watershed (e.g., from the Draft Habitat Restoration and Exotic/Non-Native Plant Removal Plan [County of San Diego Department of Parks and Recreation, 2005]) and to collect current data on non-native plant species outside of the OVRP and non-native animal species throughout the watershed. As discussed in Strategy C.9.1.1, establishing an up-to-date, watershed-wide baseline is essential to ensure that the non-native species eradication approaches taken are effective and efficient throughout the watershed.

It is also possible that the initial baseline establishment and evaluation undertaken for a given strategy confirm that existing controls or management efforts are sufficiently protecting natural resources. For example, as discussed under Strategy C.9.1.4, each jurisdiction has buffer, setback, or adjacency criteria focused on protecting particular natural resources. It is currently unknown whether the existing criteria are adequately protecting aquatic resources at the watershed scale. If this recommended strategy

were implemented, and the initial baseline establishment and evaluation confirm that existing controls are adequately protecting aquatic resources, this would suggest that further implementation of Strategy C.9.1.4 is not warranted.

Therefore, the Watershed Council or equivalent decision-making body's first tasks would be determining which strategies or actions to implement, their priority, their implementation costs, and the schedule. Section C.9.4 and Tables C.9-2 and C.9-3 provide key information and recommendations for the 17 strategies, as an initial framework the Watershed Council or equivalent body can use in making decisions. For most of the strategies, the first implementation step or action would be to establish a comprehensive baseline and evaluate whether existing controls or management approaches are adequate (i.e., strategy-focused gap analysis). This evaluation would allow the Watershed Council or equivalent body to determine whether additional action or further implementation of a particular strategy is warranted. This more complete understanding could also indicate to the Watershed Council or equivalent body that actions or strategies should be reprioritized or that gaps still exist that need or would benefit from additional study before proceeding further. Moreover, the information obtained from these initial steps or actions would also allow the Watershed Council or equivalent body to refine the schedule, responsible parties, approaches, and logistical needs (e.g., funding, access) for particular strategies to be implemented more fully.

Because watershed management is a complex enterprise and has regional effects, this decision-making body should interact regularly with equivalent bodies representing other San Diego region watersheds, as envisioned by Project Clean Water. This exchange of information would benefit all regional watershed management planning and implementation efforts through discussions of lessons learned and issues and resources of regional importance. These efforts would benefit the San Diego Bay and the San Diego NWR, which is a regional resource currently being considered for inclusion as a wetland of international importance designated under the Ramsar Convention. In addition, the Tijuana Estuary is one of the 22 U.S. Ramsar sites and is also a NWR and a National Estuarine Research Reserve supported and managed under NOAA and State Parks. Close coordination could enhance research, develop better management strategies, and identify opportunities for the San Diego Bay and the Otay River watershed.

Locations

The Otay River Watershed Council or equivalent body would be responsible for oversight and decision-making affecting the entire Otay River watershed. By coordinating with other regional Watershed Councils and international resource managers, this Watershed Council would also contribute information and approaches that could benefit other regional watersheds.

Expected Proponents

As discussed, this body needs to include decision-makers from each jurisdiction, as well as the other interest groups participating in the Otay River Watershed Working Group (i.e., Environmental, Recreation, OVRP Citizens Advisory Committee, Regulatory, Property Owners and Business Owners). As with the participation of the County of San Diego, City of Chula Vista, City of Imperial Beach, City of San Diego, and Port of San Diego in the ORWMP, it is expected that the formation of the Watershed Council or equivalent would be formalized through a JEPA or similar agreement. This agreement should formally recognize the participation of elected officials in watershed matters.

Schedule

The Otay River Watershed Working Group, Executive Steering Committee, and Policy Committee are currently performing these functions in developing the ORWMP. However, a single Watershed Council or similar decision-making body should be formed by the release of the final Watershed Management Plan. This would help ensure there is not a delay between finalization of the initial ORWMP document and the implementation of strategies.

Maintenance and Monitoring Considerations

The composition of this body should be reexamined periodically to ensure it best reflects the current watershed interests and conditions. As needed, new representatives could be added to best reflect changing interests and conditions and to replace departed or departing representatives (e.g., elected officials). The participants could agree that jurisdictional representatives can change as the need arises, or a special meeting can be called prior to the next scheduled ORWMP review or update meeting to consider proposed changes in representatives.

First-Order Cost

Because this body would be a logical extension of the Working Group, the Executive Steering Committee, and the Policy Committee, it should not involve any extra cost beyond the time required to review materials and to convene and meet as a group. Therefore, this is a low-cost (less than $10,000 in most years) strategy; although costs would be recurring, based on the frequency and length of meetings. Costs associated with updating databases, reports, and the ORWMP, including actual implementation, maintenance, and monitoring would be separate costs that are unknown at this time.

Potential Funding Sources

The jurisdictions have been funding their representatives to participate in the ORWMP-development process for the last few years. It is expected that the cost of updating the ORWMP and subsequently updating websites and producing revised copies would be shared among the jurisdictions as part of their implementation costs. As stated, it will be imperative that elected officials participate in this body, so a few more jurisdictional representatives might need to attend. Interest groups have been volunteering their time. It is expected that this involvement will continue. If alternative funding sources are desired to fund formal involvement, the SDRWCB or SWRCB might be willing to provide monetary support.

C.9.2 Medium-Priority Strategies for Watershed Protection, Enhancement, Restoration, and Management

The following strategies, in no particular order, are considered medium priority for this watershed:

- Retrofit Existing Developments as Necessary to Protect Aquatic Resources
- Restore Urban Creeks
- Implement Comprehensive Agricultural Land BMPs to Protect Aquatic Resources
- Improve Existing and Create New Recreational Facilities
- Manage Tecate Cypress Forest and Oak Woodlands
- Achieve Consistency in Regulations in Conjunction with the SAMP

C.9.2.1 Retrofit Existing Developments as Necessary to Protect Aquatic Resources

Target Goals

This strategy in intended to address the following goals of the ORWMP:

Goal 1. Protect, Enhance, and Restore Watershed Resources

Goal 4. Ensure Public Health and Safety

Activities and Benefits

This strategy involves evaluating the existing developments in the Otay River watershed to determine if any of them need to be practicably "retrofitted" (i.e., non-structural or structural changes) to protect and potentially enhance aquatic resources and beneficial uses. This strategy would require several steps:

- Retain water quality specialists, fluvial geomorphologists, and biologists to evaluate existing development in this watershed to determine where aquatic resources are adequately protected and where these resources could be better protected with feasible changes (modification of existing or addition of new non-structural or structural BMPs).
- Prioritize which modifications/additions would result in the most protection or enhancement of aquatic resources.
- Contact and reach formal agreements with the developers/property owners/HOAs to make the modifications or additions (failure to reach agreement could require reprioritization of activities).
- Identify and secure all necessary funding to complete activities (i.e., applicable jurisdiction, the developer/property owner/HOA, grants, or combination; necessary funding includes money needed to retain experts to collect the initial baseline information and to complete all other listed steps).
- As necessary, complete BMP or project design and specifications.
- Complete environmental documentation (NEPA and CEQA) and obtain the required federal, State, and local permits.
- Hire contractors as necessary to implement the modifications or additions.
- Monitor the effectiveness of the retrofits.
- Perform as-needed BMP maintenance and modifications to protect and enhance beneficial uses.

Efforts should first focus on whether there are non-structural source controls that could be implemented, such as changes in land management practices. In most cases, however, some form of structural control would probably be required.

Locations

This action could be undertaken for any area of existing development in the watershed. Because the majority of open space and preserve areas, which are highly valuable and sensitive, occur north, east, and south of the Otay Reservoirs, efforts should be focused there initially. However, there may be important opportunities between the Otay Reservoirs and I-805 to protect against channel destabilization, adverse effects to water quality, and similar threats to beneficial uses associated with Otay Ranch, East Otay Mesa Business Park, and other developments currently under construction. These newer developments should have the most current BMPs in place, but monitoring along lower Salt Creek, as an example, might indicate that some retrofitting is warranted. Opportunities west of I-805 are probably more limited, given the heavy urbanization that has occurred and the lack of open areas for detention basins or similar features. Regardless, these developments should still be evaluated,

particularly because of their proximity to San Diego Bay, which is an important and sensitive regional resource.

Expected Proponents

Each jurisdiction would be in the best position to determine initially which if any developments warrant retrofitting. However, because activities in one area would have consequences in other jurisdictions, it is recommended that the jurisdictions work collaboratively (e.g., through a JEPA) to prioritize retrofitting projects and the extent of retrofitting required. The Watershed Council or equivalent could also assist in coordinating the review and prioritization process. Appropriate prioritization would require the participation of individuals with expertise in water quality, fluvial geomorphology, and biology. It is expected that the regulatory agencies, primarily the SDRWQCB, would be supportive of this strategy.

Schedule

Retrofitting existing development is expected to be an intermediate- to long-term strategy. Some time will be required for the jurisdictions to agree on the most effective approach to prioritizing projects. In addition, it will take considerable time to work through the logistical issues with the developers/ property owners/HOAs, identify and secure necessary funding, prepare BMP or project plans and specifications, complete the environmental documentation, obtain the required local, State, and federal permits, and construct or modify BMPs.

Maintenance and Monitoring Considerations

The jurisdictions will need to monitor the effectiveness of the implemented retrofits to determine whether additional retrofitting is required. Any new or modified structural features will need to be inspected and maintained to ensure continued functionality and protection of beneficial uses. It is expected that the flood control and/or storm water departments of the respective jurisdictions would be responsible for maintaining these facilities over the long term.

First-Order Cost

This strategy is expected to cost several million dollars, depending on the number of projects, locations, retrofit types and sizes, and other factors. The cheapest "retrofits" would be changes in land management practices (i.e., non-structural source controls); but as noted above, some level of structural control would probably be required in most cases.

There will be significant costs associated with evaluating and prioritizing project candidates, reaching agreements with the developers/property owners/HOAs/residents, preparing construction plans, completing environmental documentation, obtaining permits, constructing the features, monitoring their effectiveness, and maintaining their functionality in perpetuity. Therefore, this is considered a high-cost strategy. Moreover, there might be many instances where structural retrofits are not practicable, because of cost, space limitations, insufficient benefits, or other considerations. This underscores the importance of conducting baseline studies to identify where problems exist and what can be practicably accomplished.

Potential Funding Sources

The jurisdictions could work collaboratively to fund the initial planning phase. Grant or bond money (Propositions 40 and 50) could fund many of the activities. In particular cases, the jurisdictions might

be able to have the developers/property owners/HOAs pay for part or all of specific retrofits; if, for example, there were water quality standards they were required to meet and their existing facilities or practices are inadequate. This is an option the jurisdictions could consider. Per the Municipal Permit, watershed jurisdictions including the City of Chula Vista have been identifying existing developments where water quality improvement measures will need to be implemented. Other funding sources might become available to fund the long-term maintenance, but the jurisdictions might have to fund most of these on-going activities.

C.9.2.2 Restore Urban Creeks

Target Goals

This strategy in intended to address the following goals of the ORWMP:

Goal 1. Protect, Enhance, and Restore Watershed Resources

Goal 4. Ensure Public Health and Safety

Goal 5. Maximize Integration of Existing Programs and Plans that Affect the Resources of this Watershed

Activities and Benefits

This strategy focuses on identifying and acting upon opportunities for urban creek restoration, primarily in the lower or western Otay River watershed (i.e., downstream of Savage Dam). Jurisdictions such as the City of Chula Vista have begun identifying restorable creeks within their municipal boundaries. As defined here, urban creeks are tributaries to the Otay River that have been altered by straightening, channel lining or filling, or culverting; typically to provide flood control or erosion protection to adjacent or nearby urban development. As such, the functional condition of many of these streams has been compromised. Moreover, these adverse effects can be translated downstream to the Otay River and San Diego Bay. While this strategy focuses on tributaries west of the Otay Reservoirs, suitable candidates could exist in the east and should be considered, as discussed below. Nevertheless, more urban alteration has occurred to the western tributaries and their condition is more likely to affect San Diego Bay (i.e., Savage Dam hydrologically disconnects the eastern and western watershed, except during extreme storms).

Urban creek restoration would be expected to provide numerous benefits, such as improvements in water quality, water quantity (additional flood water storage), wildlife support, aesthetic appreciation, and recreational enjoyment. While it is a worthwhile goal to restore as many urban stream reaches as possible, it is important to determine where restoration is feasible and beneficial to the ecosystem and to prioritize accordingly. As such, the following steps would be required to successfully implement this strategy:

- Retain fluvial geomorphologists, engineers, restoration ecologists, or similar experts to evaluate the feasibility of restoring tributaries (including logistics, technical aspects, costs) as well as the expected level of restoration benefits (including habitat area/stream miles restored, importance to wildlife, benefits to the quality of downstream receiving waters, aesthetic/recreation/other value to watershed users).
- Have experts prioritize the channels to restore considering the level of restoration that could occur at each, and restoration feasibility (including cost), schedule, and community input.
- Have experts determine restoration type (including the removal of flood control structures, lowering banks, expanding flood plain, planting with riparian and wetlands plants) and location (including stream reaches, stream bank or invert, etc.).

- Contact and reach formal agreements with the property owners to determine which channels can be restored and the level of restoration achievable (note that unwilling property owners would require reprioritization of projects).
- Secure all necessary funding to restore the project channels (i.e., necessary funding includes money needed to retain experts to complete restoration feasibility studies and to complete all other listed steps).
- Conduct additional necessary hydrological and hydraulic studies.
- Prepare formal restoration plans, project design and specifications.
- Complete the required environmental documentation and secure the required federal (could include FEMA), State, and local permits.
- Hire qualified contractors, as necessary, with experience in riparian restoration to complete the restoration activities (also see maintenance and monitoring considerations, below).

As noted, jurisdictions such as the City of Chula Vista have begun the process of identifying restorable creeks in their municipal boundaries. Therefore, the identification and prioritization process should be carefully coordinated with the jurisdictions in this watershed. Moreover, through the SAMP-development process, the regulatory agencies (Corps, CDFG, and, potentially, SDRWCB) might identify particular urban creeks or reaches they want restored under the SAMP's aquatic resource conservation and restoration program. Therefore, it would be prudent to involve these agencies in determining restoration priorities.

Locations

As noted, most of the urbanized streams in this watershed occur west of Savage Dam, particularly west of I-805. In many cases, the proximity of infrastructure or development would preclude or limit stream restoration. In other cases, such as a culvert through a park, this logistical constraint might not exist or would be minor. Listed below is an initial list of restoration project sites and actions for further consideration and evaluation. These were identified as candidate locations during field reconnaissance in the watershed. No specific criteria were used; these are tributaries that have been adversely affected by development and grazing in the watershed and offer restoration or enhancement potential. Undoubtedly, other candidate locations occur and might be considered a higher priority:

Potential Lower Watershed Projects:

- *Unnamed Tributary Through Loma Verde Park* – Opportunities for floodplain restoration exist on this tributary both upstream (approximately 900 linear feet to a residential culvert) and downstream (approximately 2,000 linear feet to Orange Avenue) of Max Avenue (Figure C.9-13). Upstream of Max Avenue, activities could include minor grading along the southeast side of the channel to expand the active floodplain and terraces, enhance in-stream habitat and transitional and upland buffers through the removal of exotic vegetation (fan palm, castor bean, iceplant, tree of heaven, eucalyptus, pepper tree, annual grasses) and targeted planting of natives. Similar opportunities exist downstream of Max Avenue toward Orange Avenue, although ballfields currently limit restoration potential. Restoration opportunities between Orange Avenue and Main Street are severely diminished by the proximity of residential development and the culverting and filling of the historic tributary. In contrast, there appear to be opportunities for enhancement of the tributary downstream of Main Street to its confluence with the Otay River.

Nestor Channel – Several opportunities currently exist for enhancing and restoring this tributary's floodplain and buffer area downstream and upstream of Coronado Avenue (Figure C.9-14). Potential opportunities downstream of Coronado Avenue include: minor grading to expand the active floodplain and terrace along the west side, removal of exotics, and targeted native plantings along the reshaped bank and buffer (from Coronado Boulevard downstream to Cantamar Road, approximately 2,000 feet). From Cantamar Road to Dahlia Avenue (approximately 400 feet), there are opportunities to remove

View upstream of Max Avenue: note annual grasses and other exotics and terrace/transitional zone restoration potential on southeast side of channel.

View downstream toward Max Avenue: note fills and encroachment along northwest side of floodplain, various exotic plants, and terrace/transitional zone restoration potential on southeast side.

View downstream of Max Avenue: note various grasses, exotic trees, rock riprap that could be removed, and floodplain encroachment that currently limits restoration potential.

View downstream towards Orange Avenue: note various grasses and exotic trees that could be removed, and floodplain encroachment that currently limits restoration potential.

Otay River Watershed Management Plan

Figure C.9-13

Restoration Options for the Unnamed Tributary Through Loma Verde Park

Aspen Environmental Group

View upstream on Nestor Channel near Nestor Way: note heavy infestation by exotic plants, residential encroachment on southwest side, and potential for terrace and transitional zone restoration on northeast side.

View downstream on Nestor Channel toward Coronado Boulevard: note presence of exotic plants, rock riprap, residential encroachment on southwest side, and potential for terrace and transitional zone restoration on northeast side.

View upstream on Nestor Channel toward Coronado Boulevard: note urban encroachment on east side and potential for terrace and transitional zone restoration on west side.

View downstream on Nestor Channel toward Dahlia Avenue: note urban encroachment on both sides, recent clearing of channel vegetation, and enhancement potential through debris and exotic plant removal and limitations on in-channel clearing.

Otay River Watershed Management Plan

Figure C.9-14

Enhancement and Restoration Options for Nestor Channel

Aspen Environmental Group

exotics, selectively plant natives along the banks, and limit in-stream mowing/channel clearing activities. There are similar floodplain and buffer restoration opportunities upstream of Coronado Avenue for a few hundred feet past the Hollister Street crossing (approximately 2,000 feet). There might be some enhancement opportunities upstream toward I-5, but these actions appear to be well underway in the stream reaches through the Tesoro Grove Development.

- *Palm Avenue Tributaries Near Hanson Spancrete Operation*- These ephemeral drainages originate along the north side of Palm Avenue (just east of Hollister Street) and terminate at a retention/detention basin, upstream of a spec palm nursery and the Hanson Spancrete Pacific Gavel Processing Plant (Figure C.9-15). This area is within the OVRP. If the Hanson operation and nursery can be relocated out of the Otay River floodplain, it might be possible to remove the retention/detention basin and reestablish through minor grading a stable channel cross-section and meander belt down to the Otay River. Follow-up removal of exotics and targeted native plantings would facilitate the restoration. If the Hanson operation and/or the nursery cannot be relocated, it might be possible to reestablish a channel; but it would have to be routed around these operations, which would diminish the functions and values of the restored channel.
- *Lower Poggi Canyon* – The lower part of Poggi Canyon has been impacted by channel fills, including placement of rock and concrete in the channel upstream of Main Street. This tributary drains an urbanizing area upstream, including Otay Ranch. One restoration candidate is the removal of the rock and debris, minor grading to reestablish a natural floodplain, removal of exotics, and targeted native plantings for approximately 400 feet upstream of Main Street. Upstream of this point, the stream is channelized in concrete and is surrounded by development, which limit the stream's restoration feasibility and ecosystem benefits. There might be some potential for floodplain restoration actions downstream of Main Street to its confluence with the Otay River. For approximately 1,000 feet downstream to Rancho Drive, Poggi Canyon flows through a turfed area and within an underground drain. It appears that the underground drainage system could be removed and a natural floodplain be restored through removal of exotic species (mostly turf), minor grading, and planting of native species. It also appears that the reach downstream to the confluence with the Otay River could be enhanced by removing exotic species, debris, and planting native species at select locations. These activities would provide benefits to the restored channel reaches and help filter any contaminants flowing through them from upstream development.

Potential Upper Watershed Projects:

- *Thousand Trails Pio Pico Campground* – Several restoration activities could occur along Cedar Creek and Dulzura Creek through the 180-acre campground, also known as Pio Pico. Upstream of Otay Lakes Road, the floodplain of Cedar Creek could be restored by removing RV pads adjacent to the channel, removing in-stream rock riprap, regrading the floodplain fill areas to reestablish a more natural planform, planting native species, and removing invasive, non-native plants during the follow-up maintenance and monitoring period (Figure C.9-16). Downstream of Otay Lakes Road, floodplain restoration could occur by replacing the multi-culverted dip crossing of Dulzura Creek with a railcar or similar span-type bridge, relocating the building structures outside of the floodplain on the north and south sides, removing minor fills and regrading the floodplain to a more stable planform, spot planting native species, and follow-up removal of invasive, non-native plants. Moreover, Otay Lakes Road tends to flood in the winter where Cedar Creek meets the road. A bridge could be constructed at this location to provide uninterrupted access and to remove a potential impediment to wildlife movement through this area.
- *Grazed Creek Restoration* – Several creeks in the upper watershed (e.g., including intermittent streams in the upper and central portions of Jamul Sub-Basin) are not "urban" creeks, as defined above, but they have been adversely affected by man's activity through ecologically insensitive grazing practices (Figure C.9-17). Many of these historically grazed creeks are in existing or planned preserves, and much of the grazing pressure has been removed. The channel and floodplain understory of many of these streams are beginning to recover. Activities that could assist this recovery include as-needed ripping/decompaction of the soil, minor grading to reestablish a more stable channel planform, replanting of native understory species, and follow-up invasive, non-native plant removal. As discussed in the *Otay River Watershed Special Area Management Plan Draft*

Planning Principles Report (Jones and Stokes, 2005), similar restoration opportunities exist in Lee, Lyon, Jamul, and Hollenbeck Canyon Sub-Basins.

As noted (Activities and Benefits), it is recommended that the federal and State regulatory agencies involved in preparing the SAMP be included in determining restoration priorities. The SAMP will establish an aquatic resource conservation and restoration program for this watershed, which could be partly based on restoring urban creeks.

Expected Proponents

The Watershed Council or equivalent could work with the individual jurisdictions to evaluate urban creek restoration opportunities within their respective boundaries, or they could work with them collectively to determine which would have the most benefits to the watershed, beyond their respective jurisdictional boundaries. As noted, the City of Chula Vista has been identifying urban creeks/channels in need of restoration, as well as existing developments that require implementation of measures that would improve water quality. Other jurisdictions might have done some initial evaluations in this watershed as well. As also noted, the Corps and the CDFG (and, if they choose to participate, the SDRWQCB) should also be involved in setting priorities, because urban creek restoration is expected to be an important component of the SAMP's Aquatic Resource Conservation and Restoration Program. Because of the SAMP Cooperative Agreement (signed by the County of San Diego, City of Chula Vista, City of Imperial Beach, Corps, and CDFG), there is probably not a need for a separate JEPA or similar agreement to implement this strategy.

It is expected that watershed residents would be very supportive of these efforts and could volunteer to assist in the restoration (e.g., such as planting of native species), follow-up maintenance (e.g., removal of exotic plants), and monitoring activities. The City of San Diego is currently undertaking the restoration of several tributaries of Chollas Creek, which could function as a successful regional model for urban creek restoration.

Schedule

Stream restoration, such as the examples provided above, could occur during the short- to intermediate-term. Near-term successes could galvanize stakeholder and volunteer participation and funding for future restoration projects. Larger restoration projects or those involving more effort (e.g., removal/relocation of infrastructure or significant grading) could take much longer. Evaluations of feasibility and prioritization would be followed by the logistical aspects of securing rights of entry; funding; project design; environmental review; obtaining federal, State, and local permits; restoration implementation; and maintenance and monitoring of the habitat. Regulatory agencies typically require at least five years of maintenance and monitoring for authorized restoration projects.

Maintenance and Monitoring Considerations

- The restored creek and associated habitats would require monitoring and maintenance to ensure it is successfully established and it is self-sustaining. Moreover, it is critical to ensure the restoration does not have adverse effects on downstream areas, such as unacceptable increases in sedimentation, flooding, or erosion of facilities. If such adverse effects are observed, it might be necessary to modify the restored habitat or affected areas downstream.

View downstream at Palm Avenue Tributaries: note exotic vegetation within and adjacent to the main channel and the nursery and Hanson Spancrete operations in the distance; the exotic plants could be removed, the detention basin could be removed, the channel could be reconnected downstream to the Otay River, and targeted planting of native species could occur.

View downstream toward tributary to main channel detention basin: note wetland vegetation in the detention basin is sustained by the artificial impoundment of surface waters.

View at wetland habitat in the detention basin looking back upstream toward Palm Avenue: note the dominance of bulrush and the difference in elevation between this area and the roadway.

Otay River Watershed Management Plan

Figure C.9-15

Restoration Options for the Palm Avenue Tributaries

Aspen Environmental Group

View upstream at Cedar Creek: note low-flow crossing, pedestrian bridge, rock riprap and other floodplain fills including RV pads; restoration options could include removing the fills and the creek-adjacent pads, regrading a more natural channel planform, targeted native plantings, and follow-up removal of exotic vegetation (the low-flow crossing and pedestrian bridge appear to be less of a concern at this time).

View upstream and at northern floodplain of Dulzura Creek from Pio Pico culverted crossing: note storage/parking yard in the floodplain, fills along the creek, and watermarks and deposition on and past the fence; restoration could include relocating structures out of the floodplain, replacing the culverted crossing with a span bridge, removing fills and regrading to a more natural planform, spot planting native species, and follow-up exotic species removal.

View downstream and at northern floodplain of Dulzura Creek from Pio Pico culverted crossing: note extent of water flow onto the floodplain; similar restoration options as previously described, but also remove two unsecured culverts downstream (removal of northern floodplain structures such as the kiosk appears to be less of a concern at this time).

View westward from Otay Lakes Road: note heavy flooding of the road, which slows access and can damage vehicles, and fills along the creek on both sides of the road; a bridge could be constructed at this location to ensure uninterrupted access through this area and remove or minimize a potential impediment to wildlife movement.

Otay River Watershed Management Plan

Figure C.9-16

Restoration Options for Cedar Creek and Dulzura Creek in the Pio Pico Campground

Aspen Environmental Group

View of Dulzura Creek floodplain: note flood-water storage and scattered riparian vegetation on formerly grazed land; enhancement options include removal of exotic vegetation and selected planting of native vegetation.

View of Hollenbeck Canyon Creek upstream of State Route 94: note area of bank slumping supporting new growth of riparian scrub vegetation, the area was recently rangeland but is now managed as a preserve; restoration options include minor ripping/decompaction of the floodplain, regrading of the floodplain to a more stable planform, removal of exotic vegetation, and selected planting of native species.

View upstream along ephemeral tributary to Hollenbeck Canyon Creek: this area was recently rangeland but is now managed as a preserve; potential restoration options include minor ripping/decompaction of land around the stream, regrading of the stream to a more stable planform, exotic species removal, and selected planting of native species.

Otay River Watershed Management Plan

Figure C.9-17

Enhancement and Restoration Options for Grazed Creeks

Aspen Environmental Group

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First-Order Cost

Costs for these restoration projects are expected to well exceed $100,000 each, depending on many factors, including potential land acquisition, removal/relocation of infrastructure and flood control devices, the extent of excavation and contouring and disposal of fill, the extent of the habitat to be restored and the plant materials used, the environmental review and permitting requirements, and maintenance and monitoring. It is highly likely that grant or bond money could pay for many of these activities. In addition, because the SAMP aquatic resource conservation and restoration program would likely include urban creek restoration as a component, some of the project costs could be covered under the SAMP.

Potential Funding Sources

A variety of funding sources exist for these types of projects, in addition to jurisdiction funding, such as Propositions 40 and 50, grants from the Southern California Wetlands Recovery Project Work Plan and Small Grants Programs, funding from the California Coastal Conservancy or The Nature Conservancy, and supplemental RWQCB funds. Another potential source is Section 206 of the Water Resources Development Act of 1996, as amended (P.L. 99-662), which authorizes the Corps to implement aquatic resource restoration and protection if the project would improve the quality of the environment, is in the public interest, and is cost effective. This funding source is limited to $5 million without specific authorization by Congress. As required of all Corps Civil Works projects, a non-federal co-sponsor must cost-share the project. For Section 206, the non-federal cost-share requirement is 35 percent.

C.9.2.3 Implement Comprehensive Agricultural Land Practices to Protect Aquatic Resources

Target Goals

This strategy in intended to address the following goals of the ORWMP:

Goal 1. Protect, Enhance, and Restore Watershed Resources

Goal 3. Provide Educational and Recreational Opportunities

Goal 4. Protect Public Health and Safety

Goal 5. Maximize Integration of Existing Programs and Plans that Affect the Resources of this Watershed

Activities and Benefits

Background on Agricultural Stressors

Agricultural nonpoint source pollution enters receiving waters by direct runoff to surface waters or seepage to groundwater. The nonpoint source pollutants typically associated with agriculture are nutrients, pathogens, sediments, herbicides and pesticides. Runoff of nutrients can result from excessive application of fertilizers and animal waste to land, and from improper storage of animal waste. Farming activities can cause excessive erosion, which results in sediment entering receiving waters. Improper use and over-application of herbicides and pesticides can cause water column and sediment toxicity. Improper grazing management can cause erosion, loss of vegetation, soil compaction, and excessive nutrients, all of which impair sensitive areas. Over-application of irrigation water can cause runoff of sediments and pesticides to enter surface water or seep into groundwater. Sediment, pesticides, and

excess nutrients all affect aquatic habitats by causing eutrophication, turbidity, temperature increases, toxicity, sanitary quality problems, and decreased dissolved oxygen.

The Strategy in this Watershed

The Otay River watershed has supported Western-style agriculture since non-native settlement of the region and the founding of the Missions in the 1769. Historically, agricultural activities have not been very intense, characterized by free-range cattle and crop production. Agriculture on the Otay River watershed has declined in contemporary times, and livestock is generally limited to equestrian "ranchettes" on the more rural eastern parts of the watershed. Based on field observations, livestock is usually corralled outside of streams, but there are instances where animals are kept within or immediately adjacent to streams. Currently, land use on approximately 1,741 acres (1.9 percent) of the watershed is characterized as agriculture. Agricultural activities are expected to remain at general existing scale and intensity in the foreseeable future. Because agricultural practices can directly and indirectly affect aquatic resources and there are simple sets of BMPs that can minimize adverse effects, this strategy focuses on developing several watershed-specific programs to address different agricultural operations. Many of these programs are expected to be in effect to some degree. The focus of this strategy, therefore, is to determine if there are any gaps in protection and to ensure that whatever programs are implemented are effective for protecting aquatic resources in this watershed against the various agricultural stressors.

There is a large, well-established suite of BMPs for the control of agricultural non-point source pollution. The SWRCB has identified seven specific measures for the control of agricultural non-point source pollution:

- Erosion and sediment control
- Non-CAFO Wastewater and Runoff Control
- Nutrient Management Programs
- Pesticide Management Programs
- Grazing Management Programs
- Irrigation Management Planning
- Education and Outreach

Erosion and Sediment Control

The purpose of erosion and sediment control measures is to prevent and reduce the amount of soil entering surface water. Strategies recommended for the control of rill and sheet erosion, streambank erosion, soil mass movement, and irrigation-induced erosion include:

- Leaving crop residues on the field, planting cover crops or other vegetative cover, and applying mulch to bare fields.
- Contour farming (i.e., grading fields to reduce slope length, steepness, or unsheltered distance), terraces, and/or diversions can be used to reduce slope length.
- Installation of cross-wind strips and hedgerows, trees, and shrubs along edges of fields or against prevailing winds to prevent wind erosion.
- Crop rotation (i.e., planting crops in a recurring sequence on the same field) and conservation tillage to improve soil properties and improve water infiltration.
- Installation of filter strips, field borders, fiber mats, and buffers to filter and trap sediment before it leaves the field.

- Installation of grassed waterways to prevent gullies and to filter and trap sediment.
- Installation of sediment ponds, basins, and traps to treat sediment-laden runoff.

Non-CAFO Wastewater and Runoff Control

Non-concentrated animal feeding operations (non-CAFO) are those that fall below the regulatory limits defined by the USEPA (40 CFR Parts 9, 122, 123, and 412). Smaller animal feeding operations, while not required to obtain a NPDES permit, must implement BMPs to contain wastewater and contaminated runoff from their operations. These BMPs include:

- Appropriately sized manure storage structures that store facility wastewater and contaminated runoff at all times, up to and including storms exceeding a 25-year, 24-hour frequency event.
- Protective cover from rainwater for dry manure.
- Development of a nutrient management plan, and land-apply manure and process wastewater in accordance with the plan.
- Diversion of clean water around feedlots and holding pens, animals, and manure storage facilities through the use of berms, diversions, roofs, or enclosures.
- Proper disposal of animal carcasses.
- Proper lining of waste lagoons with impermeable lining and installation of concrete pads for solid storage and animal traffic areas to prevent seepage of liquid wastes into groundwater and surface water.

Nutrient Management Programs

The development and implementation of a comprehensive nutrient management plan will reduce the nutrient loss from agricultural lands. A nutrient management plan entails a careful evaluation of field conditions and crop nutrient needs to establish a mix of nutrient sources and requirements for the crop based on realistic yield expectations. The fundamental basis of a nutrient management program is to apply nutrients as prescribed on the label with respect to timing and rate of application. The nutrient management program should also address proper maintenance, calibration, and operation of nutrient application equipment.

Pesticide and Herbicide Management Programs

The development and implementation of a comprehensive pesticide and herbicide management program will reduce or eliminate pesticide and herbicide runoff into surface water. The fundamental basis of a management program is to apply compounds as prescribed on the label with respect to timing and rate of chemical application. Integrated pest management can reduce the amount of chemicals required to manage pest damage. Pesticide and herbicide management programs also include good housekeeping measures to prevent spills, measures to protect surface waters from spills if they do happen, and proper maintenance of application equipment.

Grazing Management Programs

Grazing management programs protect sensitive areas such as streambanks, lakes, wetlands, estuaries, and riparian zones by reducing direct loadings of animal wastes and sediment. Grazing management can achieve this through several means, including:

- Carefully monitoring and manage grazing intensity, frequency, and duration.
- Installing fencing, hedgerows, or other measures to keep animals, people, and/or vehicles out of drainage courses and away from sensitive areas.

- Discouraging animals from seeking out streams by installing alternative drinking sources (e.g., water troughs) and providing shade and nutrients away from streams and sensitive areas.
- Providing stream crossings to minimize impacts on stream habitat and water quality.
- Providing improvements such as stabilized access roads, trails, and walkways that will help contain vehicular, foot, and animal traffic and limit damage to sensitive areas.

Irrigation Management Planning

Irrigation management measures help ensure that irrigation water is applied in a manner that ensures efficient use and distribution of the water and minimizes runoff and soil erosion. An irrigation management plan comprises a careful evaluation of crop water needs and the hydrologic characteristics of the soil. Irrigation facilities should control the application and timing of irrigation to minimize water runoff and soil erosion.

Education and Outreach

Education and outreach measures provide greater understanding of watersheds and increase the use of the agricultural standards and practices discussed here. Educational materials that have been developed to address the many agricultural activities and practices affecting non-point source pollution are widely available. Public education and outreach programs are most effective when they are tailored for the stakeholder group or audience they are designed to reach.

Locations

Agricultural operations are concentrated in the less urbanized parts of the watershed; particularly east, north, and south of the Otay Reservoirs.

Expected Proponents

Each jurisdiction should lead the implementation of these programs and measures on agricultural lands within their boundaries. Most of the agricultural land is in unincorporated area, so the County of San Diego Department of Agriculture Weights and Measures and County of San Diego Farm and Home Advisor would be instrumental in implementing this strategy. Also, the U.S. Department of Agriculture Natural Resource Conservation Service (NRCS) is expected to have established relationships with most if not all of the agricultural interests. These groups have in fact been working with the University of California Cooperative Extension on agriculture-related education and applied research in San Diego.

Schedule

Given that many of these programs are probably being implemented to some degree, this strategy could be implemented over the short term (within 2 years). Pamphlets could be prepared and distributed to agricultural owners (including ranchette owners) and lessees educating them about the adverse effects their activities can have and the simple BMPs they should use to protect aquatic resources. Periodic follow-up could help in reinforcing these concepts and educating new agricultural land owners/lessees over time.

Maintenance and Monitoring Considerations

This strategy would be more effective if aquatic resources in and near agricultural lands are periodically monitored to document changes. For example, it is expected that keeping livestock away from aquatic features would benefit them, but the most effective distance is unknown and could vary by location

within the watershed. Examination of infrared imagery and/or field monitoring at selected locations could allow customization of management practices to occur by location and agricultural use type.

First-Order Cost

The preparation and distribution of informational pamphlets would be a lower-cost action ($10,000 to less than $100,000). Follow-up monitoring and customization of practices would increase the cost, depending on the level of monitoring (scope and duration) and customization desired.

Potential Funding Sources

While the County and other participating jurisdictions could fund this effort, the NRCS might be able to assist in the implementation of this strategy. As noted under Expected Proponents, the NRCS typically has established relationships with the primary agricultural operators, which could increase implementation. The jurisdictions' agricultural departments or agricultural commissioners could provide this type of assistance as well. The NRCS might also be able to conduct BMP effectiveness monitoring. Other potential partners in this effort include universities (e.g., University of California Cooperative Extension) and other research institutes interested in evaluating the effects of livestock and other agricultural activities on aquatic resources. Moreover, environmental groups and volunteers might be interested in participating in the education and monitoring efforts.

C.9.2.4 Improve Existing and Create New Recreational Facilities within the Watershed

Target Goals

This strategy in intended to address the following goals of the ORWMP:

Goal 4. Provide Educational and Recreational Opportunities

Goal 5. Maximize Integration of Existing Programs and Plans that Affect the Resources of this Watershed

Activities and Benefits

The focus of this strategy is to protect sensitive resources while allowing the public access to open space for recreation. Planning guidelines are contained in the MSCP Subregional Plan and associated Subarea Plans and several local planning documents, such as the City of Chula Vista's Greenbelt Master Plan (City of Chula Vista, Revised July 2003), City of Imperial Beach's Urban Waterfront and Ecotourism Study (2005), and the Otay Ranch Resource Management Plans for Phase 1 and Phase 2 (City of Chula Vista, 1993c and 2002). Currently, safe, regularly maintained trails are limited in the Otay River watershed. In addition, safe connections to adjacent watersheds are largely absent for equestrians, bicyclists, hikers, and nature enthusiasts. However, there are multiple ongoing planning, maintenance, and land acquisition activities that are expected to implement this strategy with little additional effort as part of the ORWMP. The activities are primarily associated with the development of the OVRP by the County of San Diego, City of Chula Vista, the City of San Diego, and OVRP Advisory Bodies. As of December 2004, the OVRP Advisory Bodies had completed the *OVRP Concept Plan* (County of San Diego *et al.*, 2001), *OVRP Trail Guidelines* (County of San Diego *et al.*, 2003), the *Draft Habitat Restoration Plan for the OVRP* (County of San Diego Department of Parks and Recreation, 2005). In addition, the Draft Western Otay Valley Regional Park Natural Resource Management Plan is expected to be out for public review in 2006 (City of San Diego). The OVRP is envisioned to consist of active and passive recreational facilities, a trail system with staging areas, view

points, overlooks, and two interpretive centers for educational and environmental programs. As envisioned, the OVRP would also provide for the protection of open space within the boundaries of the MSCP, and enhancement and restoration of natural resources.

The OVRP project boundary is contained within the river valley and floodplain running west and east, but will be a critical part of the regional trail network that extends from the Bayshore Bikeway (also known as the Silver Strand Bike Trail) to the historic California Riding and Hiking trail at the eastern boundary of Lower Otay Lake (approximately 13 miles). The OVRP will also connect to existing and future trails including the Otay Mesa Residential Community to the south, the Chula Vista Greenbelt and the Otay Ranch Trail System to the north (connecting to the Sweetwater Reservoir and Sweetwater River Valley), and Eastlake and Otay Ranch trail systems to the northwest and northeast (Figures C.9-18 and C.9-19). Currently there are no official active or passive recreational areas in the OVRP other than the County-owned and operated facility at Otay Lakes. However, nature enthusiasts and equestrians utilize abandoned dirt agriculture roads and utility easements in the western portion of the OVRP, between Interstate 5 and Interstate 805. These roads are rarely maintained and have no parking, staging, or other facilities available for public use. It is estimated that approximately 32 miles of dirt trails created by people traversing the OVRP and about 24 miles of unpaved utility maintenance roads and old farm roads currently exist. Trash and transient encampment removal activities have been on-going in this reach since 1999, as planned and executed by the OVRP Citizens Advisory Committee (OVRP CAC) and volunteers.

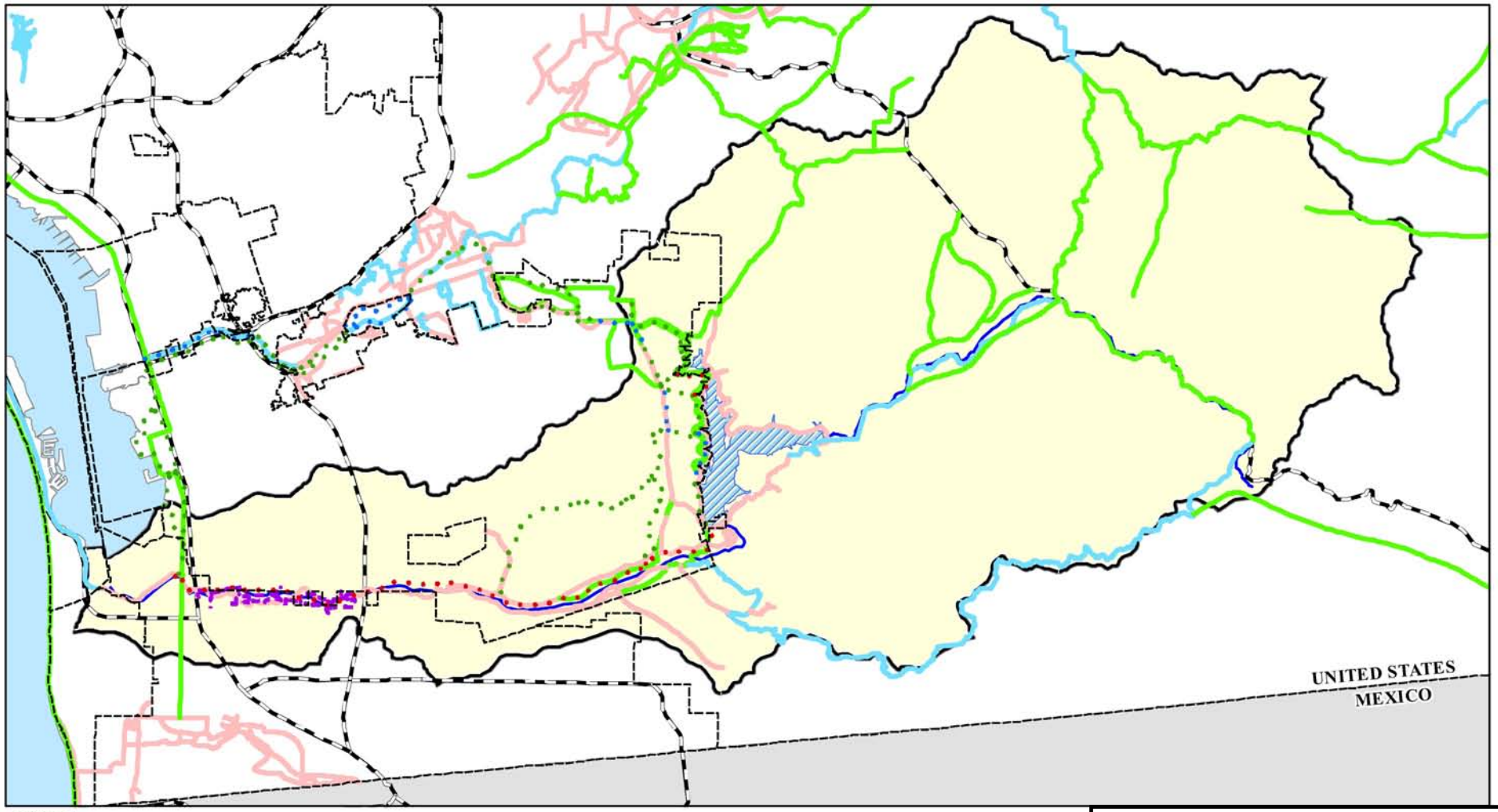
Ultimately, the OVRP is expected to include trails, staging areas, interpretive centers, and view points throughout 13 miles of the Otay River, with linkages to schools, neighborhoods, and other open space areas within the watershed. Because of its location, scope, and goals, the OVRP really serves as the cornerstone for future recreational opportunities within the Otay River watershed; however, its regional significance relies heavily on the development and maintenance of trails and recreational facilities outside of the OVRP. Maximizing the regional benefits from all the ongoing efforts will require close coordination between the local jurisdictions and open space property owners and managers. The following is a partial list of opportunities within the Otay River watershed that would create a regional trail system. Many of these opportunities are currently being planned and several are overlapping geographically.

The OVRP Trails, Staging, and Educational Facilities

The OVRP has been divided into five distinct reaches; but each reach would have a combination of staging areas, interpretive centers, viewpoints/overlooks, and biking, horseback riding, and nature trails. The OVRP CAC is one of the six current interest groups assisting in the development of the ORWMP through the Working Group meetings. Because the OVRP and other recreation facilities would also serve as outdoor educational areas, this strategy would be most efficiently implemented by coordinating efforts between environmental groups, the OVRP Advisory Bodies, and Education groups. These groups could mutually benefit by providing recreational, educational, and volunteer opportunities to one another.

The following is a partial list of recommendations that could ensure that the OVRP meets the intent of the ORWMP:

- Ensure that the implementation of the OVRP complies with the *Source Water Protection Guidelines for New Development* (City of San Diego Water Department, 2004). Although these guidelines are specific to protecting drinking water quality, it is the most recent development of BMPs for the County of San Diego.



Legend
- OVRP Trails

Chula Vista Trails
- Existing
- Future
- Proposed

County Trails
- Existing
- Planned
- Proposed

Basemap Legend
- Otay River Watershed Boundary
- City Boundary
- Streams
- Lakes

N

0 2.5 5
Scale in Miles

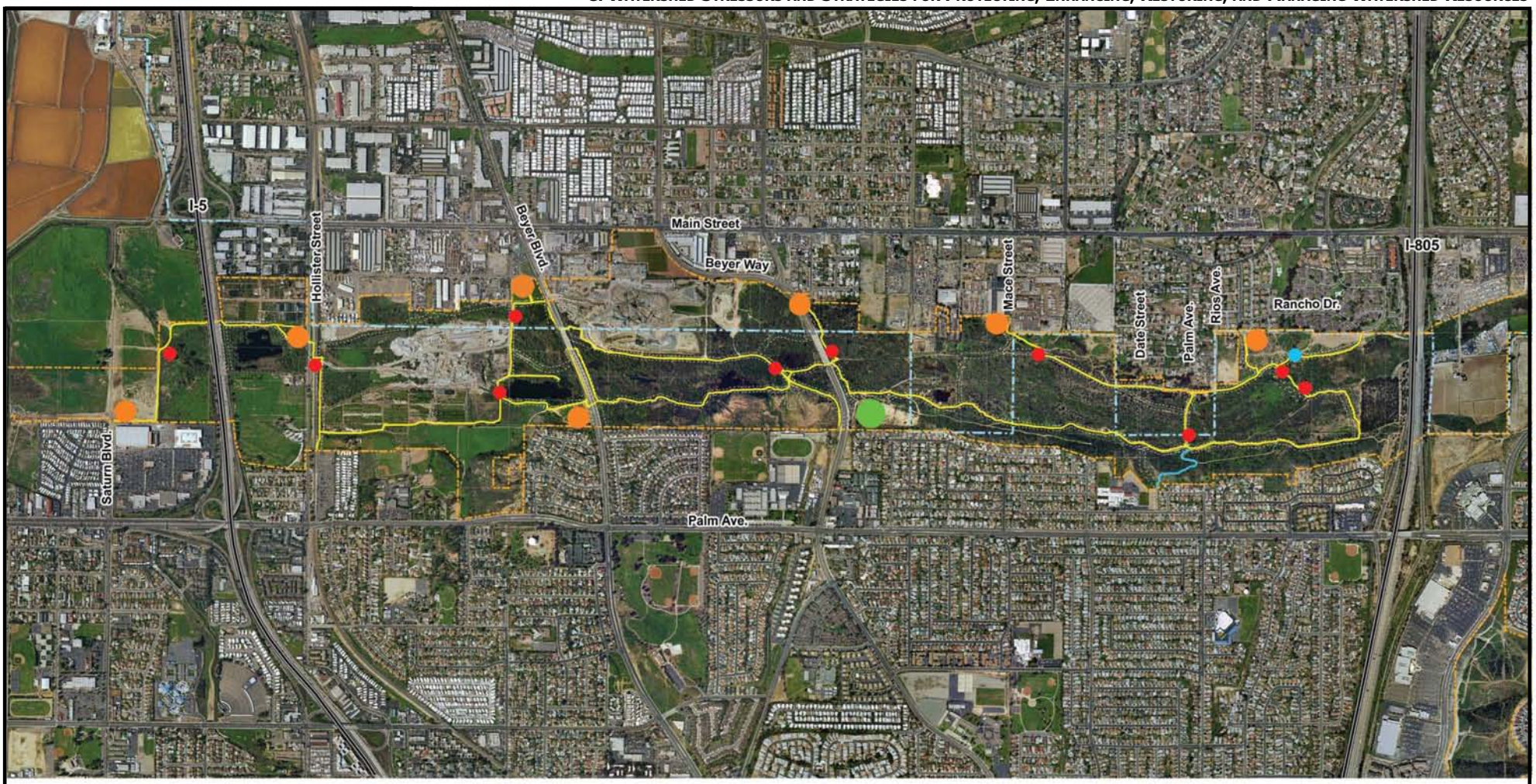
Source: TAIC, 2004

Otay River Watershed Management Plan

Figure C.9-18

Existing, Planned, and Proposed Trails

Aspen Environmental Group



LEGEND

- Culvert (10 minimum)
- Bridge (1)
- Local Staging Areas (7)
- Regional Staging Area (1)

LEGEND

- Proposed Trail
  - Type A (6'-8' wide)
  - Type C (2'-4' wide)
- Trail Below Bridge
- Municipal Boundary
- Existing Trail

N

0 0.25 0.5

Scale in Miles

Source: County of San Diego, Department of Parks and Recreation, 2005

Otay River Watershed Management Plan

Figure C.9-19

Planned Trails and Related Facilities in Western Otay Valley Regional Park

Aspen Environmental Group

- Identify existing sensitive species and habitats within the boundary of the OVRP.
- Ensure that the OVRP adequately mitigates impacts to sensitive resources through restoration and enhancement within the Otay River Valley.
  - Seasonal trail closures may be necessary to protect sensitive breeding species in spring months (any trail closures within the Western OVRP should be coordinated with the Western OVRP Senior Ranger and the Natural Resources Management staff).
- Design locations for outdoor classrooms where environmental programs can be administered to school groups and volunteers. An outdoor classroom may include a kiosk, a sitting area, trash cans, and a drinking water fountain.
- Prepare self-guided tour books so that residents can educate themselves regarding the resources in the OVRP.
- Coordinate trash removal, enhancement, restoration, and tours within the OVRP to increase awareness and stewardship in the watershed.
- Place doggie bag dispensers and trash cans along trails, at trail heads, and staging areas.

Coastal Bike Trail Connections between the OVRP, Bayshore Bikeway, and the Tijuana River Park

One key element in creating a regional trail system that connects the Otay River watershed to the adjacent Sweetwater and Tijuana River watersheds would be to create an official linkage between the existing Bayshore Bikeway on Frontage Road, located east of the San Diego Bay, and the proposed OVRP trails. A regional trail system would allow residents to take advantage of resources in adjacent areas such as the Chula Vista Nature Center and the Tijuana River Trails and Visitor Center. Currently, access from the Otay River watershed to the San Diego Bay is limited to an unofficial and unimproved path through an old agriculture property near the intersection of Frontage Road and Main Street, west of Interstate 5. The access road crosses Otay River via a culverted dip crossing that regularly floods. The trail transitions into a paved bike path, maintained by the City of San Diego along their Saturn Boulevard easement. Saturn Boulevard is never expected to be completed in this area because it is within the San Diego Bay NWR. In addition, a bike trail would remain in this general location even if the Otay River floodplain is restored by the USFWS within the limits of the NWR. The OVRP is planning a trail connection in this general area, but the details are unknown at this time.

The City of San Diego encompasses the southern boundary of the Otay River watershed, including portions of the Otay River Valley, the OVRP, and much of the Tijuana River Valley within the United States. The City of Imperial Beach encompasses the western-most portions of both the Tijuana River and the Otay River watersheds. These two cities are responsible for maintaining the Bayshore Bikeway within and adjacent to the Otay River watershed in their respective jurisdictions. The primary section of the Bayshore Bikeway is located west of the Otay River watershed as it extends from the City of Coronado on Highway 75 south to the San Diego Bay NWR. The path terminates at 13th Street, adjacent to the San Diego Bay NWR and the abandoned train tracks. The path transitions to roads along Palm Avenue and then south to Saturn Boulevard, where it continues south from the NWR to Leon Avenue, turns onto Hollister Street and again onto Monument Road in the Tijuana River Park; or trail users could transition north on Saturn Boulevard traversing the NWR along Saturn Boulevard to Main Street. The City of San Diego maintains a paved bike trail from the Otay River along their Saturn Boulevard easement; however, much of this trail is either a shared right-of-way with cars, unofficial paths, or absent from maps all together. Improvements to the coastal bike trail are currently being analyzed by SANDAG and the City of San Diego. A draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS) is currently being prepared and will include an assessment of the impacts associated with connecting the Bayshore Bikeway with the bike path along Saturn Boulevard. This

connection would likely be located through the railroad right-of-way through the San Diego Bay NWR near 13th Street. An optional route that follows the southern border of the San Diego Bay NWR is being evaluated to determine if it would reduce wildlife disturbance. This option would be located near Boundary Avenue in association with a future development (the Port property), south of Pond 20A.

It is unknown whether SANDAG is proposing improvements to Saturn Boulevard south of Leon Street or to Hollister Street in the same area. Improvement to one of these roads is important for a safe connection to Monument Road and the Tijuana River Park. The Tijuana River Park offers an extensive system of trails for hiking, biking, horseback riding, and educational opportunities, which are currently being formalized by the County of San Diego Department of Parks and Recreation (*Tijuana River Regional Park Trails and Habitat Enhancement Project*). The horse trails connect an equestrian staging area with the Pacific Ocean. Parking is available near the Visitor Center at 2310 Hollister Street. Pullouts for trailers, corrals, and picnic tables are all also available. The trails also have linkages to new baseball facilities and a new Bird and Butterfly Garden, also west of the Visitor Center. In addition, a Community Garden at the intersection of Hollister Street and Sunset Avenue provides residents a place to exercise their green thumbs.

The City of Chula Vista Greenbelt Within the Otay River Watershed

The City of Chula Vista Greenbelt is envisioned as a 28-mile continuous open space and park system and trails that encircle the City (Figure C.9-18). The Greenbelt includes the OVRP, the Sweetwater River Park, the San Diego Bayfront Redevelopment Project, and the Eastlake and Otay Ranch Trail Systems creating a regional loop system. The Greenbelt is a continuation of trails within the OVRP, extending north along Salt Creek, connecting the proposed University area and Mother Miguel Mountain and westward into Sweetwater Reservoir and Regional Park. Existing trails through the Sweetwater Regional Park extend from the Reservoir at the east end down to San Diego Bay. The City is planning a redevelopment project for 550 acres on San Diego Bay, including open space surrounding the Sweetwater Marsh and improved access to the Chula Vista Nature Center. The trail system is planned to traverse the bayfront redevelopment area south towards Otay River, connecting back with the OVRP and the Bayshore Bikeway. The Greenbelt Mater Plan was adopted by the City of Chula Vista on September 16, 2003, and it provides goals and policies, trail design standards, and implementation tools that guide the creation of the Greenbelt system of multi-use trails through open space corridors. In is important that the implementation of the Greenbelt Master Plan for the City of Chula Vista, the OVRP, and the ORWMP are closely coordinated so efforts are not duplicated and natural resources are not adversely compromised.

The California Riding and Hiking Trail

The California Riding and Hiking Trail begins at Savage Dam of Lower Otay Lake and extends along the south side of the Lake and then east past the County Park north along Otay Lakes Road. This trail has been in place for 50 years and is shown as an existing County Trail (Figure C.9-18). Maintenance and management of the trail was active, but coordinated efforts are currently lacking. From the historic trail map, it appears that the trail is actually Daley Ranch Truck Trail and traverses the Hollenbeck Canyon Wildlife Area. Part of the trail is now Otay Lakes Road. The County of San Diego is planning to replace this reach of trail, but details are unknown at this time. The trail is advertised for mountain bikes, horses, and hiking from Lower Otay Lakes to McGinty Mountain and into the CNF. The City of Chula Vista and communities in this watershed and the Sweetwater River watershed are proposing linkages to this trail. Given its regional importance, links to the OVRP, and the sensitivity of surrounding resources, implementation of this strategy should coordinate the reconnection of portions of the trail that were replaced by roads, ensure that new facilities and linkages minimize adverse

effects, prepare an environmentally sensitive maintenance and management plan, and ensure that trail users are educated about the surrounding sensitive resources and wildlife (e.g., kiosks, trail markers, signs).

Inland Otay Lakes and Tijuana River Connection

At this time, there are no inland linkages between the OVRP and the Tijuana River Park. A County trail is shown from the Otay River Valley, heading southeast partially up Johnson Canyon. A connection could be made via Otay Mesa Road near Dennery Canyon. Otay Mesa Road turns into East Beyer and then Camino De La Plaza in the Tijuana River Valley. Creating this linkage would require joint planning and agreement among the County of San Diego, the City of San Diego, and private property owners. Alternatively, a larger culvert could be installed underneath Otay Mesa Road to connect Dennery Canyon and Spring Canyon. Data indicate that the existing culvert is used by coyotes and small mountain lions. A larger culvert could accommodate passage by trail users and enhance wildlife movement, which would also assist the implementation of the high-priority strategy: Maintain, Enhance, and Restore Habitat Linkages and Wildlife Movement.

Additional Recreation Opportunities on Public and Private Lands

In addition to coordinating efforts among local jurisdictions, the recreational trail system should connect with the various open space lands in the watershed (subject to their management directives, of course), including BLM Otay Mountain Wilderness Area, the San Diego NWR, the CDFG Rancho Jamul Ecological Reserve and Hollenbeck Canyon Wildlife Area, and the CNF. The BLM Otay Mountain Wilderness Area currently has no recreational facilities; however, the Otay Truck Trail and the Minnewawa Truck Trail are open to hiking, biking, and horseback riding. BLM plans to prepare a management plan in the next 5 years for the Otay Wilderness Area and has initiated a Resource Management Plan Amendment for other public lands in the Otay River watershed and southern San Diego County. Coordination among the ORWMP Working Group, the OVRP CAC, and BLM through their development of the management plan could maximize recreation opportunities on the public lands.

Trails for passive and active recreation also exist within the CDFG Hollenbeck Canyon Wildlife Area, located approximately 5 miles east of Jamul and northeast of Lower Otay Lake and accessible via State Highway 94 (Campo Road). The 3,200-acre wildlife area provides a wildlife corridor between Otay Mountain and the Jamul Mountains. The CDFG is currently preparing a Land Management Plan expected to be completed in December 2006. Coordination among the ORWMP Working Group, the OVRP CAC, and CDFG through the development of their Land Management Plan could maximize recreation opportunities and linkages between these existing trails and the proposed OVRP and Chula Vista Greenbelt.

Although not directed solely at improving recreation, the City of Imperial Beach's Urban Waterfront and Ecotourism Study (2005) evaluated opportunities within the City for birders, cyclists, and surfers. This study identified the bayfront north of Calla Avenue and east of Highway 75 as a key development opportunity for improving birding. This portion of the City is adjacent to San Diego Bay, the San Diego Bay National Wildlife Refuge, and Pond 20. It is suggested that the City's Public Works Yard site, as well as privately owned properties, be developed as a "birding enclave" and a lodging facility directed at birders. The Bayshore Bikeway, described previously, runs adjacent to the site and provides additional recreation opportunities for birders. The future connection of the Bayshore Bikeway from Imperial Beach to Saturn Boulevard in San Diego would allow for birders to access the Chula Vista Nature Center and other interpretive opportunities proposed or contemplated for the area within and adjacent to the San Diego Bay NWR. For this to be successful, this study also recommends that the

City, the Port, and the City of San Diego renegotiate their current MOU regarding Pond 20. The MOU currently focuses on investigating the feasibility of developing Pond 20, but the Port has concluded that development is not financially feasible. The City and the USFWS believe that Pond 20 could be restored as a coastal wetland area that would provide significant benefits to wildlife and birders alike. This study also recommends obtaining ownership of several small, irregular parcels between the Public works yard and Pond 20 to create a pedestrian linkage.

Locations

The entire watershed would be targeted by this strategy, to maximize connections with other recreational facilities, but the majority of the activities would likely take place in the western portion of the watershed, between the Heritage Road and the San Diego Bay within the boundary of the OVRP and on the bayfront of the City of San Diego, City of Imperial Beach, and the City of Chula Vista.

Expected Proponents

The Watershed Council/equivalent could work with the County of San Diego, the Cities of San Diego, Chula Vista, Imperial Beach, the SDUPD, and the OVRP Advisory Bodies to implement this strategy through the continued development of the OVRP. OVRP Joint Staff and Advisory Bodies would ensure that the ORWMP complies with the adopted OVRP policy document and planning guidelines and reports.

Schedule

Development of the OVRP is ongoing. Land acquisition or acquiring easements for private properties within the OVRP could be a lengthy process. Regular coordination meetings on land acquisitions are on going with the OVRP Joint Staff and Advisory Bodies. Developing the OVRP is a long-term (more than 15 years) action depending on the location of proposed trails and the adjacent sensitive resources. Monitoring the effects of the OVRP on the natural resources and beneficial uses of the watershed is a long-term effort (more than 15 years).

Maintenance and Monitoring Considerations

There would be significant long-term maintenance and monitoring activities associated with implementing the OVRP or any other public recreational facility. Trash cans and doggie bag dispensers would likely need to be emptied and refilled on an as needed basis. Kiosks and trail guides would likely need to be monitored and repaired on a quarterly basis. Fencing, lighting, and other safety measures would also need to be monitored on an as needed basis. Trash and transient encampment removal within the OVRP should occur on an as needed basis.

Monitoring the effects of the development of recreational facilities on the natural resources and beneficial uses would be a long-term program. There is little regional information about the effects of light, noise, and pedestrians in close proximity to sensitive species while breeding and foraging or on general wildlife movement. There are also likely to be effects on water quality associated with trails and soil compaction, litter and pet waste, and regular trimming of trees and removing understory debris adjacent to trails. All of these potential impacts need to be considered when developing a long-term monitoring and maintenance program. The program must also be flexible to changes that occur in the watershed and in the regulatory environment.

First-Order Cost

The development of the trails, staging areas, and other facilities associated with the OVRP will cost several million dollars. Maintaining and monitoring the OVRP facilities would likely be more than $100,000, but less than $1 million, on an annual basis.

Potential Funding Sources

There are numerous grants that are designed specifically for recreation, and others for maintenance and monitoring (Appendix 5). Planning and developing trail facilities could be funded by California Department of Parks and Recreation through the Habitat Conservation Fund, the Land and Water Conservation Fund Program, and the Recreational Trails Program. The outdoor classroom facilities could qualify as environmental youth service centers and be funded by the Murray-Hayden Urban Parks and Youth Services Program. Kiosks and other interpretive facilities (sign posts, self-guided tour markings, etc.) could be funded by the Per Capita Grant Program, The Eastman Kodak Company Kodak American Greenways Award Program. Designing activities and coordinating community restoration groups could be funded by NOAA-Office of Habitat Conservation Community-Based Restoration Program and Wetlands Recovery Project Small Grants Program. There are also programs to maintain trails and greenways, such as the Rivers, Trails & Conservation Assistance Program through the National Parks Service. Finally, because many of the monitoring, enhancement, and restoration activities associated with the OVRP are directly and indirectly related to improving water quality, Propositions 40 and 50 could be a large contributor to the long-term effectiveness of this strategy.

C.9.2.5 Manage Tecate Cypress Forest and Oak Woodlands

Target Goals

This strategy in intended to address the following goals of the ORWMP:

Goal 1. Protect, Enhance, and Restore Watershed Resources

Goal 5. Maximize Integration of Existing Programs and Plans that Affect the Resources of this Watershed

Activities and Benefits

This strategy is intended to help facilitate the management of Tecate cypress (*Cupressus forbesii*) forest and oak woodlands and their associated resources (e.g., the Thorne's hairstreak butterfly) in the Otay River watershed. Management includes monitoring, enhancement, or restoration. The MSCP and other preserves are protecting or will protect large areas of Tecate cypress forest and oak woodland (Figure C.9-20). Considering existing and planned preserves, 100 percent of the Tecate cypress forest will be protected (97 percent existing preserves, 3 percent planned preserves) and approximately 24 percent of oak woodlands are protected in existing preserves with another 26 percent in the County's Pre-Approved Mitigation Areas. As discussed below, additional protection is afforded by State and local requirements. Because the MSCP (as implemented by the jurisdictions' MSCP Subarea Plans) includes monitoring, there should be close coordination to determine what is being accomplished under the MSCP and any additional activities that would occur under Tecate cypress forest and oak tree management programs.

The majority of the Tecate cypress forest in Otay River watershed occurs within the BLM Otay Mountain Wilderness Area and will not be impacted by future developments. Also, the Tecate cypress is an MSCP-covered species. While the species is nearly 100 percent preserved in this watershed, a management plan has not been developed to ensure its long-term persistence and health. However, an ongoing monitoring program by the U.S. Fish and Wildlife Service includes surveys for the Thorne's hairstreak, a butterfly directly associated with Tecate cypress. Careful management of Tecate cypress is particularly important at this time because this species is sensitive to fire frequency. Fire facilitates the propagation of this species by opening its cones and releasing seed. However, sufficient time (approximately 40 years, according to Esser, 1994) is required between fires to produce a sufficient cone crop; otherwise, the community can be extirpated. The fires of 1996 and 2003 affected the majority of the Tecate cypress in this watershed (Figures B.1-5 and C.9-20), and additional fires in the next 40 years could be devastating to this species.

There is some state-wide oak-specific protection. If development would affect oak woodland, mitigation might be required under CEQA, as specified in Section 21083.4 of the Public Resources Code (Conversion of Oak Woodlands). However, judgments of significance and appropriate mitigation can vary greatly depending on the county agency involved. The Oak Woodlands Conservation Act, Senate Bill 1334 (formerly SB 711) is intended to protect California's remaining oak forests. Senate Bill 1334 requires counties to include provisions for replacing oaks or restoring oak habitat, unless oak protection is covered elsewhere (e.g., through Habitat Conservation Plans such as the MSCP). The bill provides several ways this might be accomplished, including restoration of oak woodlands, purchasing conservation easements, or contribution to the Oak Woodlands Conservation Fund. The nexus for this bill to take effect is through CEQA.

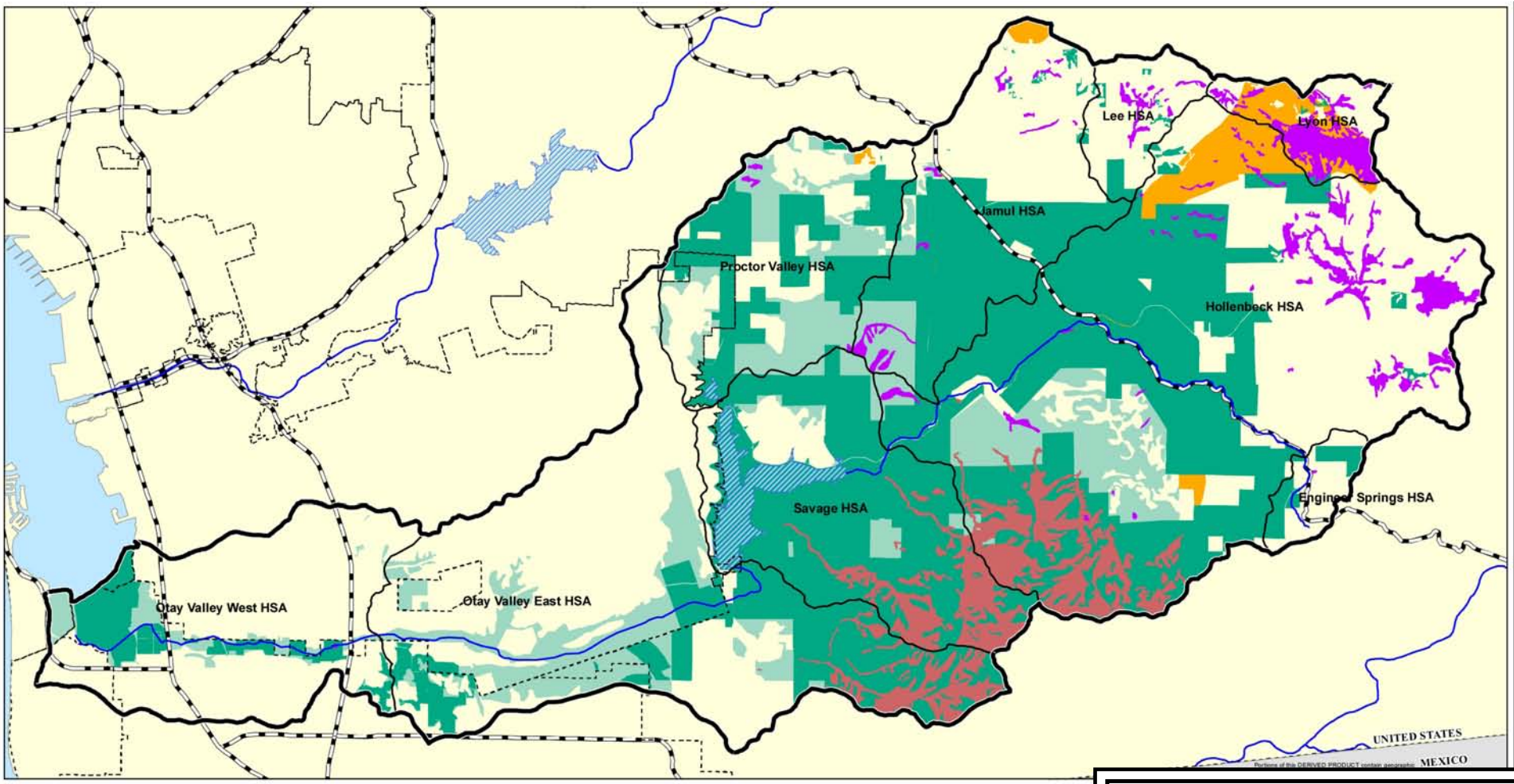
Protection of oak woodlands really falls to county and city governments, with several (e.g., Riverside and Los Angeles Counties) developing oak tree ordinances. None of the jurisdictions within the Otay River watershed have specific oak tree or oak protection ordinances. However, the County covers oaks in combination with riparian oak woodlands through their Resources Protection Ordinance (RPO), and all jurisdictions include this vegetation type in their MSCP Subarea Plans and the MSCP's Multiple Habitat Planning Area (MHPA). The County implements their MSCP Subarea Plan in the unincorporated areas via their Biological Mitigation Ordinance (BMO).

As described below, there are great concerns about whether oak trees are sustainably reproducing in California, particularly in areas that have been grazed and are now recovering. Without monitoring and long-term management, the concern is that even protected oak woodlands would be replaced by annual grasslands or another community.

This strategy, if implemented, could aid in closing these potential gaps in Tecate cypress forest and oak tree management. What follows is a brief description of these communities as well as approaches to managing them:

Tecate Cypress

The Tecate cypress is a small evergreen tree with forked trunks and irregular, spreading crowns (Stuart and Sawyer, 2001). Trees are typically less than 9 meters tall. The bark exfoliates, exposing mottled inner bark that is often cherry red. This is a rare cypress that is known from coastal chaparral communities in the Santa Ana Mountains in Orange County south into Baja California. Tecate cypress is a CNPS List 1B species and is considered rare. The most extensive population known to date is within the BLM's Otay Mountain Wilderness Area. This species appears to be restricted to elevations



Legend
Preserve Status
- Acquired Preserve
- Planned Preserve
- County Pre-Approved Mitigation Area

Woodland Types
- Tecate Cypress Forest
- Oak Woodland

Basemap Legend
- Otay River Watershed Boundary
- Hydrologic Subbasin
- City Boundary
- Rivers
- Lakes

0 2.5 5
Scale in Miles

N

Source: TAIC, 2005

Otay River Watershed Management Plan

Figure C.9-20
Preserve Status with Tecate Cypress Forest and Oak Woodland

Aspen Environmental Group

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between 300 to 2,500 meters. It is adapted to fire with serotinous seed cones that open after a fire. As noted, Tecate cypress are vulnerable to fire frequency because this species requires approximately 40 years to produce a sufficient cone crop. This species grows quickly in the first few years and is often planted in well-drained soil as wind breaks.

The Thorne's hairstreak butterfly (*Callophrys thornei*) is a federal Species of Special Concern known only from five populations within the San Ysidro Mountains (also known as the Otay Mountains). The species is dependent on the Tecate cypress as its host plant. This species, formally a candidate or proposed for federal listing on the endangered species list, holds no federal status, but is a covered species under the MSCP. Approximately 56 percent of the Tecate cypress forest burned in 2003, causing this species to be vulnerable to extinction (Center for Biological Diversity, 2005). According to California Department of Forestry and U.S. Forest Service records, approximately 58 fires have burned through and near Tecate cypress forest on Otay Mountain over the last century. This number greatly exceeds pre-European settlement fire frequency in southern California chaparral ecosystems. Because of the frequent burns, a fire management plan is critical for the survival of both the Tecate cypress forest and this species of butterfly.

Other wildlife that are potentially dependent on the Tecate cypress include rodents and deer, which feed on cypress seedlings, and the San Diego coast horned lizard, for which Tecate cypress forest is considered prime habitat.

The following items could be implemented to help facilitate the protection and management of the Tecate cypress forest:

- Retain qualified biologists to conduct a detailed survey of the remaining Tecate cypress forest within the Otay River watershed and the likely historic distribution (including mapping the entire vegetation community and individual trees by size, quality, and location). The majority of this community is within the BLM's Otay Mountain Wilderness Area.
- Assist BLM in developing a long-term management plan for the Tecate cypress forest. Key management objectives should include the following:
  - Develop fire management strategies and protocols to limit human-induced fires.
  - Determine if restoration actions are necessary. These could include collecting viable cones, propagating them in a nursery, and transplanting in recently or historically occupied areas.
  - Develop strict guidelines for recreational activities, particularly off-road vehicle and camping use that could create a fire hazard.
  - Develop education materials for local residents and wilderness users regarding this critical habitat community.
  - Improve coordination between the U.S. Border Patrol and the BLM to restrict access, and to improve response time for fires.
  - Explore opportunities to work with international resource groups and agencies to manage these communities within the Otay River watershed and the adjacent Tijuana River watershed.

Oaks

Two oak trees of primary concern occur in this watershed. These are the coast live oak (*Quercus agrifolia*) and the Engelmann oak (*Quercus engelmannii*). The coast live oak occurs in woodlands with grassland, sage scrub, and to a lesser extent, in chaparrals, from Mendocino County to Baja California, Mexico. These trees require deep, well-drained soils, often on lower slopes in riparian areas and are

shade tolerant. This species can live more than 250 years and is fire resistant due to its thick bark and sprouting ability. Engelmann oak is restricted in range to coastal southern California south to Baja California, Mexico. This species is a CNPS List 2 species due to its limited distribution and proximity to growing urban centers (Dunning *et al.*, 2002). This species grows in woodlands on dry foothill slopes and mesas in well-drained soil, but is also often found in clay soils. Engelmann oaks can live at least 350 years, but are less fire tolerant than coast live oaks. Coast live oak and Engelmann oak are often found growing in woodlands together in San Diego County.

Oak woodlands historically occurred with native bunch grassland and coastal sage scrub, presumably because of the open ground spaces between the perennial bunch grasses and shrubs, as well as the slow growing and non-competitive nature of these communities (McCreary, 2001). Although it is widely thought that oak woodland in southern California is relatively abundant and stable, problems with reproduction in both the coast live oak and the Engelmann oak are apparent (Sierra Club, 2005; Camping *et al.*, 2002). This is most likely due to the loss of native bunchgrass and overgrazing by cattle, which compacts soil, lowers soil quality and fertility (Camping *et al.*, 2002), increases competition with annual grasses for resources, and allows for consumption of oak seedlings. There is great concern that natural regeneration of oak woodlands is not sufficient to sustain populations. This concern could also be true for mature oak woodlands proposed for preservation within the MHPA and other preserve areas; without long-term management, the community could slowly convert to annual grassland.

The following steps should be implemented under the County of San Diego MSCP Subarea Plan (and other jurisdictions' Subarea Plans, if appropriate) to help facilitate the management of oak woodlands:

- Retain qualified biologists to conduct a detailed mapping study of the historic and current extent of oak woodlands within the Otay River watershed portion of the MHPA and other preserve areas.
- Evaluate the reproductive capacity of oak woodlands within the MSCP and other preserve areas.
  - Determine if oaks within the MSCP and other preserve areas are reproducing following the removal of disturbance activities such as ranching and grazing. Natural regeneration of the community is critical to the long-term persistence and health of the woodland being preserved.
  - The evaluation should answer the following questions at a minimum:
    - Are oak seedlings and saplings present?
    - Is there age structure within the community or are all the oak trees over 100 years old? Limited age structure would indicate that there has been little propagation since the time settlers began removing native grassland, sage scrub, chaparral, and oak woodlands for grazing and other activities.
    - Are acorns viable or are they compromised by insects or disease?
    - What species occur in the understory of the oak woodlands? Removing annual grassland and restoring native grassland would likely help to increase oak regeneration by restoring soil quality and fertility and decreasing soil compaction and species competition. Also, because oak woodlands in the watershed are often associated with perennial streams and tributaries, surface water volume and quality may also be an issue in maintaining quality and quantity of riparian oak woodlands.
- Prepare a long-term restoration program for areas that the evaluation determines lack regeneration or areas of historic occupancy. Suitable restoration candidates could occur in preserved areas that were formerly in ranching or agriculture. The following is a short and incomplete summary of restoration steps necessary for oak woodland restoration taken from *Small-Scale Planting of Engelmann Oak Trees* (St. John and Scott, 1997).
  - Site preparation: The soil should be moist from winter rain at the time of planting. If winter rain is not available (i.e., drought year), artificial watering to a depth of two or three feet could be suitable.

- Planting techniques: Planting must occur during the fall or winter when the soil is wet and cool. If planting is to occur more than a few feet from an established oak tree canopy, a tablespoon or so of soil should be obtained from below an established oak and added below each acorn when planting. Each acorn should be placed in a shallow depression and covered with two inches of soil.
- Protect the oak seedlings from herbivores and direct sunlight by enclosing them in a cylinder of aluminum window screen, ¼" hardware cloth, or ½" poultry netting. Bury the cylinder six inches below the ground and extend one foot above ground.
- Do not install irrigation and do not fertilize.

Locations

The locations of Tecate cypress and oak communities are shown in Figure C.9-20. It should be noted, however, that these data are part of a 1993 regional data set used in developing the MSCP; so they might not be comprehensive or completely accurate. According to these data, all of the Tecate cypress forest in this watershed occurs in the Otay Valley East, Savage, and Hollenbeck Sub-Basins. Oak woodlands occur in Proctor Valley, Jamul, Lee, Lyon, Hollenbeck, and Engineer Springs Sub-Basins.

Expected Proponents

According to the vegetation map, the Tecate cypress forest and oak woodland occur entirely within County jurisdiction. If this is accurate, the County of San Diego would be the most appropriate lead for managing these communities. If either occurs within city jurisdiction or within an area that could be incorporated (e.g., City of Chula Vista), it would be beneficial for that jurisdiction to be involved as well. Moreover, the County should work in cooperation with open space landowners and managers, such as the BLM, CDFG, USFWS, and private preserve owners and managers within the watershed while developing a monitoring and management plan for either community. These land owners/managers might have updated maps and might be implementing some management measures already that could be incorporated.

Schedule

The County of San Diego and other MSCP participants have been acquiring and preserving lands that support Tecate cypress forest and oak woodlands. Determining the health of the communities preserved can begin immediately following land acquisition. Development and implementation of comprehensive management programs for the Tecate cypress forest and oak woodlands within the MSCP and other preserve areas would be a long-term endeavor. The BLM anticipates completing such a plan for Tecate cypress in the next five years. Given the recent fires and the risk to this species from additional fires, the County should work with the BLM as soon as possible to develop and implement this plan.

Maintenance and Monitoring Considerations

Regular monitoring would be required to evaluate the effectiveness of the Tecate cypress forest and oak woodlands conservation efforts within the preserve areas. Monitoring would show whether changes should be made in either management program to maximize conservation efforts.

First-Order Cost

Administrative costs associated with assisting the BLM in assessing the status of the Tecate cypress forest and in developing a management plan for the community would likely be on the order of $100,000, assuming it takes 5 years to develop a program. Mapping and evaluating the reproductive capacity of oak woodlands in the preserve areas could also cost approximately $100,000. Costs

associated with enhancement or restoration activities and follow-up maintenance and monitoring of Tecate cypress forest or oak woodlands within the MSCP and other preserve areas would probably range from $50,000-$75,000 per acre.

Potential Funding Sources

There are many sources of funding available to prepare management plans and implement restoration projects. Grant (e.g., The Conservation Fund's American Land Conservation) and bond money (Propositions 40 and 50) are available. Also, counties may use a grant awarded pursuant to the Oak Woodlands Conservation Act (Article 3.5 [commencing with Section 1360) of Chapter 4 of Division 2 of the Fish and Game Code]) to prepare an oak woodlands management plan that meets the requirements of the Act.

C.9.2.6 Achieve Consistency in Regulations in Conjunction with the Special Area Management Plan

This strategy is intended to address the following goals of the ORWMP:

Target Goals

Goal 1. Protect, Enhance, and Restore Watershed Resources

Goal 2. Ensure Reasonable, Sustainable, and Compatible Economic Development

Goal 4. Ensure Public Health and Safety

Goal 5. Maximize Integration of Existing Programs and Plans that Affect the Resources of this Watershed

Activities and Benefits

This document proposes a variety of strategies intended to protect, enhance, and restore aquatic resources in consideration of existing and planned economic development and other uses. The companion SAMP is focusing on developing abbreviated permitting mechanisms for specific aquatic habitat impact types and locations as well as establishing an aquatic resource conservation and restoration program in this watershed. It is expected that the SAMP will require a variety of protection, enhancement, and restoration measures similar to several of the strategies recommended under the ORWMP (e.g., Strategies C.9.1.1, C.9.1.3, C.9.1.4, C.9.2.1, and C.9.2.2). In effect, implementation of the recommended ORWMP strategies would facilitate consistency with the ultimate SAMP requirements. Similarly, approval of the SAMP would benefit the watershed by implementing measures some of which are similar to the ORWMP strategies intended to achieve this document's goals. To maximize the benefits of both planning efforts on this watershed, it is important for each to recognize the functions and needs of the other and to support the implementation of the other plan.

While each plan has independent utility, both plans are important for shaping the future of the Otay River watershed. For example, the SAMP is examining the full range of effects (direct, indirect, and cumulative) to aquatic habitat to ensure no net loss of aquatic habitat functions and values. This comprehensive investigation of effects and coordinated approach to aquatic resource conservation and restoration are critical to the integrity of the watershed. The ORWMP considers these data as they become available but lacks the regulatory force to ensure that no net loss of aquatic habitat functions and values is achieved. The ORWMP also addresses a broader geographic scope (i.e., upland and aquatic resources) and considers other issues (e.g., providing recreation). Furthermore, because the

SAMP would directly change land use requirements, it more specifically examines and considers the various land use plans (e.g., General Plans, Specific Plans, MSCP) to identify and address potential inconsistencies and gaps and effectively build upon existing criteria. As a programmatic advisory document, the gap analysis in the ORWMP is less specific and detailed. However, it is important that more specific analysis does ultimately occur, to ensure the most efficient and effective implementation of additional measures in the watershed. Therefore, proponents of the ORWMP need to recognize the critical and complementary nature of the SAMP as a key vehicle for comprehensively addressing aquatic habitat in this watershed and its assistance in realizing the ORWMP's goals, such as integrating existing programs and plans.

Locations

This strategy would apply to the entire watershed, which is considered by both the ORWMP and SAMP.

Expected Proponents

All ORWMP proponents should actively support completion and implementation of the SAMP. The Working Group or Watershed Council should work with the individual jurisdictions, the Corps, and the CDFG. In addition, there should be particular focus on involving the San Diego Regional Water Quality Control Board, given their Clean Water Act Section 401 authority.

The County of San Diego, City of Chula Vista, City of Imperial Beach, and the Corps have signed a Cooperative Agreement (dated May 24, 2004) specifiying roles and responsibilities in developing the SAMP. The City of San Diego has also indicated they intend to participate in developing the SAMP.

Schedule

There has already been substantial progress on preparing key SAMP products, such as the Corps' planning-level jurisdictional delineation and assessment of riparian ecosystem integrity reports, as well as the purpose and need statement. Working Group members should continue to participate in regularly scheduled meetings and review SAMP products. Assuming a Watershed Council or equivalent is formed, this body should continue to track SAMP progress and actively support its completion and implementation. The individual jurisdictions, the Corps, and the CDFG, who have been developing SAMP products for approximately 3 years, should continue to work collaboratively, and to pursue the San Diego Regional Water Quality Control Board's participation. It is anticipated that the SAMP process could conclude in approximately 2 years, but logistical and funding limitations could further delay the process.

Maintenance and Monitoring Considerations

The proponents should ensure that the SAMP-development process continues on the agreed-upon schedule. Currently, it is anticipated that the SAMP can be completed in approximately 2 years. Slippage on milestone dates should be noted, the schedule revised accordingly, and the SAMP-development participants (particularly the agencies) notified as potential delays are identified.

First-Order Cost

It is anticipated that the agency participants will continue to meet to discuss SAMP-development progress until the SAMP is completed and approved (i.e., currently estimated at 2 years). SAMP-

development costs for each agency participant range from less than $100,000 to a few hundred thousand dollars (totaling approximately $1 million for the local jurisdictions).

Potential Funding Sources

The Cooperative Agreement participants have been funding their participation and the preparation of the SAMP products to date, and this is expected to continue. It is unlikely there are other sources of funding available, and that continued SAMP progress would continue to be funded by the Cooperative Agreement participants.

C.9.3 Low-Priority Strategies for Watershed Protection, Enhancement, Restoration, and Management

The following strategies, in no particular order, are considered low priority for this watershed because they are opportunistic in nature and there are other planning efforts or regulatory mechanisms expected to benefit the targeted resources:

- Preserve, Enhance, and Restore Additional Floodplain Parcels in the Otay River Watershed
- Protect, Enhance, and Restore Cultural Resources

C.9.3.1 Preserve, Enhance, and Restore Additional Floodplain Parcels Within the Otay River Watershed

Target Goals

This strategy in intended to address the following goals of the ORWMP:

Goal 1. Protect, Enhance, and Restore Watershed Resources

Goal 4. Protect Public Health and Safety

Activities and Benefits

This strategy is intended to capitalize on *opportunities* to purchase (from willing sellers) or secure conservation easements over floodplain parcels in the Otay River watershed, in addition to any parcel purchases or interests obtained as part of implementing the other strategies presented in this document. For example, the OVRP Joint Staff and Advisory Staff have prepared plans for parcel acquisition in the OVRP boundaries, but many other opportunities could become available along the Otay River outside of the OVRP or along other tributaries in this watershed. Land or property interest acquisition is expensive, particularly in the coastal areas of southern California. Enhancing or restoring natural resources on these parcels or demolishing structures or infrastructure would increase this cost. These activities might also require coordination with FEMA for a LOMR/CLOMR, in addition to other federal, State, and local approvals (similar to the high-priority strategy: Restore the Lower Otay River Floodplain to Enhance the Quality of Water Entering San Diego Bay). There are also uncertainties regarding properties that can be obtained or what property interests are available. For these reasons, this strategy is not considered a high or medium priority at this time. Nevertheless, acquisitions of properties or recordation of conservation easements along floodplains for conservation protects these sensitive areas from urbanization and provides additional buffers for streams from direct and indirect effects. This conservation protects habitats and species dependent on these streams, the quality of the receiving waters, as well as other resources, such as cultural and historical properties. Acquiring or otherwise protecting floodplains also maintains flood water storage capacity in the watershed.

Locations

This type of land interest acquisition could occur anywhere along the streams in this watershed, primarily within the 100-year floodplain but could include transitional or upland buffer habitats as well. An example is property currently used for storage on both sides of the lower Otay River immediately upstream of I-805. There appears to be a river crossing at this location as well. The floodplain is noticeably narrower compared to reaches upstream and downstream of this location.

Expected Proponents

The Working Group or Watershed Council should work with the jurisdictions, NRCS, and the Greater San Diego Resource Conservation District to identify potential parcels that are available. There might be parcels that regularly flood or suffer erosion, and their owners might be interested in selling or sharing management responsibilities. There might also be parcels of strategic interest along the Otay River or one of the main creeks (e.g., Jamul Creek, Dulzura Creek, Salt Creek). The group can then work together, perhaps with fluvial geomorphologists, restoration ecologists, or similar experts, to prioritize the list of available floodplain parcels. Prioritization should consider the costs (e.g., land acquisition or conservation easement, demolition or relocation of structures or infrastructure, enhancement or restoration planning, project design and specifications, environmental review [CEQA and NEPA] and permits[federal, State, local], implementation of habitat enhancement or restoration activities, habitat maintenance and monitoring, and long-term land management) and the benefits (e.g., net gain in functions and values, increases in habitat types and species, protection of cultural resources, aesthetic improvements, increase in water storage/flood protection, water quality improvements).

Schedule

It is possible that some parcels could be acquired in the short term (within 2 years), but this strategy is expected to be ongoing, as more is learned about the watershed and additional parcels become available. Based on monitoring activities in this watershed, floodplain acquisition as a strategy might increase in priority.

Maintenance and Monitoring Considerations

Acquired parcels or areas protected by conservation easements would need to be periodically monitored, to ensure dumping or other harmful activities are not occurring on these parcels. If parcels are enhanced or restored, maintenance and monitoring would be necessary to ensure the habitat is successful in meeting performance standards and success criteria. Many of these activities could be performed by trained volunteers, or by a conservation entity, particularly if parcels are turned over to such an entity for long-term management.

First-Order Cost

Property acquisition costs vary based on many factors. Most acquisitions are expected to cost several hundred thousand dollars, but could exceed $1 million. Costs associated with enhancement or restoration activities and follow-up maintenance and monitoring for a 5-year period would probably range from and average of $30,000-$80,000 per acre. There would also be longer-term maintenance, monitoring, and land management costs. As noted under Activities and Benefits, this is an opportunistic strategy; there is not an identified need, but protection and improvements of floodplain parcels could benefit the watershed. Therefore, the costs of implementing this strategy would depend on what potential opportunities are acted upon, which are unknown at this time.

Potential Funding Sources

There are many sources of funding available to acquire floodplain properties. Grant (e.g., The Conservation Fund's American Land Conservation Award, Wetland Recovery Project Work Plan, and Small Grants Programs) and bond money (Propositions 40 and 50) are available. The SDRWQCB could also provide funding. In some cases, jurisdictions might determine that it makes fiscal sense (e.g., regular flooding or erosion) to acquire floodplain properties.

C.9.3.2 Protect, Enhance, and Restore Cultural Resources

Target Goals

This strategy in intended to address the following goal of the ORWMP:

Goal 1. Protect, Enhance, and Restore Watershed Resources

Activities and Benefits

This strategy is intended to capitalize on *opportunities* for protecting, enhancing, or restoring cultural resources in the watershed. There are a variety of cultural/historical resources in this watershed, which is not surprising given that people have occupied parts of this watershed for the last 9,000 years. Resources include isolated artifacts, lithic scatter artifacts, temporary camps, habitation sites, historic buildings, and historic trash deposits. Several historical sites were identified in Section B.2.2. These include the following: Barrett House, circa 1890, central Jamul; La Follet House, circa 1895, off Jefferson; Rock House, circa 1895, on Hillside Drive; Jamul School House; Lawson Valley School in Lee Valley; Schnell house, west of intersection of Lawson Valley Road and Skyline Truck Trail; Bratton House, circa 1900, Deerhorn Valley Road; Wats House, Mother Grundy Truck Trail; Jamul Rancho building site east of Pio Pico Park; Plumers House, circa 1915, north of Dulzura Café; Dulzura Café, circa 1900; Clark Ranch, rebuilt 1900, on Dulzura Creek; Hagenback House, near Forestry Station; Schekler House, east of Highway 94 at Marron Valley Road; and the Winnetka Ranch House.

Many cultural resources are protected within the preserves established by the MSCP and various other resource and land-use plans and programs in this watershed. In addition, many cultural resources are associated with aquatic resource areas, which are afforded federal, State, and local protection. There are also local ordinances (e.g., County's RPO) and other local and State requirements (e.g., Otay Ranch RMP protects and enhances natural and cultural resources in the Otay Ranch Preserve) specifically focused on protecting these sensitive resources. The companion Otay River watershed SAMP process includes the identification and protection of many of the cultural resources in this watershed. In fact, as part of the SAMP-development process, the Corps and the County of San Diego are currently developing a map of known cultural resource locations in this watershed. This map will assist the completion of the Section 106 consultation process (pursuant to the National Historic Preservation Act of 1966) with the State Historic Preservation Officer. Therefore, efforts solely focused on protecting or enhancing/restoring cultural resources are not considered a high or medium priority for the ORWMP at this time. Rather, there might be instances where culture resource protection or enhancement/restoration opportunities become available in the watershed. These opportunities should be seriously considered, particularly if they would also protect natural resources.

Locations

Cultural resources occur throughout the watershed. As discussed, the County of San Diego and the Corps are currently preparing a map of known resource locations, which will assist the Corps in

satisfying their Section 106 (National Historic Preservation Act) responsibilities as part of the SAMP. Typically, maps of cultural resources are not made available to the public to limit the potential for vandalism or destruction of these sensitive resources.

Expected Proponents

The Working Group or Watershed Council should work with local historical societies/groups to identify cultural or historical resources of interest. They can then prioritize the list of resources that should be protected and which ones could be enhanced or restored. Prioritization should be based on consideration of all the costs and benefits anticipated with each potential project.

Schedule

Cultural resource protection, enhancement, and/or restoration could occur at any time. Timeframes could be lengthened if property acquisition or conservation easements are necessary.

Maintenance and Monitoring Considerations

In some cases, such as buried resources, follow-up monitoring would not be necessary. For exposed resources, such as buildings, some level of ongoing maintenance and monitoring would be required.

First-Order Cost

The main costs associated with this strategy would be expected to be property or easement acquisitions and on-going maintenance and monitoring activities. Acquisition costs would depend on many factors, but could be well in excess of $100,000. As noted under Activities and Benefits, this is a strategy simply focused on identifying and acting upon opportunities to protect or enhancing cultural resources. Therefore, the costs of implementing this strategy would depend on what potential opportunities are acted upon, which are unknown at this time.

Potential Funding Sources

There are fewer opportunities for grant and bond money to protect and enhance cultural resources. In many cases, benefactors fund these activities, or local preservation groups provide or raise the necessary funds. Nevertheless, the new California Cultural and Historical Endowment Board recently awarded more than $35 million in grant funding to 33 State projects. This Board used money from Proposition 40, a $2.6 billion bond measure that includes $276 million for acquisition, development, and preservation of culturally and/or historically significant properties, structures, and artifacts. Half of the total allotment went to projects specified in Proposition 40, but the rest is being distributed by the Board. More of the remaining funds will be awarded in two cycles starting next year.

C.9.4 Strategy Summary and Implementation Strategy

The recommended strategies are individually described and initially prioritized in Sections C.9.1 to C.9.3. Table C.9-2 summarizes key information for each of these strategies to assist decision-makers in comparing and evaluating their merits and determining whether they should be implemented.

Table C.9-2 Strategy Summary

Strategy	Primary Component(s)	Location/ Scale	Proponents	Schedule	M&M Considerations	Implementa-tion Cost	M&M Cost	Baseline Survey/ Update Needed	Building on Existing Program/Plan/Effort
C.9.1.1 - Eradicate Non-Native Flora and Fauna and Prevent Reinfestation and New Introductions	Implement and complete removal/control activities	Watershed	Watershed Council/Equivalent, Jurisdictions, SDUPD, Preserve Owners/ Managers, RCD, Resource and Regulatory Agencies, NGOs, Consultants	>5 years	Follow-up removal and remedial actions	$5 million - $60 million	Included in implementation cost	Yes	OVRP Habitat Restoration and Non-Native Plant Removal, Otay Ranch RMP, Rancho Jamul Reserve, MSCP
	Prepare and distribute educational materials	Watershed	Watershed Council/Equivalent, Jurisdictions, SDUPD, Preserve Owners/ Managers, Resource and Regulatory Agencies, RCD, NGOs, Consultants	≤2 years	Follow-up education	<$100,000 initial	<$10,000 annually	No	MSCP, Otay Ranch RMP, SDUPD, Project Clean Water
	Prepare and adopt prohibited plant list	Watershed	Watershed Council/Equivalent, Jurisdictions, SDUPD, Preserve Owners/ Managers, Resource and Regulatory Agencies, RCD, NGOs for the list; Jurisdictions for adoption	≤2 years	Update list every 3 years or as-needed	<$10,000 for list; adoption cost unknown (internal)	Unknown (internal)	No	Update Project Review Processes As-Needed
	Discourage nurseries within and adjacent to watershed from selling plants on prohibited list	Otay River Watershed and Adjacent Watersheds	Watershed Council/Equivalent, Jurisdictions, SDUPD, Preserve Owners/Managers, Resource and Regulatory Agencies, RCD, NGOs, Volunteers	≤2 years	Send new letters as list is updated or new nurseries open	<$10,000	<$10,000 for each additional mailing	No	No
C.9.1.2 - Maintain, Enhance, and Restore Habitat Linkages and Wildlife Movement	Undertake projects and actions to protect, enhance, restore, and manage habitat linkages and wildlife movement	Watershed and Adjacent Watersheds	Watershed Council/Equivalent, Jurisdictions, SDUPD, Preserve Owners/Managers, Resource Agencies, NGOs, Regional Experts, Consultants	>5 years	Conduct monitoring and land management	Varies - up to $200,000 per acre	Included in implementation cost	Yes	Otay Ranch RMP, MSCP, CBI Data
C.9.1.3 - Restore the Lower Otay River Floodplain	Restore self-sustaining habitat mosaic along the lower river	Below Savage Dam, particularly west of I-805	Watershed Council/Equivalent, Jurisdictions, SDUPD, USFWS NWR, Other Resource and Regulatory Agencies, OVRP Advisory Bodies, NGOs, Consultants	>5 years	Follow-up exotics removal, replanting, land alterations, land management	Varies - up to $200,000 per acre	Included in implementation cost	Yes	San Diego INRMP, San Diego Bay NWR CCP, OVRP Restoration
C.9.1.4 - Implement Setbacks or Buffers Around Aquatic Resources	Develop a watershed-focused plan identifying appropriate setbacks or buffers by location and land use type	All watershed aquatic resources	Jurisdictions, Resource and Regulatory Agencies, Preserve Owners/Managers, NGOs, Consultants	≤2 years	None at this stage - there will be field work to evaluate the effectiveness of currently implemented buffer criteria	Up to $100,000	None	Yes	Municipal Permit, SUSMPs, Otay Ranch RMP, MSCP, Jurisdiction Criteria and Ordinances

Strategy	Primary Component(s)	Location/ Scale	Proponents	Schedule	M&M Considerations	Implementa-tion Cost	M&M Cost	Baseline Survey/ Update Needed	Building on Existing Program/Plan/Effort
	Adopt and implement the buffer criteria agreed to by the jurisdictions and others in the collaborative plan	All watershed aquatic resources	Jurisdictions	≤2 years	Monitoring to evaluate effectiveness at protecting aquatic resources and making distance adjustments as-necessary	Unknown (internal)	<$100,000 annually	No	Jurisdiction Criteria and Ordinances
C.9.1.5 - Limit Future and Remove Existing Trash and Debris	Develop and implement a watershed-wide program for removing trash and debris and limiting future introductions	Watershed	Watershed Council/Equivalent, Jurisdictions, Preserve Owners/Managers, OVRP Advisory Bodies, NGOs, Volunteers, Consultants	3-5 years	Follow-up removal, maintenance of treatment BMPs, changes in BMPs implemented	>$10,000 annually; could exceed $1 million with structural BMPs	Varies	Yes	OVRP Advisory Body Efforts, Jurisdiction ordinances
	Prepare and distribute educational materials	Watershed	Watershed Council/Equivalent, Jurisdictions, Preserve Owners/Managers, OVRP Advisory Bodies, NGOs, Volunteers	≤2years	Follow-up education	<$10,000 initial	<$1,000 annually	No	OVRP Advisory Body Efforts
C.9.1.6 - Protect Drinking Water Quality in the Reservoirs	Adopt City of San Diego Water Department's *Source Water Protection Guidelines for New Development*	All of upper watershed draining into Upper and Lower Otay Reservoirs	County of San Diego, City of San Diego, City of Chula Vista	≤2 years	Follow-up monitoring to confirm if reservoir water quality is being protected; changes to the guidelines and adoption of changes to ensure water quality protection	Unknown (internal)	<$100,000 annually (monitoring)	No	City of San Diego Water Department's Guidelines (Municipal Permit and SUSMP considered in developing these Guidelines)
C.9.1.7 - Limit Impervious Surface Area	Conduct additional research to more accurately determine percent impervious cover (connected and not connected to surface waters) for each Hydrologic Sub-Area	Watershed	Jurisdictions, NGOs, Consultants	≤2 years	No	<$100,000	NA	Yes	County of San Diego DPLU Watershed Protection Program's research on the San Diego River Watershed
	Develop impervious cover limitations program	Watershed	Jurisdictions, NGOs, Consultants	≤2 years	No	$100,000	$100,000	No	County of San Diego DPLU Watershed Protection Program's research on the San Diego River Watershed

Strategy	Primary Component(s)	Location/ Scale	Proponents	Schedule	M&M Considerations	Implementa-tion Cost	M&M Cost	Baseline Survey/ Update Needed	Building on Existing Program/Plan/Effort
	Adopt and implement impervious cover limitations program	Watershed	Jurisdictions	3-5 years	Monitoring to determine whether restrictions are adequately protecting resources, and make changes as-needed	Unknown (internal)	<$100,000 annually (monitoring)	No	None
C.9.1.8 - Implement a Watershed-Wide Education Program	Reach out to stakeholders to participate in ORWMP development and updates	Watershed	County of San Diego, Watershed Council/Equivalent	≤2 years	No, except watershed-wide notification of future meetings	<$10,000	Included in implementation cost	No	ORWMP and SAMP Working Group
	Integrate and coordinate programs	Regional, State, and National	Watershed Council/Equivalent, Jurisdictions, Preserve Owners/Managers, NGOs, Volunteers	≤2 years	Periodic research to identify new programs	<$10,000	Included in implementation cost	No	MSCP, Project Clean Water, CREEC, USEPA Adopt Your Watershed, USFWS Education for Conservation and San Diego NWR, Eelink, San Diego Natural History Museum
	Develop and distribute educational materials	Regional, State	Watershed Council/Equivalent, Jurisdictions, Preserve Owners/Managers, NGOs, Volunteers, Consultants	≤2years	Periodic research and updates to materials	<$100,000	<$10,000 annually	No	Living Lightly in Our Watersheds, A Guide for Residents of the Malibu Creek Watershed and Adjoining Watersheds, Project Clean Water
	Implement active education program - train educators; coordinate watershed tours; involve community in stewardship/beneficial activities; host educational workshops; ensure jurisdictions implement environmentally friendly practices; implement environmentally beneficial development requirements	Watershed	Watershed Council/Equivalent, Jurisdictions, Preserve Owners/Managers, NGOs, Volunteers	≤2 years	Research and updates to approaches and materials, as-needed updates to development requirements	<$100,000	<$10,000 annually	No	Project Clean Water, MSCP

Strategy	Primary Component(s)	Location/ Scale	Proponents	Schedule	M&M Considerations	Implementa-tion Cost	M&M Cost	Baseline Survey/ Update Needed	Building on Existing Program/Plan/Effort
C.9.1.9 - Form a Watershed Council to Implement the ORWMP	Establish and regularly convene a Watershed Council or equivalent decision-making body to update/revise the ORWMP	Watershed and Region	Existing Working Group, Executive Committee, Policy Committee, Jurisdictions	≤2 years	Change council members, meeting protocol	<$10,000	<$10,000 annually	No	Project Clean Water, Regional Watershed Councils
C.9.2.1 - Retrofit Existing Developments to Protect Aquatic Resources	Identify practicable changes to existing developments that could improve aquatic resource (habitat and species) protection	Watershed - focus should be near preserve areas initially but other opportunities should also be explored	Watershed Council/Equivalent, Jurisdictions, Regulatory and Resource Agencies, Consultants	≤2 years	None at this stage. There will be field work to evaluate whether particular changes would improve aquatic resource protection	<$100,000	None	Yes	Jurisdictions
	Implement practicable additions or modifications as-necessary (non-structural or structural) to increase protection of aquatic resources	Watershed - focus should be near preserve areas initially but other opportunities should also be explored	Watershed Council/Equivalent, Jurisdictions, Consultants/ Contractors	>3 years	Monitoring will be necessary to determine whether additional changes are needed; inspections and maintenance required for structural BMPs	Varies	<$100,000 annually (monitoring); maintenance costs will depend on number and types of BMPs	No	Jurisdictions
C.9.2.2 - Restore Urban Creeks	Identify and prioritize urban creek restoration activities and projects	Watershed - focus west of Savage Dam but also look for opportunities east	Watershed Council/Equivalent, Jurisdictions, Resource and Regulatory Agencies, Consultants	≤2 years	No	<$100,000	None	Yes	Jurisdictions
	Implement urban creek restoration activities and projects	Watershed - focus west of Savage Dam but also look for opportunities east	Watershed Council/Equivalent, Jurisdictions, Resource and Regulatory Agencies, Consultants	Varies	Maintenance and monitoring of restored habitat (for success and to ensure no adverse effects downstream or to adjacent areas) - minimum of 5 years required by regulatory agencies	>$100,000 per project	<$10,000 per acre annually	No	Jurisdictions
C.9.2.3 - Implement Agricultural Land BMPs to Protect Aquatic	Develop and implement or build upon seven types of programs, as follows:	Primarily east of Savage Dam	Jurisdictions and NRCS	≤2 years	Monitoring of effectiveness of programs/measures/ BMPs and changes as-needed	<$100,000	<$100,000 annually	Yes	NRCS, Agricultural Department programs, Municipal Permit, SUSMP, Jurisdiction ordinances

Strategy	Primary Component(s)	Location/ Scale	Proponents	Schedule	M&M Considerations	Implementa-tion Cost	M&M Cost	Baseline Survey/ Update Needed	Building on Existing Program/Plan/Effort
Resources	Erosion and sediment control	Primarily east of Savage Dam	Jurisdictions and NRCS	≤2 years	Monitoring of effectiveness of programs/measures/ BMPs and changes as-needed	<$10,000	<$10,000 annually	Yes	NRCS, Agricultural Department programs, Municipal Permit, SUSMP, Jurisdiction ordinances
	Non-CAFO wastewater and runoff control	Primarily east of Savage Dam	Jurisdictions and NRCS	≤2 years	Monitoring of effectiveness of programs/measures/ BMPs and changes as-needed	<$10,000	<$10,000 annually	Yes	NRCS, Agricultural Department programs, Municipal Permit, SUSMP, Jurisdiction ordinances
	Nutrient management programs	Primarily east of Savage Dam	Jurisdictions and NRCS	≤2 years	Monitoring of effectiveness of programs/measures/ BMPs and changes as-needed	<$10,000	<$10,000 annually	Yes	NRCS, Agricultural Department programs, Municipal Permit, SUSMP, Jurisdiction ordinances
	Pesticide and herbicide management programs	Primarily east of Savage Dam	Jurisdictions and NRCS	≤2 years	Monitoring of effectiveness of programs/measures/ BMPs and changes as-needed	<$10,000	<$10,000 annually	Yes	NRCS, Agricultural Department programs, Municipal Permit, SUSMP, Jurisdiction ordinances
	Grazing management programs	Primarily east of Savage Dam	Jurisdictions and NRCS	≤2 years	Monitoring of effectiveness of programs/measures/ BMPs and changes as-needed	<$10,000	<$10,000 annually	Yes	NRCS, Agricultural Department programs, Municipal Permit, SUSMP, Jurisdiction ordinances
	Irrigation management measures	Primarily east of Savage Dam	Jurisdictions and NRCS	≤2 years	Monitoring of effectiveness of programs/measures/ BMPs and changes as-needed	<$10,000	<$10,000 annually	Yes	NRCS, Agricultural Department programs, Municipal Permit, SUSMP, Jurisdiction ordinances
	Education and outreach	Primarily east of Savage Dam	Jurisdictions and NRCS	≤2 years	Monitoring of effectiveness of programs/measures/ BMPs and changes as-needed	<$10,000	<$10,000 annually	Yes	NRCS, Agricultural Departments, Project Clean Water

Strategy	Primary Component(s)	Location/ Scale	Proponents	Schedule	M&M Considerations	Implementa-tion Cost	M&M Cost	Baseline Survey/ Update Needed	Building on Existing Program/Plan/Effort
C.9.2.4 - Improve Existing and Create New Recreational Facilities	OVRP trails, staging, and educational facilities	Surrounding Otay Reservoirs and westward	OVRP Advisory Bodies, Jurisdictions, Watershed Council/Equivalent, School District, NGOs	>5 years	Monitoring of effects of new recreational facilities, maintenance of facilities	>$1 million initial	<$100,000 annually	Yes	OVRP, Project Clean Water, MSCP Outreach and Education
	Coastal Bike Trail connections between the OVRP, Bayshore Bikeway, and Tijuana River Park	Surrounding Otay Reservoirs and westward	OVRP Advisory Bodies, Jurisdictions, Watershed Council/Equivalent, SANDAG, USFWS, CDFG, Salt Works, Private Landowners	≤2 years	Monitoring of effects of new recreational facilities, maintenance of facilities	<$1 million initial	<$100,000 annually	Yes	OVRP, Project Clean Water, MSCP Outreach and Education
	City of Chula Vista Greenbelt within the Otay River watershed	Portion of the City of Chula Vista in the Otay River Watershed	OVRP Advisory Bodies, Jurisdictions, Watershed Council/Equivalent	≥3years	Monitoring of effects of new recreational facilities, maintenance of facilities	<$1 million initial	<$100,000 annually	Yes	OVRP, Project Clean Water, MSCP Outreach and Education
	California Riding and Hiking Trail	From Otay Lakes eastward	OVRP Advisory Bodies, Jurisdictions, Watershed Council/Equivalent, USFS, BLM, Private landowners	≥3years	Monitoring of effects of new recreational facilities, maintenance of facilities	<$1 million initial	<$100,000 annually	Yes	OVRP, Project Clean Water, MSCP Outreach and Education
	Inland Otay Lakes and Tijuana River Connection	Otay River Watershed-Tijuana River Watershed	OVRP Advisory Bodies, Jurisdictions, Watershed Council/Equivalent	≥3years	Monitoring of effects of new recreational facilities, maintenance of facilities	<$1million initial	<$100,000 annually	Yes	OVRP, Project Clean Water, MSCP Outreach and Education
	Additional recreational opportunities on public and private lands	Watershed	OVRP Advisory Bodies, Jurisdictions, Watershed Council/Equivalent, USFS, BLM, Private landowners.	≥3years	Monitoring of effects of new recreational facilities, maintenance of facilities	<$1 million initial	<$100,000 annually	Yes	OVRP, Project Clean Water, MSCP Outreach and Education

Strategy	Primary Component(s)	Location/ Scale	Proponents	Schedule	M&M Considerations	Implementa-tion Cost	M&M Cost	Baseline Survey/ Update Needed	Building on Existing Program/Plan/Effort
C.9.2.5 - Manage Tecate Cypress Forest and Oak Woodlands	Develop and implement Tecate Cypress Forest management plan	Primarily southeast and east of Lower Otay Reservoir	County of San Diego, BLM, USFWS, CDFG, Consultants	≥3 years	Monitoring of Tecate Cypress Forest persistence, vigor, and recovery	<$100,000 initial	<$10,000 per acre annually	Yes	BLM South Coast Resource Management Plan and Otay Wilderness Plan
	Retain qualified biologists to map existing and historic extent of Oak Woodlands within the MHPA and other preserve areas and evaluate whether the community is reproducing or regenerating	Primarily on unincorporated County lands east of Otay Reservoirs	County of San Diego, City of Chula Vista, USFWS, CDFG, Consultants	≤2 years	No, unless initial evaluation determines additional study/monitoring warranted	<$100,000 initial	No, or <$10,000 per acre annually if initial evaluation determines additional study/monitoring warranted	Yes	MSCP, Otay Ranch RMP, County and City ordinances, CEQA, regional experts
	Develop and implement a long-term oak restoration and/or management program	Primarily on unincorporated County lands east of Otay Reservoirs	County of San Diego, City of Chula Vista, USFWS, CDFG	>5 years	Long-term monitoring of the health of the vegetation community, managing any restoration actions	<$100,000 (program) <$75,000 per acre (restoration)	<$10,000 per acre annually	Yes	MSCP, Otay Ranch RMP, Senate Bill 1334, CEQA, regional experts
C.9.2.6 – Achieve Consistency in Regulations in Conjunction with the SAMP	Actively support completion and implementation of the SAMP as a complementary and essential watershed plan	Otay River Watershed	Watershed Council/Equivalent, Jurisdictions, Resource and Regulatory Agencies	≤2 years	Monitor SAMP-development schedule	<$1 million	Not Applicable	No	OtayRiver Watershed Management Plan, continued Working Group participation
C.9.3.1 - Preserve, Enhance, Restore Additional Floodplain Parcels Within the Otay River Watershed	Opportunistically identify floodplain parcels for acquisition and enhancement or restoration	Otay River and its tributaries	Watershed Council/Equivalent, Jurisdictions, RCD, NRCS, Resource and Regulatory Agencies, NGOs, Consultants	Varies	Maintenance and monitoring of enhanced or restored property; land management	Varies, but expected to >$1 million for most acquisitions; $30,000-$80,000 per acre for enhancement or restoration	Included in implementation cost; also land management costs	Yes, as potential properties are being considered	Discussions with jurisdictions flood control and land use departments

Strategy	Primary Component(s)	Location/ Scale	Proponents	Schedule	M&M Considerations	Implementa-tion Cost	M&M Cost	Baseline Survey/ Update Needed	Building on Existing Program/Plan/Effort
C.9.3.2 - Preserve, Enhance, Restore Cultural Resources	Opportunistically identify cultural resources to preserve and enhance or restore	Watershed	Watershed Council/Equivalent, Jurisdictions, NGOs	Varies	Monitoring and management of enhanced or restored cultural resources	Varies, but expected to >$100,000 for most acquisitions	Varies	Yes, as potential cultural resources are being considered	Otay River watershed SAMP, local historical societies

Implementation Strategy

While Sections C.9.1 to C.9.3 and Tables C.9-1 and C.9-2 offer an initial prioritization of these strategies, stakeholders and decision-makers could determine that priorities should be changed (individual strategies or actions/steps of individual strategies). Important factors to consider in prioritizing strategies and actions include:

- Strategy or action efficiencies considering benefits and impediments
- Available funds
- Return on investment of those funds
- Time requirements and other non-financial needs
- Ability to complete the action
- Opportunity for early successes that could motivate future action
- The need for pre-cursor actions to complete long-term actions
- Regulatory obligations can facilitate actions or divert resources
- Partnering might be essential to effectively accomplish some actions
- The impact of the strategy on the ability of the jurisdiction to implement other community development goals including provision of housing, employment, and local and regional infrastructure
- The level of protection, enhancement, or restoration afforded by existing regulations, plans, programs, and permits

It is important that decision-makers remain flexible, opportunistic, and goal-oriented in the sequence and approach they take in implementing whichever strategies or steps/actions of particular strategies they choose. For example, funding or access limitations or disagreements among decision-makers could delay full implementation of particular strategies or their components.

One jurisdiction could determine that a particular strategy should not be implemented or that it should be implemented differently than it would be by other jurisdictions with an interest in the watershed. The effect of non-participation or differential implementation would depend on several factors, including the strategy at issue, the location and size of watershed lands controlled by the jurisdiction not participating or implementing the strategy differently, and whether that jurisdiction is already implementing measures that provide some level of benefit targeted by the strategy (e.g., setback or buffer criteria).

In these cases, even partial implementation could be beneficial to the watershed, or perhaps another strategy or action/step should be moved up from a lower priority; at least until the impediment or disagreement is resolved. In contrast, the implementation of another plan, program, or permit related to one of strategies could accelerate the implementation of that strategy. One example is the County of San Diego Department of Parks and Recreation's efforts focused on eradicating non-native plant species in the OVRP; this could serve as a key pilot project for implementing Strategy C.9.1.1 (Eradicate Non-Native Flora and Fauna and Prevent Reinfestation and New Introductions). While this strategy has been initially identified as a high-priority strategy, it would be expensive and logistically difficult to implement watershed-wide. Nevertheless, successful implementation of a related project within the OVRP could galvanize the community and agencies to take early action on this broader strategy.

Table C.9-3 provides a recommended schedule for implementing the 17 recommended strategies, by their primary components and more specific actions/steps. It also includes potential proponents/responsible parties, recommended start dates, and action/step duration expected. In reality,

the proponents/responsible parties would become clearer as strategies are advanced to the implementation phase. Also, recommended start dates are based on the initial prioritization, with high-priority strategies recommended for early action (January 2006) and medium-priority strategies recommended for later initiation (January 2008). The low-priority strategies are opportunistic in nature, so there is no start date given. As noted, factors such as the availability and requirements of funding sources could warrant reprioritization. Even if priorities or start dates change, the duration timeframes and other information provided in this table should assist decision-makers in moving forward with strategies in a logical and effective manner.

Table C.9-3 Strategy Schedule

Strategy	Primary Component(s)	Steps/Actions	Proponents/ Responsible Parties	Target Start Date	Duration	Notes
C.9.1.1 - Eradicate Non-Native Flora and Fauna and Prevent Reinfestation and New Introductions	Implement removal/control activities	Compile a baseline inventory of non-native species and prioritize response needs	Watershed Council/Equivalent, Jurisdictions, SDUPD, Preserve Owners/ Managers, RCD, Resource and Regulatory Agencies, NGOs, Consultants	1/1/2006	4-6 months	Data on non-native species are lacking except for OVRP (plants only) and the Rancho Jamul Ecological Reserve. Collected data should be input into the watershed GIS for tracking and evaluation over time.
		Develop a systematic eradication plan/program with eradication methods, measures of short-term and long-term progress and success, potential remedial actions, controls for limiting new introductions or reintroductions, outreach strategies, and funding programs	Watershed Council/Equivalent, Jurisdictions, SDUPD, Preserve Owners/ Managers, RCD, Resource and Regulatory Agencies, NGOs, Consultants	6/1/2006	6-9 months	Methods could vary greatly by species, location in the watershed, timing, and other factors. Initial work on this could begin before the first step is complete.
		Secure necessary access	Watershed Council/Equivalent, Jurisdictions, SDUPD, Preserve Owners/ Managers, RCD, Resource and Regulatory Agencies, NGOs	6/1/2006	6-12 months; ongoing	Access limitations can greatly diminish the scope and effectiveness of the program; so efforts on this step should begin as soon as possible (as the scope of non-native species infestation becomes known).
		Obtain needed funding	Watershed Council/Equivalent, Jurisdictions, SDUPD, Preserve Owners/ Managers, RCD, Resource and Regulatory Agencies, NGOs	6/1/2006	6-18 months; ongoing	Funding limitations can greatly diminish the scope and effectiveness of the program; so efforts on this step should begin as soon as possible.

Strategy	Primary Component(s)	Steps/Actions	Proponents/ Responsible Parties	Target Start Date	Duration	Notes
		Complete environmental documentation and obtain necessary permits	Watershed Council/Equivalent, Jurisdictions, Preserve Owners/Managers, RCD, Resource and Regulatory Agencies, NGOs, Consultants	6/1/2006	6-30 months	Pilot projects (e.g., proposed habitat restoration and non-native plant removal in the OVRP - County of San Diego Department of Parks and Recreation, 2005) to increase support and/or perfect techniques could receive authorizations sooner than a larger program.
		Implement Comprehensive Non-Native Species Eradication Program	Watershed Council/Equivalent, Jurisdictions, SDUPD, Preserve Owners/ Managers, RCD, Resource and Regulatory Agencies, NGOs, Volunteers, Contractors	1/1/2008	ongoing	Pilot projects (e.g., the proposed habitat restoration and non-native plant removal in the OVRP - County of San Diego Department of Parks and Recreation, 2005) to increase support/participation and to perfect techniques in this area could begin sooner.
	Prepare and distribute educational materials	Prepare and distribute a free pamphlet or guidebook to watershed residents of plants prohibited or to avoid in landscaping	Watershed Council/Equivalent, Jurisdictions, SDUPD, Preserve Owners/ Managers, Resource and Regulatory Agencies, RCD, NGOs, Consultants	6/1/2006	2-3 months for initial materials; ongoing	Use information from the baseline survey and the CalEPPC List A; a guidebook would take longer to prepare and would be more expensive to distribute.
	Prepare and adopt prohibited plant list in plan review processes	Prepare prohibited plan list based on baseline survey and CalEPPC List A, and update project review processes	Watershed Council/Equivalent, Jurisdictions, SDUPD, Preserve Owners/ Managers, Resource and Regulatory Agencies, RCD, NGOs for the list; Jurisdictions for adoptions	6/1/2006	2-3 months to prepare list; 6-12 months for adoption; ongoing updates	This would require substantial coordination among jurisdictions, and critical for jurisdictions to abide by this list as well.
	Discourage nurseries within and adjacent to watershed from selling plants on the prohibited list	Identify and visit/send letters to nurseries in this watershed and adjacent watersheds discouraging them from selling species on the prohibited plant list	Watershed Council/Equivalent, Jurisdictions, SDUPD, Preserve Owners/Managers, Resource and Regulatory Agencies, RCD, NGOs, Volunteers	9/1/06 for initial list	2-3 months; ongoing/ periodic dialogue	In most cases, enforcement is not likely; education and jurisdictional pressure are more realistic goals.

Strategy	Primary Component(s)	Steps/Actions	Proponents/ Responsible Parties	Target Start Date	Duration	Notes
C.9.1.2 - Maintain, Enhance, and Restore Habitat Linkages and Wildlife Movement	Undertake activities and projects to protect, enhance, restore habitat linkages and wildlife movement	Retain experts to compile baseline inventory of habitat linkages and wildlife use for the entire watershed using existing inventories and publications	Watershed Council/Equivalent, Jurisdictions, SDUPD, Resource Agencies, NGOs, Regional Experts	1/1/2006	3-6 months	Range of options from acquisition of properties or conservation easements, agreements with existing land owners to manage properties to encourage wildlife movement, and/or enhancement or restoration activities to improve movement.
		Have experts evaluate current linkages and prioritize linkages for protection or improvements	Watershed Council/Equivalent, Jurisdictions, SDUPD, Preserve Owners/Managers, Resource Agencies, NGOs, Regional Experts	5/1/2006	6-12 months	Some field work and studies are expected. Note that unwilling property owners or funding limitations could require reprioritization of activities or projects.
		Develop protection, enhancement, and restoration protocols for conserving and improving the various linkages	Watershed Council/Equivalent, Jurisdictions, SDUPD, Preserve Owners/Managers, Resource Agencies, NGOs, Regional Experts, Consultants	1/1/2007	6-9 months	Some of the work on these protocols can begin before the prioritization process is complete.
		Secure necessary access	Watershed Council/Equivalent, Jurisdictions, SDUPD, Preserve Owners/Managers, Resource Agencies, NGOs, Volunteers, Consultants	1/1/2007	0-12 months; ongoing	Some of this work can occur during the prioritization process, and access problems could require reprioritization. Access problems could limit the scope of wildlife movement protection and improvements; so this work should occur as soon as possible. Access might not be necessary in some cases.
		Obtain needed funding	Watershed Council/Equivalent, Jurisdictions, SDUPD, Preserve Owners/Managers, Resource Agencies, NGOs, Volunteers, Consultants	1/1/2007	6-18 months; ongoing	Some of this work can occur during the prioritization process, and funding problems could require reprioritization. Funding problems could limit the scope of wildlife movement protection and improvements; so this work should occur as soon as possible.

Strategy	Primary Component(s)	Steps/Actions	Proponents/ Responsible Parties	Target Start Date	Duration	Notes
		Complete environmental documentation and obtain necessary permits	Watershed Council/Equivalent, Jurisdictions, SDUPD, Resource Agencies, NGOs, Consultants	9/1/2007	0-12 months; ongoing	Activities focused on acquisition or agreements with land owners might not require environmental documentation or permits, while those involving physical or biological changes (e.g., removal of exotics or structures, planting of natives) would in most cases.
		As needed, prepare project design and specifications	Watershed Council/Equivalent, Jurisdictions, SDUPD, Resource Agencies, NGOs, Consultants	9/1/2007	3-6 months; ongoing	This could be necessary for some enhancement or restoration activities (e.g., installation of culverts intended to facilitate wildlife passage).
		Implement Wildlife Movement Protection and Improvement Activities and Projects	Watershed Council/Equivalent, Jurisdictions, SDUPD, Preserve Owners/Managers, Resource Agencies, NGOs, Volunteers, Contractors	1/1/2007	ongoing	As noted, there could be a variety of activities and projects, some of which could occur within a few months of prioritization, while those involving physical or biological changes could take much longer (typically >5 years considering follow-up maintenance and monitoring) to complete.
C.9.1.3 - Restore the Lower Otay River Floodplain	Restore self-sustaining habitat mosaic along the lower river	Retain experts to evaluate restoration opportunities and constraints	Watershed Council/Equivalent, Jurisdictions, SDUPD, USFWS NWR, Other Resource and Regulatory Agencies, OVRP Advisory Bodies, NGOs, Consultants	1/1/2006	3-4 months	It would be important to understand clearly what other restoration activities are already occurring or in the planning stages (e.g., OVRP, San Diego Bay NWR) as well as other activities or project planned for these areas.
		Have the experts prioritize restoration activities and projects in coordination with the various jurisdictions and agencies.	Watershed Council/Equivalent, Jurisdictions, SDUPD, USFWS NWR, Other Resource and Regulatory Agencies, OVRP Advisory Bodies, NGOs, Consultants	4/1/2006	3-6 months	Need to coordinate closely with USFWS NWR, OVRP Advisory Bodies, local flood control districts, FEMA, Corps, and CDFG.

Strategy	Primary Component(s)	Steps/Actions	Proponents/ Responsible Parties	Target Start Date	Duration	Notes
		Secure necessary access	Watershed Council/Equivalent, Jurisdictions, SDUPD, USFWS NWR, OVRP Advisory Bodies, NGOs	7/1/2006	3-6 months for access (USFWS and OVRP have made progress)	Unwilling property owners could require reprioritization. Access limitations could limit the scope of the restoration activities; so work on this step should occur as soon as possible (as priorities emerge).
		Obtain any needed funding	Watershed Council/Equivalent, Jurisdictions, SDUPD, USFWS NWR, OVRP Advisory Bodies, NGOs	7/1/2006	6-18 months for access (USFWS and OVRP have made progress); ongoing	Funding problems would limit the scope of the restoration activities; so work on this step should occur as soon as possible (as priorities emerge).
		Prepare formal restoration plans, including project designs and specifications	Watershed Council/Equivalent, Jurisdictions, SDUPD, USFWS NWR, Other Resource and Regulatory Agencies, NGOs, Consultants	1/1/2007	6-12 months; ongoing	Some work along the lower Otay River is already in the planning stages; formal planning could begin sooner for smaller, simpler projects.
		Complete environmental documentation and obtain necessary permits	Watershed Council/Equivalent, Jurisdictions, SDUPD, USFWS NWR, Other Resource and Regulatory Agencies, OVRP Advisory Bodies, Consultants	10/1/2007	3-30 months; CCP/EIS expected to be finalized this year; ongoing	Small, simple restoration activities could be authorized quickly, while larger, more complex restoration could require an EIS/EIR, which could take a couple of years to complete.
		Implement Restoration Activities and Projects	Watershed Council/Equivalent, Jurisdictions, SDUPD, USFWS NWR, Other Resource and Regulatory Agencies, OVRP Advisory Bodies, NGOs, Volunteers, Contractors	1/1/2008	ongoing	As noted, smaller, simpler activities could occur within a few months, but larger, more complex restoration could require years (>5 years when considering follow-up maintenance and monitoring). The San Diego Bay NWR and the OVRP are currently planning restoration activities, so it would be important to coordinate activities and projects with these on-going efforts.

Strategy	Primary Component(s)	Steps/Actions	Proponents/ Responsible Parties	Target Start Date	Duration	Notes
C.9.1.4 - Implement Setbacks or Buffers Around Aquatic Resources	Develop a watershed-focused plan identifying appropriate setbacks or buffers by location and land use type	Evaluate the effectiveness of existing buffer criteria in protecting aquatic resources (habitat and species)	Jurisdictions, Resource and Regulatory Agencies, Preserve Owners/Managers, NGOs, Consultants	1/1/2006	4-6 months	The County, the City of Chula Vista, and the City of San Diego have buffer criteria, but they differ. Buffer criteria implemented in this watershed should focus on protecting resources in this watershed and are likely to vary by location.
		Develop a comprehensive, watershed-wide plan for implementing effective buffers	Jurisdictions, Resource and Regulatory Agencies, Preserve Owners/Managers, NGOs, Consultants	5/1/2006	4-6 months	Some work for preparing the plan can probably begin before the effectiveness evaluation is complete.
	Adopt and implement the buffer criteria agreed to by the jurisdictions and others in the collaborative plan	Ensure project review and approval processes implement the agreed-upon criteria	Jurisdictions	11/1/2006	6-12 months	To maximize effectiveness, it would be critical that most new development and significant redevelopment projects implement the watershed-focused criteria. It would also be important to restrict what can occur in the buffer or setback area (i.e., restricted access, no or limited non-native species). Follow-up monitoring at select locations would be essential to determine whether implemented buffer criteria are adequate or should be adjusted (increased or decreased).
C.9.1.5 - Limit Future and Remove Existing Trash and Debris	Develop and implement a watershed-wide approach for removing trash and debris and limiting their future introductions	Coordinate with the OVRP in conducting watershed-wide reconnaissance surveys to evaluate the extent of trash and debris and the effectiveness of current trash and debris controls/BMPs	Watershed Council/Equivalent, Jurisdictions, Preserve Owners/Managers, OVRP Advisory Bodies, NGOs, Volunteers, Consultants	1/1/2006	3-6 months	A lot of work has been focused already on cleaning up trash and debris, particularly west of the reservoirs. Post-2001 developments should have effective BMPs to limit introduction of trash, but developments constructed before the 2001 Municipal Permit might not have sufficient controls.
		Prioritize debris and trash removal areas as well as areas in need of additional or modified controls (source or treatment BMPs)	Watershed Council/Equivalent, Jurisdictions, Preserve Owners/Managers, OVRP Advisory Bodies, NGOs, Volunteers, Consultants	5/1/2006	3-6 months	Source-control and treatment control BMPs (as well as removal of trash and debris) need to be implemented as necessary to limit introductions and to clean-up existing materials. Structural controls, which can be expensive, might be necessary in some situations.

Strategy	Primary Component(s)	Steps/Actions	Proponents/ Responsible Parties	Target Start Date	Duration	Notes
		Secure necessary access	Watershed Council/Equivalent, Jurisdictions, Preserve Owners/Managers, OVRP Advisory Bodies, NGOs, Volunteers, Consultants	8/1/2006	3-6 months (the OVRP has made a lot of progress already); ongoing	Some of this work could begin earlier. Access limitations could require reprioritization; so this step needs to begin as soon as possible (as priorities emerge).
		Obtain needed implementation funding	Watershed Council/Equivalent, Jurisdictions, Preserve Owners/Managers, OVRP Advisory Bodies, NGOs, Volunteers, Consultants	8/1/2006	6-18 months; ongoing	Maximizing use of volunteers and getting fee waivers for disposal would reduce costs, while modifying or adding structural BMPs would increase costs. Funding problems could require reprioritization, so this work should begin as soon as possible (as priorities emerge).
		Complete environmental documentation and obtain permits	Watershed Council/Equivalent, Jurisdictions, Preserve Owners/Managers, OVRP Advisory Bodies, Consultants	1/1/2007	3-18 months; ongoing	Small, limited actions could be authorized in a few months, while larger, more complex activities or a larger program would take a year or longer to approve.
		Implement trash and debris removal activities and actions focused on controlling sources and treatment	Watershed Council/Equivalent, Jurisdictions, Preserve Owners/Managers, OVRP Advisory Bodies, Volunteers, Contractors	ongoing	ongoing	The OVRP CAC has been actively involved in trash and debris removal activities in this watershed. Small, limited activities could occur within a few months, while large, more complex activities or a program could take years (considering follow-up maintenance and monitoring).
	Prepare and distribute educational materials	Prepare and distribute educational materials	Watershed Council/Equivalent, Jurisdictions, Preserve Owners/Managers, OVRP Advisory Bodies, NGOs, Volunteers	1/1/2006	3 months; ongoing	Behavioral modification is essential to limit future introductions (i.e., key source control BMP).
C.9.1.6 - Protect Drinking Water Quality in the Reservoirs	Adopt City of San Diego Water Department's *Source Water Protection Guidelines for New Development*	Update project review and approval processes to implement the Guidelines in areas draining to the reservoirs	County of San Diego, City of San Diego, City of Chula Vista	1/1/2006	6-12 months	These Guidelines are consistent with the SUSMP, Municipal Permit, and jurisdictions' requirements.

Strategy	Primary Component(s)	Steps/Actions	Proponents/ Responsible Parties	Target Start Date	Duration	Notes
C.9.1.7 - Limit Impervious Surface Area	Conduct additional research to more accurately determine percent impervious cover (connected and not connected to surface waters) for each Hydrologic Sub-Area	More accurately identify impervious cover in this watershed, including what is connected and what is not connected to surface waters	Jurisdictions, NGOs, Consultants	1/1/2006	3-6 months	Accurate maps of existing land use and the routing of water into, within, or out of the watershed are essential.
	Develop impervious cover limitations program	Convene meetings of natural resource specialists (biologists, hydrologists, engineers, water quality specialists) and land use planners from jurisdictions in the watershed to develop the specifics of the program	Jurisdictions, NGOs, Consultants	5/1/2006	3-6 months	The goal should be to develop a flexible and fair approach to controlling increases in impervious cover that discourages urban sprawl.
		Prepare plan about the thresholds to use, the points of flexibility, how the program would be funded, administered, and monitored	Jurisdictions, NGOs, Consultants	9/1/2006	4-6 months	Some of this work can occur before the meetings are completed, particularly if there is general agreement on approach.
	Implement impervious cover limitations program	Update project review and approval processes to implement the impervious cover limitations program	Jurisdictions	3/1/2007	6-12 months; update as necessary	If the jurisdictions collaborate from the beginning, adoption could occur sooner. Monitoring would be necessary at select locations to determine whether impervious cover limits or other aspects of the program should be changed.

Strategy	Primary Component(s)	Steps/Actions	Proponents/ Responsible Parties	Target Start Date	Duration	Notes
C.9.1.8 - Implement a Watershed-Wide Education Program	Reach out to stakeholders to participate in ORWMP development and updates	Reach out to stakeholders to participate in ORWMP development and updates	County of San Diego, Watershed Council/Equivalent	ongoing	ongoing	The County of San Diego has been taking the lead on this effort for more than one year. The Watershed Council/Equivalent should take this over for future ORWMP updates.
	Integrate and coordinate programs	Integrate and coordinate programs	Watershed Council/Equivalent, Jurisdictions, Preserve Owners/Managers, NGOs, Volunteers	1/1/2006	ongoing	Several programs are on-going that should be coordinated with for mutual benefit.
	Develop and distribute educational materials	Develop and distribute educational materials	Watershed Council/Equivalent, Jurisdictions, Preserve Owners/Managers, NGOs, Volunteers, Consultants	1/1/2006	ongoing	Many southern California examples exist that can be used as templates.
	Implement active education program	Implement active education program - train educators; coordinate watershed tours; involve community in stewardship/beneficial activities; host educational workshops; ensure jurisdictions implement environmentally friendly practices; implement environmentally beneficial development requirements	Watershed Council/Equivalent, Jurisdictions, Preserve Owners/Managers, NGOs, Volunteers	ongoing	ongoing	A watershed tour occurred in January 2005.
C.9.1.9 - Form a Watershed Council to Implement the ORWMP	Establish and regularly convene a broad-based Watershed Council or equivalent decision-making body	Establish and regularly convene a broad-based Watershed Council or equivalent decision-making body	Existing Working Group, Executive Committee, Policy Committee, Jurisdictions	1/1/2006	4-6 months	The Watershed Council or equivalent should be in place before the ORWMP is finalized. This decision-making body could be a logical extension of the Working Group, Executive Committee, and Policy Committee. It is essential that this body have some decision-making capability. This body needs to coordinate actively with similar bodies in other regional watersheds for mutual benefit.

Strategy	Primary Component(s)	Steps/Actions	Proponents/ Responsible Parties	Target Start Date	Duration	Notes
C.9.2.1 - Retrofit Existing Developments to Protect Aquatic Resources	Identify practicable changes to existing developments that could improve aquatic resource (habitat and species) protection	Retain water quality specialists, fluvial geomorphologists, hydrologists, and biologists to evaluate existing developments to determine if aquatic resources (habitat and species) are adequately protected	Watershed Council/Equivalent, Jurisdictions, Regulatory and Resource Agencies, Consultants	1/1/2008	4-6 months	It would be critical to get access to properties with or near aquatic resources in the watershed. The jurisdictions should take the lead on contacting property owners and securing access for the investigations.
		Have specialists prioritize locations and activities for improving aquatic resource protection	Watershed Council/Equivalent, Jurisdictions, Regulatory and Resource Agencies, Consultants	6/1/2008	4-6 months	The jurisdictions and consultants should coordinate with regulatory and resource agencies to ensure prioritization reflects expected effectiveness and feasibility.
	Implement practicable additions or modifications as-necessary (non-structural or structural) to increase protection of aquatic resources	Secure access necessary to undertake activities	Watershed Council/Equivalent, Jurisdictions, Consultants	10/1/2008	3-12 months; ongoing	Securing access to implement and maintain/monitor actions could take significant time. As such, this step should begin as early as possible (as priorities emerge). If access is not granted, reprioritization might be necessary.
		Obtain any needed funding	Watershed Council/Equivalent, Jurisdictions, Consultants	10/1/2008	6-18 months; ongoing	Funding would depend on what activities would occur and where. Funding can take several months to obtain. Therefore, applications for funding should be prepared and submitted as soon as possible (as priorities emerge).
		As necessary, complete design and specifications	Watershed Council/Equivalent, Jurisdictions, Consultants	4/1/2009	3-6 months; ongoing	This step could begin sooner if funding is already available for it and access would not be a concern.
		Complete environmental documentation and obtain necessary permits	Watershed Council/Equivalent, Jurisdictions, Consultants	7/1/2009	0-12 months; ongoing	Changes in practices, such as storing manure farther away from aquatic resources, would not require environmental documentation or permits, but structural additions or modifications would in most cases. Environmental documentation and permitting should begin before project design and specifications are completed.

Strategy	Primary Component(s)	Steps/Actions	Proponents/ Responsible Parties	Target Start Date	Duration	Notes
		Implement additions or changes necessary to improve protection of aquatic resources	Watershed Council/Equivalent, Jurisdictions, Consultants/ Contractors	9/1/2008	ongoing	Structural additions or changes could require hiring contractors and would require regular maintenance. Non-structural changes, such as changes in approaches to storage of manure, could occur any time. Monitoring would be necessary to ensure whether implemented changes are sufficient or whether further action is necessary.
C.9.2.2 - Restore Urban Creeks	Identify and prioritize urban creek restoration activities and projects	Retain fluvial geomorphologists, hydrologists, engineers, restoration ecologists, and similar experts to evaluate the feasibility and benefits of restoring tributaries	Watershed Council/Equivalent, Jurisdictions, Resource and Regulatory Agencies, Consultants	1/1/2008	4-6 months	The jurisdictions have been conducting initial evaluations of tributaries that could be restored. Under the SAMP, the Corps will prepare a Restoration Study, which will identify and evaluate potential restoration sites
		Have the experts prioritize restoration activities and projects in coordination with the various jurisdictions and agencies.	Watershed Council/Equivalent, Jurisdictions, Resource and Regulatory Agencies, Consultants	6/1/2008	4-6 months	The SAMP is expected to identify restoration areas in this watershed, so coordination with the regulatory and resource agencies would be very important. It would also be very important to get community participation and input.
	Implement urban creek restoration activities and projects	Have the experts develop restoration concepts showing restoration types and locations	Watershed Council/Equivalent, Jurisdictions, Resource and Regulatory Agencies, Consultants	11/1/2008	3-6 months	Restoration concepts, particularly graphics, can be developed as priorities emerge.
		Secure access as necessary	Watershed Council/Equivalent, Jurisdictions, NGOs, Consultants	2/1/2009	3-12 months; ongoing	Inability to secure access could require reprioritization of activities. This step should begin as soon as possible, as restoration priorities emerge.
		Secure any funding needed	Watershed Council/Equivalent, Jurisdictions, NGOs, Consultants	2/1/2009	6-18 months; ongoing	Funding difficulties could also necessitate reprioritization of restoration activities; so funding applications should be prepared and submitted as restoration concepts are finalized.
		Conduct any additional hydraulic and geomorphic analysis	Watershed Council/Equivalent, Jurisdictions, Consultants	2/1/2009	2-4 months; ongoing	Additional analyses should adequately account for the effects of development (existing and expected) on the hydrology and geomorphology of this watershed.

Strategy	Primary Component(s)	Steps/Actions	Proponents/ Responsible Parties	Target Start Date	Duration	Notes
		Prepare restoration plans, project designs, and specifications	Watershed Council/Equivalent, Jurisdictions, Consultants	5/1/2009	3-6 months; ongoing	In addition to implementation, the restoration plan should include maintenance and monitoring measures as well as remedial actions to take if identified performance standards and success criteria are not met.
		Complete environmental documentation and obtain required permits	Watershed Council/Equivalent, Jurisdictions, Consultants	9/1/2009	4-12 months; ongoing	Involving the appropriate regulatory and resource agencies early in the prioritization and planning phase would be expected to reduce the time necessary for environmental review and permitting.
		Implement urban creek restoration activities, including follow-up maintenance and monitoring	Watershed Council/Equivalent, Jurisdictions, Consultants	1/1/2010	≥5 years for each (including maintenance and monitoring)	Follow-up maintenance and monitoring would be critical to ensure restoration success and to determine whether any changes are needed to meet flood control/erosion/other requirements.
C.9.2.3 - Implement Agricultural Land BMPs to Protect Aquatic Resources	Implement BMPs to control non-point source pollution from agricultural activities	Implement erosion and sediment control BMPs, such as: leaving crop residues on the field, planting cover crops, and applying mulch on bare fields; contour farming; installing cross-wind strips of vegetation along fields to prevent wind erosion; rotating crops and conservation tillage to protect soil properties; and installation of sediment-trapping features	Jurisdictions and NRCS	1/1/2008	ongoing	Many of these BMPs are probably already in place. The focus is to make sure that is the case and to ensure any gaps are addressed in this watershed. The jurisdictions should work with the NRCS to identify any gaps that exist and to address them accordingly.

Strategy	Primary Component(s)	Steps/Actions	Proponents/ Responsible Parties	Target Start Date	Duration	Notes
		Implement non-CAFO wastewater and runoff control, such as: manure storage structures that can withstand a 25-year (24 hour) storm event; protective cover from rainwater for dry manure; development of a nutrient management plan and application of manure and process wastewater in accordance with this plan; diversion of clean water around feedlots and holding pens, animals and manure storage facilities; proper disposal of animal carcasses; and proper lining of waste lagoons and storage of solid storage on concrete pads	Jurisdictions and NRCS	1/1/2008	ongoing	Many of these BMPs are probably already in place. The focus is to make sure that is the case and to ensure any gaps are addressed in this watershed. The jurisdictions should work with the NRCS to identify any gaps that exist and to address them accordingly.
		Implement nutrient management programs	Jurisdictions and NRCS	1/1/2008	ongoing	Many of these BMPs are probably already in place. The focus is to make sure that is the case and to ensure any gaps are addressed in this watershed. The jurisdictions should work with the NRCS to identify any gaps that exist and to address them accordingly.

Strategy	Primary Component(s)	Steps/Actions	Proponents/ Responsible Parties	Target Start Date	Duration	Notes
		Implement pesticide and herbicide management programs that reduce or eliminate pesticide and herbicide runoff into surface water, by: ensuring compounds are applied as prescribed on the labels (timing and rate); using integrated pest management to reduce the amount of chemicals required; and implementing good housekeeping measures to prevent spills, protect surface waters from any spills, and the proper maintenance of application equipment	Jurisdictions and NRCS	1/1/2008	ongoing	Many of these BMPs are probably already in place. The focus is to make sure that is the case and to ensure any gaps are addressed in this watershed. The jurisdictions should work with the NRCS to identify any gaps that exist and to address them accordingly.

Strategy	Primary Component(s)	Steps/Actions	Proponents/ Responsible Parties	Target Start Date	Duration	Notes
		Implement grazing management programs, including: monitoring and managing grazing intensity, frequency, and duration; installing fencing, hedgerows, or other measures to keep people, animals, and vehicles out of drainages and away from other sensitive areas; discouraging animals from seeking out streams by installing alternative drinking sources and providing shade and food away from streams and other sensitive areas; providing stream crossings to minimize impacts on stream habitat and quality	Jurisdictions and NRCS	1/1/2008	ongoing	Many of these BMPs are probably already in place. The focus is to make sure that is the case and to ensure any gaps are addressed in this watershed. The jurisdictions should work with the NRCS to identify any gaps that exist and to address them accordingly.
		Implement irrigation management measures pursuant to a location-specific irrigation management plan that ensures an efficient use and distribution of water and minimizes water runoff and soil erosion	Jurisdictions and NRCS	1/1/2008	ongoing	Many of these BMPs are probably already in place. The focus is to make sure that is the case and to ensure any gaps are addressed in this watershed. The jurisdictions should work with the NRCS to identify any gaps that exist and to address them accordingly.

Strategy	Primary Component(s)	Steps/Actions	Proponents/ Responsible Parties	Target Start Date	Duration	Notes
		Implement education and outreach targeted to the appropriate agricultural interests in the watershed	Jurisdictions and NRCS	1/1/2008	ongoing	Pamphlets could be prepared and meetings with agricultural interests could be held to ensure these interests are aware of the latest technologies and requirements. The NRCS could have some of these educational materials already, which could be tailored for this watershed. The NRCS could also identify which groups should be targeted for follow-up meetings. Follow-up monitoring at select locations could identify whether implemented BMPs are sufficient to protect aquatic resources or whether changes are necessary.
C.9.2.4 - Improve Existing and Create New Recreational Facilities	OVRP trails, staging, and educational facilities	Work with the City of San Diego and the San Diego Regional Water Quality Control Board to ensure that the OVRP complies with the Source Water Protection Guidelines for New Development (City of San Diego Water Department, 2004).	OVRP Advisory Bodies, Jurisdictions, Watershed Council/Equivalent	on-going	5-10 years	It is important that drinking water quality will not be compromised by the temporary or permanent impacts as well as the long-term recreation activities that will occur within the OVRP. Therefore, it is important to work with the jurisdictions and regulatory agencies that can aid in the development of the OVRP so that it does not compromise water quality.
		Retain qualified biologists to identify existing sensitive species and habitats within the boundary of the OVRP. If necessary, prepare and implement a detailed mitigation and monitoring plan to adequately mitigate the short- and long-term impacts of developing the OVRP.	OVRP Advisory Bodies, Jurisdictions, Watershed Council/Equivalent	1/1/2008	18 months (12 months to complete the surveys and 6 months to prepare a plan)	The driving force behind the ORWMP is to balance the preservation of natural resources and the use of watershed resources by humans.

Strategy	Primary Component(s)	Steps/Actions	Proponents/ Responsible Parties	Target Start Date	Duration	Notes
		Broaden efforts to involve stakeholders who are also educators and nature enthusiasts for direction on the type, size, and location of the facilities that they need.	OVRP Advisory Bodies, Jurisdictions, Watershed Council/Equivalent, School District, Environmental Groups	1/1/2008	on-going	The individuals who will ultimately use the OVRP facilities are likely the best source of ideas for the type, size, design and location of kiosks, trail heads, nature centers, bathrooms, etc. These individuals can also be used to help design kiosks, self-guided tour books, and make suggestions on the locations for doggie-bag dispensers, etc.
	Coastal Bike Trail connections between the OVRP, Bayshore Bikeway, and Tijuana River Park	Contact SANDAG to determine progress on their draft EIR/EIS currently being prepared. Work with SANDAG to see if the proposed trail location and associated facilities are consistent with the ORWMP. Encourage stakeholders and jurisdictions to provide comments during the public comment period and provide recommendations as a group for changes that will balance the development of the bikeway and preserving or restoring natural resources.	OVRP Advisory Bodies, Jurisdictions, Watershed Council/Equivalent, SANDAG, USFWS, CDFG, Salt Works, Private Landowners	1/1/2008	1-2 years	A study is currently underway by SANDAG. It is important that SANDAG be made aware of the ORWMP and how the bikeway should be designed and maintained within the Otay River watershed. Coordination and involvement in the planning process is all that is likely necessary.
	City of Chula Vista Greenbelt within the Otay River watershed	Work with the City of Chula Vista when new projects are proposed that have an impact on the development or location of the Greenbelt.	OVRP Advisory Bodies, Jurisdictions, Watershed Council/Equivalent	1/1/2008	on-going, dependant on development of neighboring communities	The Watershed Council/Equivalent can help the City of Chula Vista in determining whether or not proposed projects affecting the development of the Greenbelt are consistent with the goals of the ORWMP.

Strategy	Primary Component(s)	Steps/Actions	Proponents/ Responsible Parties	Target Start Date	Duration	Notes
	California Riding and Hiking Trail, Inland Otay Lakes and Tijuana River Connection, Additional recreational opportunities on public and private lands	Determine where the County of San Diego, the USFS, and other jurisdictions are in the planning of these trails and facilities. Determine whether or not the Watershed Council/Equivalent can assist in the process or at a minimum determine if the proposed projects meet with the goals of the ORWMP.	OVRP Advisory Bodies, Jurisdictions, Watershed Council/Equivalent, USFS, BLM, Private landowners.	1/1/2008	on-going, dependant on the individual planning processes	The Watershed Council/Equivalent can help the different planning groups in determining whether or not proposed trails are consistent with the goals of the ORWMP.
C.9.2.5 – Manage Tecate Cypress Forest and Oak Woodlands	Develop and implement Tecate cypress forest management plan	Retain qualified biologists to conduct a detailed survey of the Tecate cypress forest and this community's historic distribution within existing and planned preserve areas.	County of San Diego, BLM, USFWS, CDFG, Consultants	1/1/2008	4-6 months	This plan should be developed in close coordination with the BLM because most of this community is in their Otay Mountain Wilderness Area. The BLM intends to develop such a plan as soon as possible, given that Tecate cypress forest is at risk from future near-term fires.
		Have the experts work with the BLM to develop a comprehensive management plan for this vegetation community	County of San Diego, BLM, USFWS, CDFG, Consultants	6/1/2008	6-12 months	The plan should include strategies for limiting human-induced fires, any restoration activities needed, strict guidelines for recreational activities, strategies for educating local residents and wilderness users, and strategies for improving coordination with the U.S. Border Patrol and the BLM to restrict access and to improve fire-response times.
		As necessary, secure access to implement the actions identified in the plan	County of San Diego, BLM, USFWS, CDFG, Consultants	1/1/2009	3-6 months	Much of this community is on BLM land, so access should be a minor issue. Nevertheless, access can be a key issue, so work on securing access should occur as soon as possible.

Strategy	Primary Component(s)	Steps/Actions	Proponents/ Responsible Parties	Target Start Date	Duration	Notes
		Complete environmental documentation and obtain permits	County of San Diego, BLM, USFWS, CDFG, Consultants	1/1/2009	3-9 months	The regulatory and resource agencies are particularly concerned about this vegetation community, which should expedite the environmental review and permitting (if these agencies agree with the plan, so coordination is key).
		Implement actions, including restoration activities, identified in the Tecate cypress management plan	County of San Diego, BLM, USFWS, CDFG, Consultants, NGOs, Volunteers	5/1/2009	ongoing	Restoration could require use of contractors, but it is expected the BLM, other agencies, and even volunteers would be involved in implementing actions.
	Retain qualified biologists to map the existing and historic extent of Oak Woodlands with the MHPA and other preserve areas and evaluate whether the community is reproducing or regenerating	Retain qualified biologists to conduct a detailed mapping of oak woodlands within the Otay River watershed's portion of the MHPA and to evaluate their historic extent	County of San Diego, possibly City of Chula Vista, USFWS, CDFG, Consultants	1/1/2008	3-6 months	Mapping was completed for the MSCP, but it was regional with little ground-truthing. This effort would involve considerably more fieldwork.
		Have the experts evaluate whether oak woodlands within the MSCP and other preserve areas are sustainably reproducing and regenerating	County of San Diego, possibly City of Chula Vista, USFWS, CDFG, Consultants	6/1/2008	3-6 months, unless initial evaluation determines more study is warranted	Preserving oak woodlands might not be enough to retain a healthy population. It is necessary to evaluate the health of the oak woodlands to determine whether or not they are self sustaining, if they are reproducing, or if they need active management measures.
	If necessary, develop and implement long-term oak restoration program	Prepare a long-term oak restoration, management, and monitoring program	County of San Diego, possibly City of Chula Vista, USFWS, CDFG	12/1/2008	6-12 months	The restoration component of the plan should describe site preparation, planting techniques, maintenance and monitoring measures, and remedial actions. The monitoring component of the plan should be focused on determining whether oaks are propagating and regenerating in protected areas.
		Secure any needed access	County of San Diego, possibly City of Chula Vista, USFWS, CDFG	6/1/2009	3-12 months	Access limitations can greatly diminish the scope and effectiveness of the program; so efforts on this step should begin as soon as possible.

Strategy	Primary Component(s)	Steps/Actions	Proponents/ Responsible Parties	Target Start Date	Duration	Notes
		Obtain necessary funding	County of San Diego, possibly City of Chula Vista, USFWS, CDFG	6/1/2009	6-18 months	Funding limitations can greatly diminish the scope and effectiveness of the program; so efforts on this step should begin as soon as possible.
		Complete environmental documentation an obtain permits	County of San Diego, possibly City of Chula Vista, USFWS, CDFG	6/1/2009	3-6 months	Resource and regulatory agencies consider oak woodlands to be a highly sensitive and important community. It is expected that the environmental review and permitting for this program would be expedited, if these agencies agree with it (so it is important to coordinate closely with them during its development).
		Implement restoration, management, and monitoring activities	County of San Diego, possibly City of Chula Vista, USFWS, CDFG, Volunteers	9/1/2009	>5 years	Restoration activities typically require at least 5 years of follow-up maintenance and monitoring (required by the permitting agencies). Management and monitoring could go on indefinitely.
C.9.2.6 – Achieve Consistency with Regulations in Conjunction with the SAMP	Continue with regular progress on the SAMP pursuant to the project schedule	Continue with regular progress on the SAMP pursuant to the project schedule	Watershed Council/Equivalent, Jurisdictions, Resource and Regulatory Agencies	ongoing	ongoing	The SAMP would change land use requirements necessitating analysis of inconsistencies and gaps with existing planning criteria. It would also ensure no net loss of aquatic habitat functions and values. As such, ORWMP proponents should seek the completion and implementation of the SAMP as a complementary watershed document.
C.9.3.1 - Preserve, Enhance, Restore Additional Floodplain Parcels Within the Otay River Watershed	Opportunistically identify floodplain parcels for acquisition and enhancement or restoration	Identify parcels that are potentially available for purchase (from willing sellers) or recordation of a conservation easement	Watershed Council/Equivalent, Jurisdictions, RCD, NRCS, NGOs	any time	ongoing	This strategy would act upon opportunities for floodplain parcel acquisition in addition to those acquired for the OVRP, the San Diego Bay NWR, and other parcels acquired or being acquired to implement other ORWMP strategies.
		Retain fluvial geomorphologists, engineers, restoration ecologists, and similar experts to evaluate and prioritize the feasibility and benefits of conserving, enhancing, and/or restoring the parcels	Watershed Council/Equivalent, Jurisdictions, RCD, NRCS, Resource and Regulatory Agencies, NGOs, Consultants	any time	3-6 months	The group should work collaboratively to determine which acquisitions would provide the most total benefits for the costs.

Strategy	Primary Component(s)	Steps/Actions	Proponents/ Responsible Parties	Target Start Date	Duration	Notes
		For enhancement or restoration projects, prepare conceptual enhancement/restoration plans	Watershed Council/Equivalent, Jurisdictions, RCD, NRCS, NGOs, Consultants	any time	3-6 months	The plan should include maintenance and monitoring measures, performance standards and success criteria, remedial actions, and long-term management responsibilities.
		Obtain necessary funding	Watershed Council/Equivalent, Jurisdictions, RCD, NRCS, NGOs, Consultants	any time	6-18 months	Funding limitations can diminish the scope of the activities that occur on a particular parcel; so funding options should be explored as soon as possible (as priorities emerge).
		Complete environmental documentation and obtain permits	Watershed Council/Equivalent, Jurisdictions, RCD, NRCS, NGOs, Consultants	any time	3-12 months	Acquisitions should not need any environmental documentation or permits, but enhancement or restoration activities usually do require environmental review and/or permits.
		Prepare project design and specifications	Watershed Council/Equivalent, Jurisdictions, RCD, NGOs, Consultants	any time	3-6 months	Typically more important for restoration projects.
		Implement enhancement, restoration, and/or other management activities	Watershed Council/Equivalent, Jurisdictions, RCD, NRCS, NGOs, Consultants	any time	ongoing	The nature of the activities would depend on the parcel.
C.9.3.2 - Preserve, Enhance, Restore Cultural Resources	Opportunistically identify cultural resources to preserve and enhance or restore	Identify cultural resources that are potentially available for purchase or recordation of a conservation easement	Watershed Council/Equivalent, Jurisdictions, NGOs	any time	ongoing	The SAMP includes watershed-wide consideration of cultural resources. Other permitting and planning processes regulate effects to cultural resources. This strategy would identify and consider any opportunities for cultural resource conservation, enhancement, or restoration that might arise.
		Retain cultural resource specialists to evaluate and prioritize the feasibility and benefits of conserving, enhancing, and/or restoring the cultural resources	Watershed Council/Equivalent, Jurisdictions, NGOs	any time	3-6 months	The group should work collaboratively to determine which acquisitions would provide the most total benefits for the costs.

Strategy	Primary Component(s)	Steps/Actions	Proponents/ Responsible Parties	Target Start Date	Duration	Notes
		Prepare cultural resource management plan	Watershed Council/Equivalent, Jurisdictions, NGOs	any time	3-6 months	The plan should be prepared in coordination with the SHPO and local cultural resource groups (e.g., San Diego Historical Society).
		Obtain necessary funding	Watershed Council/Equivalent, Jurisdictions, NGOs	any time	6-12 months	Funding limitations can diminish the scope of the activities that occur; so funding options should be explored as soon as possible (as priorities emerge).
		Complete environmental documentation and obtain permits	Watershed Council/Equivalent, Jurisdictions, NGOs	any time	3-6 months	Acquisitions should not need any environmental documentation or permits, but enhancement or restoration activities usually do require environmental review and/or authorizations/agreements.
		Implement acquisition, enhancement, restoration, and/or other management activities	Watershed Council/Equivalent, Jurisdictions, NGOs	any time	ongoing	The nature of the activities would depend on the cultural resource.

D. MONITORING AND EVALUATION PROGRAM

Pressures on the environmental quality of the Otay River watershed are expected to increase with urbanization. As discussed in Section B, urbanization and other intensive landscape uses are anticipated to continue, with the population and housing expected to nearly double, as are efforts to protect, enhance, and restore the remaining upland and aquatic resources within this watershed.

As described in Section C, several strategies have been developed to protect, enhance, restore, and manage watershed resources and beneficial uses in consideration of existing and anticipated stressors. While these strategies provide an important framework for action, actual strategy implementation will require several steps, including evaluating feasibility, preparing environmental documentation and obtaining necessary permits, securing funding, and obtaining site access. Furthermore, it will be critical to monitor and evaluate the effectiveness of the implemented strategies to ensure that the ORWMP goals are achieved. Both watershed-wide and strategy-specific monitoring are recommended to establish a comprehensive baseline for comparison, identify trends, and evaluate whether specific actions are effectively protecting and benefiting resources.

This section of the ORWMP presents the:

- Watershed water quality monitoring strategy or program (Section D.1-D.5)
- Approaches for monitoring a suite of hydrologic, geomorphic, water quality, biological, land use, and socioeconomic indicators in order to evaluate the effectiveness of the implemented protection, enhancement, restoration, and management strategies (Sections D.6-D.8)
- Recommended schedule of monitoring and evaluation (Section D.9)
- Potential remedial actions to take if indicators or strategies are ineffective or have limited effectiveness (Section D.10); and
- Protocol for updating the ORWMP (Section D.11).

D.1 INTRODUCTION TO THE WATERSHED WATER QUALITY MONITORING PROGRAM

To ensure that beneficial uses in the Otay River system continue to be supported, it is critical to establish baseline water quality conditions and to document any changes in conditions that may occur in the future. Water quality data for this watershed are very limited spatially and temporally. Therefore, a long-term monitoring program for the various sub-watersheds and reservoirs must be implemented to establish baseline conditions, identify trends in degradation, isolate sources of contamination, and determine effects of management practices.

The water quality monitoring strategy outlined here describes the type of program needed to establish a baseline for and document future changes to water quality on the watershed, based upon the beneficial uses of receiving waters and the water quality stressors expected on the watershed. The monitoring strategy is not an implementation program, which would specify particular monitoring methodologies and schedules, monitoring program costs, and the parties responsible for funding the programs.

In general, the monitoring recommendations, frequency, number of sites, and timing of sample collection suggested here are preliminary suggestions, based on previous experience, intended to achieve the stated goals of the monitoring strategy. Unknown factors and site constraints might affect the monitoring approach or protocol at a specific site or watershed, making precise cost opinions premature at a planning level. Proponents of specific enhancement projects or strategies will be expected to integrate water quality monitoring and evaluation programs into their proposals, helping to fill in the general outline of the overall monitoring strategy presented here.

As shown in Figure B.3-12, degradation of water quality may already be occurring in this watershed. Smith (2004) assessed the riparian integrity of the Otay River watershed by calculating a Water Quality Index for 212 riparian reaches comprising the Otay River system. The Water Quality Index is a measure of existing pollutant loading (including nutrients, pesticides, hydrocarbons, and sediment) relative to the historical pollutant loadings from culturally unmodified watersheds in the region. Because of a scarcity of data, the Water Quality Index for the Otay River watershed was determined based on the relative change in watershed characteristics that influence water quality integrity. The Water Quality Index analysis considered 20 watershed characteristics, covering three general categories: (1) change in land use on the overall watershed and local drainages; (2) change in stream channels on the watershed; and (3) changes to the connection between the watershed and conveyance (e.g., sediment regime, floodplain, and the condition of riparian vegetation).

Recommendations contained in *Baseline Water Quality Indicators for the Otay River Watershed* (Appendix 6) are the basis for the watershed water quality monitoring program. The establishment of a monitoring program is an important and cost-effective action for several reasons, which stem from the likelihood that future development can negatively affect the various watercourses addressed in this program. First, and most important, the trends evidenced in monitoring data can provide an early indication of degradation in water quality or channel characteristics. This will enable corrective actions to be implemented before catastrophic impacts are evidenced, at a considerable savings over what would be required in belated remediation and recovery projects. A monitoring program should be initiated as soon as possible; preferably implemented in advance of new development in the watershed, which allows the establishment of baseline conditions in the watercourses and a quantitative evaluation of future impacts. This in turn will permit determination of the efficacy of corrective actions, should these become necessary.

From a scientific viewpoint, the water quality and stream channel characteristics of these watercourses undergo time and space variations on a range of scales, a fact that complicates the problem of isolating the specific impacts on a watercourse from development or other anthropogenic activities. The longer duration for which a database can be assembled, including both the proposed monitoring as well as historical data, the more reliable can anthropogenic effects be separated from natural hydroclimatological variability. The more reliably that specific impacts can be quantified in general, the more specific, and therefore cost-effective, the necessary corrective actions can be delineated.

The implementation of a watershed monitoring program can adopt several strategies that substantially improve the reliability and scientific value of the data with relatively small incremental cost in execution. One of these strategies is to recognize and exploit the economies of scale. In monitoring, an initial investment must be made in equipment and manpower. This investment is a threshold expense (fielding a sampling crew, for example) above which increases in scope such as occupying more stations, profiling with field probes, or analyzing additional variables incur minor (or perhaps zero) additional expense, yet greatly enhance the value of the data. Another strategy is timely data entry and review of data by competent scientists, including analyses and plots of trends, spatial variations, and dependencies among variables. Not only does this provide provisional information about what the data disclose, more importantly, this allows the identification of aberrant or erroneous data quickly enough that the original measurements can be scrutinized or perhaps repeated.

Due to the large geographic area covered by the Otay River watershed, inherent variability of the system, and differential nature of historical impacts to the watershed, the selection of appropriate locations and constituents for monitoring is critical. These locations may include the reservoirs, local drainages, main stem channels, main stem tributary channels, and drainage basins. The local drainage includes the area from which surface water drains directly to the main stem channel, or tributaries that

enter the main stem channel. The main stem channel is the primary channel in the local drainage, and main stem tributaries are stream channels that originate in the local drainage of the riparian reach and flow directly to the main stem channel.

At each of the locations considered for monitoring, specific constituents must be selected for monitoring that are associated with changes in land use and beneficial uses of the water body. Assessing changes in the range of loading in each pollutant category can be determined directly by comparing data on current loading with data on historical loading when such data are available. While there is some historical and recent monitoring data available for a limited number of stations in the Otay River watershed, little or no data are available at the larger scale.

An important additional feature to consider is the hydrology, particularly the perennialization of stream flow. Perennialization refers to the conversion of intermittent or ephemeral stream channels to a perennial stream through the addition of surface water flow (usually at low levels) in a stream channel from artificial supplies of surface water and shallow groundwater aquifers. The source of water usually occurs in the form of irrigation or treated return water. In arid and semi-arid regions, perennialization facilitates a shift in plant and animal community composition away from what normally occurs in a channel that is not perennialized. Perennialization also has the potential to affect physical and chemical processes in riparian ecosystems. Figure B.3-11 indicates that changes in hydrology may already affect many reaches in the watershed.

Conventional water quality monitoring is very problematic on a system with so little flow, especially in the lower reaches of the system and may be of limited value because of the lack of historical data with which to compare newly acquired data. Consequently, a substantial focus of the monitoring strategy deals with characterization of the hydrology and channel morphology of the system. This is a particularly important element in the sub-basins expected to experience the most urbanization.

The approach for the development of this monitoring strategy comprised three basic components: (1) identifying the beneficial uses of local water resources; (2) identifying the pollutants of concern (i.e., the pollutants with the most potential to have negative effects on the identified beneficial uses), especially those associated with existing and proposed land use and activities on the watershed; and (3) developing a monitoring strategy that will be able to describe baseline conditions and document future changes to water quality.

The Otay River watershed has three distinct areas for which individual monitoring strategies are required. These three include the Upper Watersheds, Upper and Lower Otay Reservoirs, and the Lower Watersheds. These divisions are generally based upon the existing physical and hydrologic features of the watershed, the different beneficial uses present on the watershed, and the existing and planned land uses of the watershed. The monitoring strategy is thus tailored to account for the different potential effects on “free flowing” segments of the watershed above the reservoirs, the reservoir system, and the lower watershed, where flows are significantly affected by the reservoir impoundment. The strategies for each of these will be considered separately.

D.2 UPPER WATERSHED MONITORING AT JAMUL CREEK

Upper Watershed Strategy: *Ambient and wet-weather monitoring plan to document baseline conditions and trends with an emphasis on potential changes associated with the widespread use of septic systems in the watershed.*

The Upper Watersheds are only sparsely developed in most areas and are unlikely to experience significant urbanization in the near future. Nevertheless, environmental impacts may be caused by

recreational uses and low-density residential development constructed along and near creeks. These creeks include: Jamul Creek, Dulzura Creek, Hollenbeck Canyon Creek, and Proctor Valley Creek. Potential environmental impacts in the Upper Watersheds also have the potential to degrade water quality in the Upper and Lower Otay Reservoirs, which are important for recreation and water supply.

The Upper Watersheds are vital to the public health of the surrounding areas because they contribute to the water supply of the area. A key facet of the overall monitoring strategy must be to gather data to assist in the preservation of the designated municipal water supply use (MUN). The major threats to the integrity of the Upper Watersheds are non-point source inputs of nutrients and pathogens, such as failed septic systems and loading from waterfowl and other wildlife. The soils in the Upper Watersheds are also of very poor quality and are characterized as severely erodible.

The water quality monitoring strategy for the Upper Watersheds includes routine bioassessment, characterization of storm water runoff, and evaluation of changes in the quality of dry weather flows. The priority of the monitoring strategy is to determine whether beneficial uses are being maintained. Current and potential uses mainly include:

- Recreation (REC1, REC2)
- Water supply (MUN, IND, PROC, AGR)
- Habitat (WARM, WILD).

These beneficial use designations are defined as:

REC1 - Contact Water Recreation. Includes uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and SCUBA diving, surfing, white water activities, fishing, or use of natural hot springs.

REC2 - Non-Contact Water Recreation. Includes the uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

MUN - Municipal and Domestic Supply. Includes uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.

PROC - Industrial Process Supply. Includes uses of water for industrial activities that depend primarily on water quality.

IND - Industrial Service Supply. Includes uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well re-pressurization.

AGR - Agricultural Supply. Includes uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.

WARM - Warm Freshwater Habitat. Includes uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish or wildlife, including invertebrates.

WILD - Wildlife Habitat. Includes uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

The USGS currently operates the Jamul Creek Gauging Station (USGS 11014000) above the reservoir. Water quality monitoring (wet and dry weather) should be conducted at this site so that flow-weighted samples can be collected and annual loads determined for selected constituents. Wet weather monitoring should occur in at least four events per year to develop a sufficient number of samples for statistical analysis.

D.2.1 Recreation

Recreational activities are one of the main beneficial uses in the Upper Watersheds of the Otay River. Hiking, camping, and passive recreational activities of relatively low intensity will most likely characterize these activities. The primary water quality concern is increases in bacteria concentrations in dry weather flows may affect designated REC1 and REC2 beneficial uses and further contribute to the impairments already identified in San Diego Bay. Consequently, monitoring should include:

- Fecal coliform
- Total coliform
- Enterococci

These various indicator organisms were chosen to provide a comparison with historical data from this area and to assess compliance with objectives that are now being adopted for beaches and waterways in the San Diego area. Monitoring a spectrum of indicator organisms, as suggested above, can help assemble a more complete picture of both ambient conditions and illegal connection/illegal discharge situations.

A potential source of pathogenic and indicator organisms is septic tanks that are not functioning properly. There are several potential causes of discharge of bacteria and viruses from septic systems. Excessively sandy soil may not provide sufficient filtering of the discharge and allow the partially filtered effluent to enter the creeks as baseflow. On the other hand, soils with high clay content may not be sufficiently permeable and may result in the effluent appearing on the ground surface especially during extended wet periods. The effluent may then be washed into adjacent waterways during storm events. Finally, drainfields may clog or may be undersized for current water use, which also results in effluent on the surface.

Bacteria concentrations are commonly high in storm water runoff, even in relatively undeveloped watersheds. Consequently, it is important also to characterize bacteria concentrations under ambient conditions (in dry weather) to evaluate the potential impact of septic system failure. In addition, these are the periods when contact recreation is most likely to occur. Ambient monitoring should occur a minimum of four times annually, during both winter and summer, following a period of at least one week without rainfall.

D.2.2 Water Supply

Water supply for various beneficial uses (MUN, IND, AGR, PROC) is an important function of the Otay River watershed. An important element in preserving drinking water quality, especially in reservoirs, is the trophic status of the system, which is controlled by the input of nutrients. Eutrophic systems, characterized by a high level of biological activity, often exhibit algal blooms that can seriously impair drinking water quality. Septic systems located along the Upper Watersheds may

contribute a substantial nutrient (nitrogen and phosphorus) input to the creeks and then to the Upper and Lower Otay Reservoirs. In addition to these residential stressors, activities such as hobby farms and agriculture also contribute organic input to the watershed, and there will be natural background levels of nutrients and bacteria from wild animals and waterfowl.

Reservoirs respond to changes in nutrient loads rather than to changes in concentrations. The load is the total mass of a constituent discharged and is calculated as the product of concentrations and volume of discharge. Consequently, monitoring for these constituents in the Upper Watersheds must occur where flow data are available for calculation of event mean concentrations in storms and total annual load. The City of San Diego Water Department samples two sites above the reservoir monthly (when water is flowing) for nutrients, including NH_4, NO_2, NO_3, Total Nitrogen, PO_4, and Total Phosphorous. Bacteria (*E. coli* and enteroccoccus), suspended solids, and total dissolved solids are monitored monthly at five sites above the reservoir (again, when water is flowing). Metals and organics are also monitored quarterly at these sites. Table B.5-7 summarizes the City of San Diego Water Department water quality monitoring program.

The cost to include additional conventional constituents once a monitoring site and program are developed is small; consequently, it is recommended that a suite of water quality parameters be collected in addition to nutrient data. Samples should be collected during at least four storm events per year and four times under ambient conditions. The recommended list is presented in Table D-1; with the exception of chemical oxygen demand (COD), these constituents are already part of the Water Department's monitoring program. This type of monitoring effort likely would cost on the order of $100,000 the first year when equipment is purchased and installed, and perhaps half of that for subsequent years.

Table D-1 Recommended Constituents for Monitoring at Jamul Creek

Nitrate + Nitrite as Nitrogen	Total Suspended Solids (TSS)
Total Kjeldahl Nitrogen (TKN)	Total Dissolved Solids (TDS)
Total Phosphorus	Dissolved Phosphorus
Total Zinc	Dissolved Zinc
Total Iron	Dissolved Iron
Total Copper	Dissolved Copper
Chemical Oxygen Demand (COD)	Total Coliform
Fecal Coliform	Enterococci

D.2.3 Habitat Protection

Regular bioassessments provide an integrated approach to assessing changes in the river ecosystem and water quality and provide a direct measurement of the degree to which the river supports the WARM beneficial use designation. Historical data are available for the Upper Watersheds and provide good benchmark information to determine whether changes in the aquatic ecosystem are occurring. Typically, bioassessments should be conducted semiannually (spring and fall) using the protocol applied in the previous studies by the San Diego Stream Team (*http://sdstreamteam.org/*), which is a citizen monitoring effort. This bioassessment protocol has been endorsed by various wildlife agencies, and is described in SWRCB Clean Water Team's *The California Streamside Biosurvey: An Introduction to Using Aquatic Invertebrates as Water Quality Indicators* (September 2001) and the U.S. EPA's *Volunteer Stream Monitoring: A Methods Manual* (November 1997).

While semiannual surveys are standard, an annual survey interval could be satisfactory for long-term monitoring. Moreover, limited stream flows might necessitate annual surveys. It is important that if the

surveys are conducted annually, they should occur when ecosystem communities and hydrometeorology are stable in time, normally around late May or June of each year. The City of San Diego Water Department has instituted an annual survey in the springtime, usually in May.

Table D-2 presents a summary of the historical data, which will be useful as a benchmark (representing near "natural" conditions) for comparison with downstream urbanized areas as such data become available. Table D-3 provides a description of the metrics used in the historical data and their response to impairment. A bioassessment provides a measurable assessment of the long-term health of a stream by examination of the aquatic invertebrates that live in the water. Many insect taxa have aquatic larvae that inhabit a stream from several months to several years. Larval groups have differential tolerances to stream conditions including pollution. There are different feeding methods requiring certain conditions for obtaining food, anchoring in the substrate of the stream, etc.

Table D-2 Bioassessment Data from the Otay River Watershed (Spring 2001)

Bioassessment Metrics	Dulzura Creek	Jamul Creek
Richness Measures		
Taxa Richness	6 *	5.3
Ephemeroptera Taxa	2	1
Plecoptera Taxa	0	0
Trichoptera Taxa	2	1
EPT Taxa	4	2
Composition Measures		
EPT Index	98	46.4
Sensitive EPT Index	1	0
% Hydropsychidae	92.9	24.8
% Baetidae	0	21.6
Tolerance/Intolerance		
Tolerance Value	4	5.2
% Intolerant Organisms	0	0
% Tolerant Organisms	0	3.1
% Dominant Taxa	92.9	43.9
Feeding Groups		
% Collectors (c)	5.1	55.1
% Filterers (f)	92.9	42.9
% Scrapers (g)	1	0.3
% Predators	1	1.7
% Shredders (s)	0	0
** Value based on average of three composite samples per site*		

Bioassessments integrate many of the effects of all potential changes in the river due to changes in runoff volumes, runoff rates, and changes in the chemical and physical characteristics, including the synergistic effects of multiple pollutants. Bioassesments are an important, though not entirely comprehensive, indicator of stream ecology. Physical and chemical measurements, as well as assessments of macro-scale flora and fauna, can help complete the picture of overall stream health.

A program of semiannual or annual bioassessments, depending on the presence of sufficient flow, in the Upper Watersheds could provide one of the better baseline indicators of the effectiveness of the BMP program. Initial bioassessments (such as those summarized in Table D-2) can provide a baseline with which to compare future conditions. Bioassessments are a good integrator of all the potential effects including those resulting from changes in flow regime. Additional monitoring for chemistry and toxicity

Table D-3 Bioassessment Metrics Used to Describe Benthic Populations in the San Diego Area

Benthic Macroinvertebrate (BMI) Metric	Description	Response to Impairment
Richness Measures		
Taxa Richness	Total number of individual taxa	Decrease
EPT Taxa	Number of taxa in the Ephemeroptera (mayfly), Plecoptera (stonefly) and Trichoptera (caddisfly) insect orders	Decrease
Dipteran Taxa	Number of taxa in the insect order (Diptera, "true flies")	Increase
Non-Insect Taxa	Number of non-insect taxa	Increase
Composition Measures		
EPT Index	Percent composition of mayfly, stonefly and caddisfly larvae	Decrease
Sensitive EPT Index	Percent composition of mayfly, stonefly and caddisfly larvae with tolerance values between 0 and 3	Decrease
Shannon Diversity Index	General measure of sample diversity that incorporates richness and evenness (Shannon and Weaver 1963)	Decrease
Tolerance/Intolerance Measures		
Tolerance Value	Value between 0 and 10 weighted for abundance of individuals designated as pollution tolerant (higher values) or intolerant (lower values)	Increase
Percent Dominant Taxa	Percent composition of the single most abundant taxon	Increase
Percent Hydropsychidae	Percent composition of the tolerant caddisfly family Hydropsychidae	Increase
Percent Baetidae	Percent composition of the tolerant mayfly family Baetidae	Increase
Percent Diptera	Percent composition of the tolerant insect order Diptera	Increase
Percent Non-Insects	Percent composition of the generally tolerant non-insect taxa	Increase
Percent Chironomidae	Percent composition of the tolerant dipteran family Chironomidae	Increase
Percent Intolerant Organisms	Percent of organisms in sample that are highly intolerant to impairment as indicated by a tolerance value of 0, 1 or 2	Decrease
Percent Tolerant Organisms	Percent of organisms in sample that are highly tolerant to impairment as indicated by a tolerance value of 8, 9 or 10	Increase
Functional Feeding Groups (FFG)		
Percent Collectors	Percent of macrobenthos that collect or gather fine particulate matter	Increase
Percent Filterers	Percent of macrobenthos that filter fine particulate matter	Increase
Percent Grazers	Percent of macrobenthos that graze upon periphyton	Variable
Percent Predators	Percent of macrobenhtos that feed on other organisms	Variable
Percent Shredders	Percent of macrobenthos that shreds coarse particulate matter	Decrease

(also referred to as the "Triad Approach") would be warranted in the future if the bioassessments indicate that degradation is occurring, but may not be desired at the current time because of cost considerations. The City of San Diego Water Department currently performs chemical, physical, and bioassessment in Jamul Creek at the USGS gauging station, which is the largest tributary to Lower Otay Reservoir.

Bioassessment sites and sample times should be chosen carefully to obtain assessments that are most representative of ambient conditions, and avoid locations where physical constraints might prevent development of robust biological activity. A bad score during a baseline study may indicate that there are physical constraints in the system, but declining scores, irrespective of the starting point, would clearly indicate that BMPs were not working as intended, either because of changes in in-stream chemistry or channel degradation.

Table D-3 describes Benthic Macroinvertebrate (BMI) metrics that may be used for bioassessments and their expected responses as a receiving water becomes impaired. The expected baseline levels of BMI metrics will vary depending on location on the watershed. If the bioassessment indicates a decline in

bioassessment metrics, the monitoring plan would initiate an investigation, including additional chemistry and toxicity tests if necessary, to identify the possible causes of the degradation. If future bioassessments indicate little or no change in biological functioning and urbanization/development has occurred in these watersheds, it is a positive indication that the BMPs are effectively mitigating the receiving water degradation that would normally occur following development.

D.3 UPPER AND LOWER OTAY RESERVOIRS

Reservoir Monitoring Strategy: *Ambient water quality monitoring plan to determine whether land use changes, fires, or other factors will compromise the use of the reservoirs as a source of drinking water and for recreation.*

Water quality in the Otay Reservoirs may be threatened by a variety of sources. Substantial urbanization has occurred along the western shore of the Upper and Lower Otay Reservoirs. Storm water runoff from these areas has the potential to convey sediment, nutrients, and other constituents to the lakes. In addition, a large wildfire in the fall of 2003 exposed much of the area along the banks on the east side of the reservoirs to increased erosion. This erosion may substantially increase the turbidity, and convey large quantities of nutrients to the lakes that might promote eutrophication. Finally, additional development in the Jamul and Dulzura watersheds that rely on septic systems can also increase the discharge of bacteria and nutrients to the lower reservoir. In addition to these residential stressors, activities such as hobby farms and agriculture will also contribute organic input on the watershed. There will also be natural background levels of nutrients and bacteria from wildlife.

This proposed monitoring strategy is designed to build upon existing drinking water protection monitoring programs. The City of San Diego has monitored the quality of water in Lower Otay Reservoir for many years, focusing on parameters related to its use as a drinking water source. This historical monitoring has consisted of hydrographic profiles (temperature, dissolved oxygen, conductivity, pH) and surface-water grab samples, the latter being analyzed for various suites of physicochemical constituents. Any enhanced monitoring program for the Otay Reservoirs would most likely need to be spearheaded by the City of San Diego Water Department, which is in the best position to identify the need for enhanced monitoring and integrate enhanced monitoring strategies into its existing monitoring programs.

Monitoring data for the period of record is confined to the vicinity of the Otay Water Treatment Plant intake near Savage Dam, with sampling intervals of time ranging from weekly to semiannually (depending upon the importance of the parameter). However, for periods in the past, the City of San Diego has monitored water quality at stations along the main axis of the reservoir to determine spatial variability of water quality, and has maintained automated profilers to observe short-term time variability in key hydrographic parameters.

The present concern is the quality of the reservoir as an environmental resource, which introduces considerations that require expanded baseline data collection. The primary issues are the potential for hyperstimulation of productivity, increased turbidity, increased TDS, and the introduction of organic pollutants. Hyperstimulation (popularly, eutrophication) is manifested by excessive blooms of phytoplankton and growth of stands of rooted aquatic plants (macrophytes). It is the result of increased loadings of nutrients, notably phosphorus and nitrogen compounds, due to both point and non-point pollution. Increased turbidity (diminished water clarity) can be either biological or physical in origin. The anticipated peripheral and watershed development of Upper and Lower Otay Reservoirs can entail increased sediment loadings and associated increased turbidity due to suspended matter. Algal blooms, associated with eutrophication, are the primary biological cause of increased turbidity. These two

sources of turbidity can oppose each other: increased turbidity due to inorganic suspended matter can suppress photosynthesis and thereby mask the high productivity that is symptomatic of hyperstimulation.

Enhanced Water Quality Monitoring of Otay Reservoirs

The necessary monitoring program has two strategic objectives: (1) characterize the hydrographic structure of the reservoirs; (2) characterize the biochemical quality of the reservoirs. "Hydrographic structure" includes the seasonal development and dissolution of stratification, as well as the response of the reservoirs to transient events such as storms and floods. With seasonal heat influx, the lake develops a two-layer structure, of which the upper aerated layer is most important for the biological functioning of the reservoir. The seasonal stratification is indicated by the thermocline depth and stability (both of which are quantified from vertical profiles of temperature in the reservoir). The "biochemical quality" of the reservoir refers to both the suite of chemical parameters that typically control biological processes, and the measures of biological response. "Characterize" includes delineation of the variation of the structure and biochemical measures in both space and time.

Because of the expense of frequent sampling at multiple stations, the intensity of the sampling program is always a compromise between the urgency of the data and the available resources. In particular, before there are indications of water-quality degradation, it is prudent to implement the sampling program at the minimum intensity necessary to detect such alterations in water quality. The City of San Diego's present strategy of routine monitoring at its primary station near Savage Dam, combined with the analysis of its historical data, should suffice for this purpose.

Once symptoms of degradation of biochemical quality become manifest, it may be necessary to perform profiling and water sampling at a series of stations distributed through the reservoir (depending upon the nature of the biochemical problem). At the outset, this should be approximately five stations on the mainstem (thalweg) of the Lower Otay Reservoir from the dam to the upper reaches of the Jamul Creek arm, and one station in Upper Otay Reservoir. At each station, vertical profiles of temperature, dissolved oxygen (DO), conductivity and pH should be obtained with increased resolution (on the order of a meter) in the layers in which the variables undergo substantial changes (e.g., the thermocline layer). Water samples from the surface layer will be analyzed for nitrogen and phosphorus series, total suspended solids, chlorophyll-a, turbidity, coliforms, and enterococci. Pending additional information on the specific nature of the developing water quality problem, the sampling interval should be monthly around midday. As data are collected and analyzed, both the station distribution and the sampling interval will be adjusted as necessary, and over time, the suite of analytes will be revised to better reflect present and probable future conditions. The presence of nuisance algae (evidenced by discolored, turbid water, and floating mats) or development of stands of microphytes should be especially noted from field surveys, and may motivate station selection.

As data collection progresses, particularly if symptoms of hyperstimulation become evident, it may be desirable to moor automated recording sondes, which monitor DO, temperature, and conductivity, for several days in the most affected regions of the reservoir to determine the photosynthetic diurnal variation in oxygen. These data will allow the direct computation of primary production, as well as related DO kinetic terms such as biochemical uptake and surface reaeration. In addition to the mainstem stations, it may be desirable to occupy stations in coves along the shore(s) of maximal future development. Eutrophication is generally first manifested in the coves and inlets of a lake. These are the regions that usually receive direct storm runoff, and moreover, are shallow, relatively sheltered segments, so that nutrients may accumulate and stimulate the growth of flora. Whether such a strategy

is warranted for Otay will depend upon the nature of development, the foci of discharges into the lake, and the spatial distribution of impacted areas.

It is assumed that the physical operation of the reservoir is adequately quantified, by routine recording of lake surface elevation, an accurate set of capacity-area-elevation relations, and relatively recent bathymetry, as well as historical data on pumpage, imports, diversions and spills, to enable a closing of the volume budget of the lake for at least a monthly time resolution. Any deficiencies in this sort of data should be repaired by the necessary measurements being incorporated into the baseline monitoring program.

In addition to measuring water quality responses in the reservoirs, it will also be important to measure stimuli (i.e., the inputs) to the reservoir system. Development in upstream watersheds has the potential to perennialize streams and thus introduce increased flow volume and pollutant loading to the Otay Reservoir system during periods when historically there has been little or no flow. Monitoring these additional inputs can begin on an as-needed basis as part of the existing sampling program, grabbing samples when unanticipated dry-weather flows are noted at established monitoring stations (e.g., Jamul and Dulzura Creeks for the eastern arm of the Lower Reservoir, and Proctor Valley Creek at the Upper Otay Reservoir). If unanticipated dry-weather flows persist, it will be necessary to evaluate the benefit of stepping up the monitoring program to account for the perennialized flow, either with increased sampling frequency, an increased number of monitoring stations, or both. The goals of a more intensive monitoring program would be to better define the potential threat to the beneficial uses of the reservoir (for instance, better define the increased cost of water treatment due to the increase in pollutant loading), establish a basis for taking corrective measures upstream (if necessary), and monitor the effectiveness of any such measures taken.

D.4 LOWER WATERSHEDS

Lower Watershed Strategy: *Ambient and wet weather monitoring plan to document baseline conditions and trends associated with urbanization with an emphasis on potential impacts to the designated beneficial uses.*

Substantial urbanization has already occurred in portions of the Otay River watershed below the reservoirs, and additional changes in land use are expected in the coming years. This urbanization increases the volume and rate of storm water runoff. This runoff may also be of lower quality than would occur in natural conditions. The effects of this urbanization will be seen in the tributaries and on a river system that has had 100 years to adapt to the hydrologic regime imposed by the dam. Since 2001, the Municipal Permit has mandated implementation of treatment-control BMPs to counter the effects of urbanization on runoff rate and quality. Implementation of BMPs may reduce these changes, but it will be difficult to quantify this reduction without better data on current and future streamflow and water quality.

In addition, approximately 20 leaking underground storage tanks (LUSTs) have been identified within the Lower Otay Watershed. Fortunately, almost all of these sites are currently undergoing site assessment or have remedial action already underway. Contaminated groundwater discharges could impact all of the designated uses of the Lower Otay Watershed (see Section B.5.6.2, Groundwater Quality, and Figure B.5-22). By inspection of the groundwater features near these underground storage tanks, it is clear that they pose a direct threat to the San Diego Formation Aquifer. If this contaminated groundwater were discharged into Otay streams as baseflow, there could be significant surface water quality impacts. Another threat to the lower basin is increased erosion of stream channels.

A particularly important consequence of urbanization is channel instability, which impacts many beneficial uses and contributes to other identified problems. This problem is caused by natural channel change, development inside the watershed, increased flood flow peaks and/or volumes, and increased dry weather discharge and reduced sediment supply. Lowering of the channel invert, which historically would be interspersed with periods of channel aggradation (or infilling), turns into an increasingly destructive trend as the cyclical erosion and fill cycle has been replaced by continued degradation (general scour). Many of these impacts may be more prevalent in the tributaries such as Salt Creek, rather than in the main Otay River channel.

The majority of the sediment load from the upstream reaches of the Otay is deposited upstream of Savage Dam and is not allowed to continue into the lower reaches. This disruption of the natural aggradation/degradation process coupled with the slight erodibility of soils in the lower basin combine to greatly increase channel erosion and incision. Monitoring of sediment transport rates in the lower reaches is critical to design controls for channel stabilization and rehabilitation. Sediment transport monitoring is also critical in this area because the area immediately east of Chula Vista is slated for development to exceed 30 percent impervious cover. This increase in impervious cover will further reduce times of concentration and increase peak flows during storm events, hence the capability of storm hydrographs to erode the channel.

D.4.1 Habitat Protection

Protection of the beneficial uses associated with wildlife (WARM, WILD) requires preservation of the water quality in the system and the morphology of the existing channel and riparian corridor. The monitoring strategy to evaluate the water quality component should be based on the use of bioassessments.

D.4.1.1 Bioassessments

Regular bioassessments provide an integrated approach to assessing changes in the river ecosystem and water quality and provide a direct measurement of the degree to which the river supports the WARM beneficial use designation. Previously collected data upstream of the reservoirs (Table D-2) can provide good benchmark information for comparison with the data collected in the Lower Watersheds. As described in Section D.2.3, typically, a bioassessment should be conducted semiannually or annually using the protocol applied in the previous studies by the San Diego Stream Team (*http://sdstreamteam.org/*) to facilitate comparison with historical data.

At this stage of planning, it is difficult to delineate specifics of a bioassessment monitoring program. Station selection should be based upon representativeness of the combination of morphology and plant life, proximity to potential future development areas, and historical bioassessment surveys. Most important is building up a series of bioassessment surveys over time at established locations. While new stations can be added in the future in response to changes in the watershed, this should be in addition to, and not at the expense of, established bioassessment stations. While semiannual surveys are standard, an annual survey interval could be satisfactory for long-term monitoring. Moreover, limited stream flows might necessitate annual surveys. It is important that if the surveys are conducted annually, they should occur when ecosystem communities and hydrometeorology are stable in time, normally around late May or June of each year.

D.4.1.2 Channel Stability Assessments on Salt Creek

The second monitoring element is the assessment of channel stability. Changes in the rate of erosion can have dire and costly consequences for urban infrastructure installed in or adjacent to stream

channels and impair RARE and WILD beneficial uses. Salt Creek is particularly susceptible to these problems because of the degree of urbanization expected in its watershed.

Urbanization has already eliminated much of the riparian habitat in the lower Otay River watersheds, and threatens those along Salt Creek. Figure B.3-11 summarizes the relative hydrologic integrity of riparian reaches on the Otay River watershed. Smith (2004) calculated a Hydrologic Integrity Index score for 212 riparian reaches comprising the Otay River system in order to assess the change in the hydrologic characteristics (e.g., frequency, magnitude, and temporal distribution of stream discharge, baseflow, and flood patterns) relative to historical hydrologic characteristics of culturally unmodified riparian ecosystems in the region.

Because of the scarcity of data for the Otay River watershed, the Hydrologic Integrity Index was tied to two types of characteristics: (1) those that influence on the frequency, magnitude, and temporal distribution of stream discharge; and (2) characteristics that influence the hydrologic interaction between the stream channel, floodplain, and historical terraces. The Hydrologic Integrity Index thus provides an indirect estimate of deviation from reference condition based on changes in specific characteristics and processes of a drainage basin such as interception, infiltration, evapotranspiration, percolation, groundwater flow, and surface water flow overland and in channels.

Salt Creek runs north to south along the western side of the Otay Reservoir. The headwaters of Salt Creek are located near Mother Miguel Mountain. There are several small water reservoirs near the foot of the mountain and the Auld Golf Course. The upper part of the Salt Creek watershed is undergoing significant urbanization, with major road crossings with culverts at Proctor Valley Road, Otay Lakes Road/Wueste Road, and Olympic Parkway. Hunte Parkway generally runs parallel, but offset by several hundred feet, on the west side of the creek between Proctor Valley and Otay Lakes Road. Salt Creek Road is an unimproved road that runs parallel on the east side creek below Olympic Parkway, much closer to the drainage course. The Salt Creek watershed below Olympic Parkway is generally open-space preserve, but there are two underground aqueducts that transect the watershed on their way to the Otay Water Treatment Plant. Salt Creek confluences with the Otay River just upstream of the planned State Route 125 crossing.

Consequently, a program to characterize changes in channel morphology is recommended for Salt Creek. This program will assess the effectiveness of storm water BMPs implemented in the new developments and determine whether they are successfully preventing downstream impacts. One method to characterize the stream morphology is the Rosgen system. The Rosgen system exploits the fact that streams tend to organize themselves around the most likely combination of variables based on physical and chemical laws. This tendency to seek a dynamic equilibrium reflecting landscape conditions in a watershed lends itself nicely to classification. The Rosgen classification system assessment should be completed for selected stream reaches in Salt Creek every two years to track changes to the stream cross-section and profile. This assessment should include reaches downstream of Olympic Parkway as well as one or two upstream reaches that are surrounded by development. One would expect that the overall cost of a limited monitoring effort (e.g., two or three cross-sections) on one creek might be on the order of $50,000 to $100,000 over a period of several years.

D.4.1.3 Stream Gauging on Otay Main Stem at I-5

Changes in river and stream morphology are generally related to changes in the volume and rate of runoff and sediment supply. Implementation of BMPs may reduce these changes, but it would be difficult to quantify without better data on current and future river discharges. Consequently, a permanent station to monitor river discharge rates is warranted in the lower part of the watershed.

The establishment of a river gauging station on the main stem of the Otay River near its mouth would also provide useful information for assessing the impact of overflow from Otay Reservoir, urbanization, and other land use changes. It would also allow evaluation of the degree of perennialization of the streams in the watershed. A location near the crossing of I-5 would integrate the changes in runoff volume and rate. Usage of data collected on the Otay Main Stem downstream of the Otay Dam must account for the influence of possible overflows from the Otay Reservoir, which would have the effect of diluting samples and make them less representative of runoff originating from the lower watersheds. The station could also be used to establish a water quality monitoring site should one be desired in the future. Data on water quantity and quality collected in this area would be of particular interest to the USFWS and proponents of the OVRP, who are planning restoration activities along the lower Otay River. Water quality monitoring station construction and operation costs can range from $10,000 to $100,000 depending on location, configuration, and sampling protocol.

D.4.2 Recreation

The Lower Watersheds of the Otay River have recreational designated beneficial uses (REC1 and REC2). In addition, the river discharges to San Diego Bay, which also has recreational uses. These uses in the watershed may be impaired by the changes in channel configuration described above or by reduction in water quality.

D.4.2.1 Water Quality Monitoring on Otay River Main Stem

The primary water quality concern is that increases in bacteria concentrations in dry weather flows may adversely affect designated REC1 and REC2 beneficial uses. Consequently, monitoring should include:

- fecal coliform
- total coliform
- enterococci

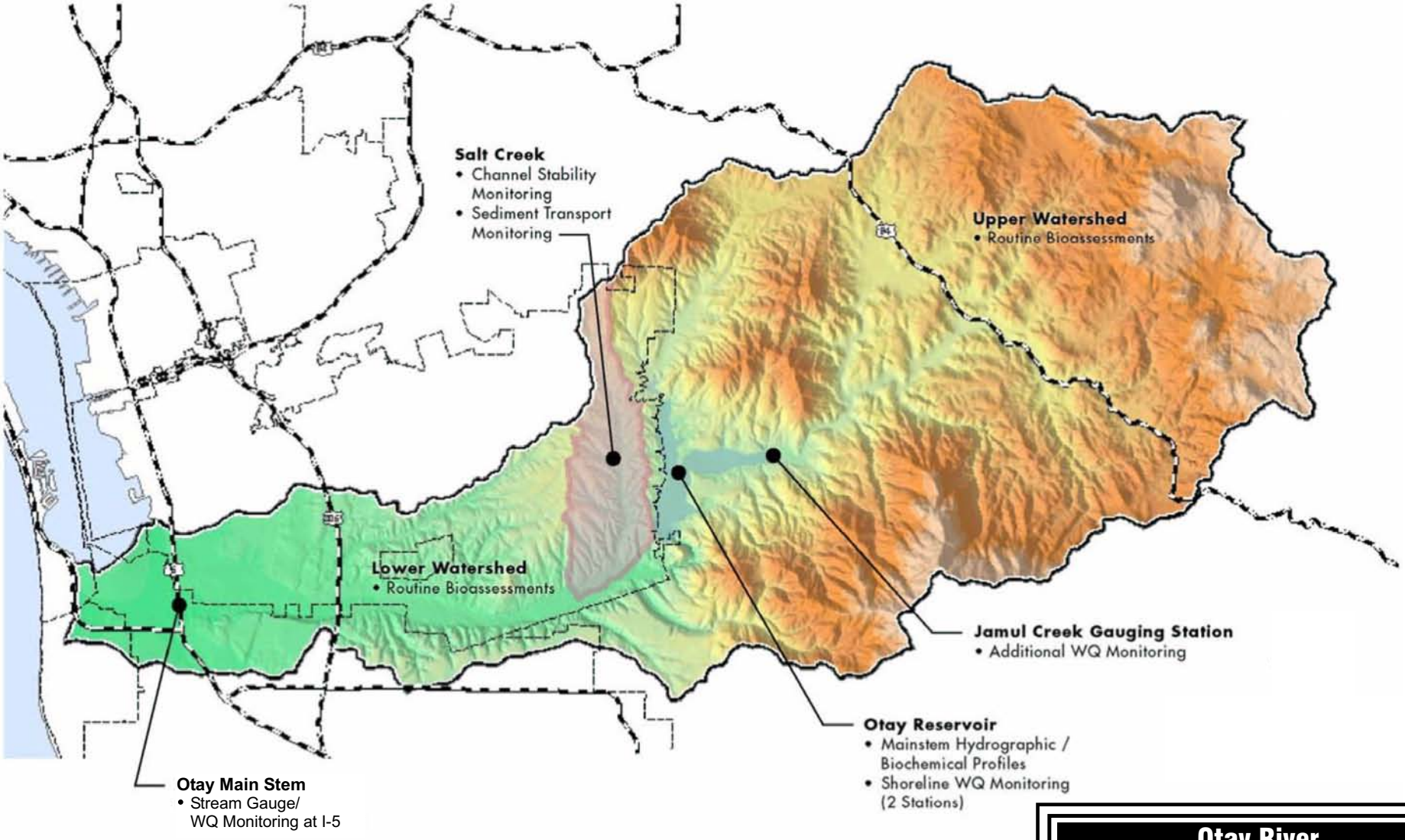
These various indicator organisms were chosen to provide a comparison with historical data from this area and to assess compliance with objectives that are now being adopted for beaches and waterways in the San Diego area.

Bacteria may increase in baseflow from sewer overflows, pet wastes, the homeless, and other sources. These are conveyed to the river by storm water runoff or non-storm discharges resulting from excess irrigation, car washing, or other activities that generate dry weather flows.

Bacteria concentrations are commonly high in storm water runoff, even in relatively undeveloped watersheds. Consequently, it is important also to characterize bacteria concentrations under ambient conditions (in dry weather) to evaluate the potential impact of leaking sewer lines, septic system failure, and other sources of bacteria on water quality. In addition, these are the periods when contact recreation is most likely to occur. Ambient monitoring should occur a minimum of four times annually, during both winter and summer, following a period of at least one week without rainfall.

D.5 WATERSHED WATER QUALITY MONITORING STRATEGY SUMMARY

The water quality monitoring strategy for the Otay River watershed establishes a basis for a long-term monitoring program for the watersheds and reservoirs to establish baseline conditions, identify trends in degradation, isolate sources of contamination, and determine effects of management practices. Table D-4 and Figure D-1 summarize the water quality monitoring strategy for the Otay River watershed.



Source: RBF Consulting, 2005

Otay River Watershed Management Plan

Figure D-1
Water Quality Monitoring Strategy for the Otay River Watershed

Aspen Environmental Group

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Table D-4 Summary of Water Quality Monitoring Strategy for Otay River Watershed

Watershed Region	Target Beneficial Uses	Monitoring Strategy
Upper Watersheds	Recreation Water Supply Habitat Protection	Permanent water quality monitoring station on Jamul Creek to monitor nutrient and bacteria loading to the Otay Reservoirs. Ambient monitoring focused on characterizing concentrations of indicator organisms under baseflow conditions.
Upper and Lower Otay Reservoir	Water Supply	Enhance existing water quality monitoring in response to manifest changes in reservoir water quality. Expanding the existing monitoring program on as-needed basis to characterize increases in runoff volume and the biochemical quality of perennialized flow due to urbanization.
Lower Watersheds	Habitat Protection Recreation	Bioassessments. Channel stability assessments on rapidly urbanizing watersheds (Salt Creek). Water quality monitoring on Otay River Main Stem

Upper Watersheds. *Ambient and wet weather monitoring plan to document baseline conditions and trends with an emphasis on potential changes associated with the widespread use of septic systems in the watershed*. The strategy is to install a permanent water quality monitoring station at the USGS Jamul Creek gauging station to monitor loads of nutrients and bacteria discharged to the Otay Reservoirs. This will be supplemented with ambient monitoring focused on characterizing concentrations of indicator organisms under baseflow conditions.

Reservoirs. *Ambient water quality monitoring plan to determine whether land use changes, fires, or other factors will compromise the use of the reservoirs as a source of drinking water and for recreation*. The monitoring strategy is designed to build upon existing drinking water protection monitoring programs and has two strategic objectives: (1) maintain existing water quality monitoring within the reservoir, and enhance the program in response to water quality problems if needed; (2) characterize the biochemical quality of inputs to the reservoir, expanding the existing monitoring program as necessary to characterize increases in volume and pollutant loading due to perennialization of flow.

Lower Watersheds. *Ambient and wet weather monitoring to document baseline conditions and trends associated urbanization with an emphasis on potential impacts to the designated beneficial uses*. This effort has multiple objectives. The first objective is to document changes in channel stability from storm water runoff associated with urbanization, which is the product of the channel stability assessments. The second objective is to quantify current and future concentrations of bacteria that impact recreational uses in the river and bay through a dry weather monitoring program. Finally, the monitoring effort will provide the data for an assessment of urbanization on the water balance for the watershed through establishment of a stream gauging station near the mouth of the river.

D.6 OVERVIEW OF WATERSHED RESOURCE PROTECTION, ENHANCEMENT, RESTORATION, AND MANAGEMENT STRATEGIES

Table D-5 again lists the strategies identified to protect, enhance, restore, and manage the watershed's resources going forward. While several of these strategies address water quality and water quantity stressors, others focus on other anthropogenic and natural watershed stressors. Details for these strategies, including their prioritization, are provided in Section C.

Table D-5 List of Strategies by Priority

Priority	Strategy
High	• Eradicate Non-Native Flora and Fauna and Prevent Reinfestation and New Introductions
	• Maintain, Enhance, and Restore Habitat Linkages and Wildlife Movement
	• Restore the Lower Otay River Floodplain to Enhance the Quality of Water Entering San Diego Bay
	• Implement Setbacks or Buffers Around Aquatic Resources for New Developments
	• Limit Future and Remove Existing Trash and Debris
	• Protect Drinking Water Quality in the Reservoirs
	• Limit Impervious Surface Area
	• Implement a Watershed-Wide Education Program to Improve Public Awareness and Stewardship
	• Form a Watershed Council or Equivalent to Implement and Update the Watershed Management Plan
Medium	• Retrofit Existing Developments as Necessary to Protect Aquatic Resources
	• Restore Urban Creeks
	• Implement Comprehensive Agricultural Land BMPs to Protect Aquatic Resources
	• Improve Existing and Create New Recreational Facilities
	• Manage Tecate Cypress Forest and Oak Woodlands
	• Achieve Consistency in Regulations in Conjunction with the Special Area Management Plan
Low	• Preserve, Enhance, and Restore Additional Floodplain Parcels Within the Otay River Watershed
	• Protect, Enhance, and Restore Cultural Resources

D.7 BASIS FOR ADAPTIVE MANAGEMENT

Adaptive management is a broadly used term, but it focuses on revising approaches to incorporate what has been learned from previous work; typically, in a step-wise, experimental manner (Holling, 1978). Adaptive management in a general sense is critical to watershed management planning, particularly in southern California. Adaptive approaches are necessary because conditions and stressors are so complex and variable, it is virtually impossible to identify completely effective strategies upfront. In the case of the Otay River watershed, there are key gaps in information, such as understanding and predicting the full range of effects of the San Diego wildfires of 2003 on the watershed's hydrology, geomorphology, water quality, and biology, which make it difficult to plan for future watershed changes. Moreover, with the very limited water quality monitoring in this watershed to date, there are significant uncertainties regarding the constituents that actually threaten the system and what approaches would be most effective in minimizing or eliminating adverse effects to its beneficial uses. The watershed water quality program presented in Sections D.1-D.5 is intended to fill some of these gaps in understanding. Until better understanding of the watershed is gained, assumptions have to be made, based on land use and water quality studies conducted elsewhere in southern California, pollutant loading modeling, and best professional judgment.

There are six main steps in adaptive management: (1) identification of the problem or management goal; (2) design of the management action or implementation plan; (3) implementation; (4) monitoring of management results; (5) evaluation of the results relative to the desired management goals; and (6) adjustment of management actions. The trigger for a change in the management approach/actions

occurs when management results have not achieved the desired management goals. The assumptions underlying management goals must be stated explicitly and considered as hypotheses to be tested by carefully designed and implemented monitoring programs that are, in effect, management experiments. Ideally, management actions would be designed and implemented with experimental control sites and replication that would allow statistical interpretation of management results. This may be possible for some management actions in some protected areas, but is not a realistic expectation for all management actions across the whole Otay River watershed. At a minimum, careful measurement of key environmental and biological variables before and after the management action can provide some insight into the effects of management at that particular site.

D.8 PERFORMANCE INDICATORS

Even if everything were known about current conditions, watersheds in this region are naturally dynamic systems and anthropogenic activities can rapidly and significantly change them. Therefore, it is critical to develop reliable means of evaluating condition changes and the effectiveness of strategies intended to protect, enhance, restore, and manage watershed resources. A common approach is to employ a suite of metrics or indicators that can be monitored over time, to evaluate the performance of implemented strategies toward achieving success.

Indicators are qualitative or quantitative measures related in some way to an assessment endpoint, such as habitat integrity. An example of a qualitative indicator is presence/absence of wildlife; an example of a quantitative indicator is tree basal area, which is an indirect metric for tree biomass. There are also direct metrics, which are quantitative direct measures of an endpoint (e.g., cubic feet per second is a direct metric for measuring the stream discharge endpoint). When dealing with complex ecosystems (such as watersheds) and abstract notions such as health and integrity, it is rare to identify a direct metric that can be used cost effectively. Instead, most assessment methods today use indicators. Indicator-based methods include the Habitat Evaluation Procedure (HEP) (USFWS, 1980), Index of Biological Integrity (Karr and Chu, 1997), the Hydrogeomorpohic (HGM) Approach (Brinson, 1993), and the California Rapid Assessment Method (CRAM) for Wetlands, which is currently being developed as a joint effort between the San Francisco Estuary Institute and the Southern California Coastal Water Research Project (Collins *et. al.*, 2004, version 3.0). As described in Sections D.1-D.5, the Corps' Engineering and Research Development Center (ERDC) recently used an indicator-based approach to evaluate the riparian ecosystem integrity of the Otay River watershed (Smith, 2004). The Corps will use this approach to evaluate land use and resource alternatives as part of the Special Area Management Plan being developed for this watershed.

In the Otay River watershed, a broad suite of indicators should be monitored and evaluated as strategies are implemented, which can be used to track each strategy's progress in meeting identified objectives and broader goals. Several biological, water quality, hydrologic, geomorphic, socioeconomic, and land use indicators were identified for this purpose early in the ORWMP-development process (Appendix 6). These and a few other recently added indicators are identified in Table D-6. While many of these indicators can be used to monitor the effectiveness of specific strategies, others, such as population and housing density, and population growth, have broader application in the watershed and can be used to conduct trend analysis; similar to the water quality monitoring program described in Sections D.1 to D.5.

For the indicators used, threshold values/conditions or objectives need to be identified to distinguish beneficial from adverse changes. For many beneficial uses, the *Water Quality Control Plan for the San Diego Basin (Region 9)* (San Diego Basin Plan) has identified water quality objectives that can assist this evaluation. Appropriate objectives also need to be identified for other indicators that are used. As

with all components of the ORWMP, the indicators and objectives proposed and implemented will be subject to change. Specific indicators or objectives could be deleted, modified, or added to ensure that the effectiveness of strategies or activities is measurable and adequately gauges achievement of objectives and broader goals. What follows is an overview of proposed indicators, including how they would be monitored.

Table D-6 List of Indicators

Water Quality, Quantity, and Geomorphic Indicators	Biological Indicators	Socioeconomic and Land Use Indicators
• Bioassessment Program • Permanent Stream Gauging Station • Channel Stability Monitoring • Ambient Bacteria Monitoring • Water Quality Monitoring • Trash Monitoring • Percent Impervious Cover	• Vegetation Community Mapping and Monitoring • Individual Species Monitoring • Focused Species Surveys • Exotic Species Monitoring • Wildlife Movement Studies • Edge Effect Monitoring • Biological Trend Analysis	• Population and Housing Density • Population Growth • Land Cover types • Projections of Future Land Use Changes • Awareness/Attitude Survey • Update to jurisdictions' review and approval processes

D.8.1 Water Quality, Quantity, and Geomorphic Indicators

The following indicators, approaches, and beneficial uses are described further in Appendix 6 and Sections D.1 to D.5. As previously discussed, the watershed water quality monitoring strategy would employ several of these indicators to establish valuable baseline information and allow hydrogeomorphic and water quality trend analysis for the larger watershed. As described in Section D.9, the following indicators could also be used to monitor the effectiveness of several of the specific protection, enhancement, restoration, and management strategies.

D.8.1.1 Bioassessment

As discussed in Section D.2.3, regular bioassessments provide an approach to assessing changes in the river ecosystem and water quality and provide a direct measurement of the degree to which the river supports the WARM beneficial use designation. Bioassessments are completed by collecting insect larva, which have differential tolerances to stream conditions including pollution. Assessments are repeated semiannually or annually at set locations such that data can be easily and accurately compared over time.

D.8.1.2 Permanent Stream Gauging Station

Changes in river and stream morphology are generally related to changes in the volume and rate of runoff and sediment supply. Implementation of BMPs may reduce these changes, but it would be difficult to quantify without better data on current and future river discharges. Consequently, a permanent station to monitor river discharge rates is warranted in the lower part of the watershed. As discussed in Section D.4.1.3, a permanent stream gauging station is recommended near the I-5 crossing of the Otay River, which would integrate the changes in runoff volume and rate. This station could also be used to establish a water quality monitoring site in the future.

D.8.1.3 Channel Stability Monitoring

Changes in the rate of erosion can have dire and costly consequences for urban infrastructure installed in or adjacent to stream channels and impair RARE and WILD beneficial uses. The Rosgen classification system (Rosgen, 1994) assessment should be completed for selected stream reaches on a bi-annual basis to track changes to the stream cross-section and profile. As discussed in Section D.4.1.2., one recommended location is along lower Salt Creek, downstream of the Otay Ranch

development. BMPs have been implemented in the upper part of Salt Creek as part of the on-going development, and monitoring of the lower creek would be useful in determining their effectiveness. The cost of a Rosgen assessment program can vary greatly based on the number of sections established and the frequency of the monitoring effort. One would expect that the overall cost of a limited monitoring effort (e.g., two or three cross-sections) on one creek might be on the order of $50,000 to $100,000 over a period of several years.

D.8.1.4 Ambient Bacteria Monitoring

Increases in bacteria concentrations in dry weather flows may affect designated REC1 and REC2 beneficial uses and further contribute to the impairments already identified in San Diego Bay. As discussed in Section D.4.2.1, ambient bacteria monitoring is recommended in the lower watershed (i.e., near the I-5 crossing of the Otay River). Ambient bacteria monitoring in the upper watershed could also assist in determining whether the septic systems in the upper watershed are functioning properly.

D.8.1.5 Water Quality Monitoring

Conventional water quality monitoring is very problematic on a system with so little flow and may be of limited value because of the lack of historical data with which to compare newly acquired data. Regardless, as discussed in Sections D.2-D.4, a few locations are suggested for monitoring to provide data for evaluating the local relationships between land use types and effects on beneficial uses (e.g., Jamul Creek at the USGS Gauging Station). The San Diego Basin Plan provides water quality objectives for several constituents, including Total Dissolved Solids (TDS), trace metals, and fecal coliforms. For example, monitoring of TDS can provide a measure of the degree to which the receiving water supports AGR, MUN, IND, and PROC beneficial uses; however, urbanization is unlikely to increase TDS. The objectives specified in the San Diego Basin Plan for the Otay River watershed provide useful initial threshold values for water quality evaluations in this watershed. Moreover, enhanced water quality monitoring is recommended for the Otay Reservoirs; focused on hydrographic structure (i.e., seasonal stratification and changes in pH, dissolved oxygen, temperature, conductivity) as well as biochemical quality.

D.8.1.6 Trash Monitoring

Trash and litter are common components of storm water runoff, and Total Maximum Daily Loads (TMDLs) have been developed to address this issue in the Los Angeles area. Monitoring of representative storm drain outfalls (rather than the river itself) may provide useful information on the degree to which trash is contained in storm water discharges. This monitoring could also assist in evaluating the effectiveness of trash-control BMPs.

D.8.1.7 Percent Impervious Cover

Percent impervious cover has received more study recently relative to thresholds for impact to aquatic life. Tracking of percent impervious cover within the watershed can provide additional information in making weight-of-evidence-type evaluations of watershed impact. Research in other parts of the country suggests that impervious surface coverage of as little as 10 percent can have measurable effects on streams, in terms of channel stability and water quality, with severe degradation occurring above 25 percent (Scheuler 1994; Center for Watershed Protection, 1999). While the results might not be applicable in the Otay River watershed, a recent study by the Southern California Coastal Water Research Project suggested that impervious surface cover of as little as 2-3 percent can result in ephemeral and intermittent stream incision and widening within small (less than 5 square miles)

watersheds in southern California (SCCWRP, 2005). The County of San Diego Department of Planning & Land Use's Watershed Planning Program has conducted studies on impervious surfaces in the San Diego River watershed (County of San Diego DPLU, 2003). Their study recommended maintaining areas with 15 percent or less impervious surface coverage below this figure through low intensity development and acquisition of open space; similarly, their research recommended redevelopment and retrofitting of developments in areas exceeding 40 percent impervious cover to improve water quality. Water quality restoration, acquisition of undeveloped land, and impervious cover limits were recommended for areas between 16 and 40 percent impervious cover. These are threshold values that can serve as initial objectives for planning purposes. Their research recommended conducting additional studies to further test their findings.

D.8.2 Biological Indicators

Riparian areas may be the most important natural habitat in the western United States. While they comprise less than 1 percent of land area, riparian habitats support the most diverse and abundant wildlife communities. Yet they are disappearing at an alarming rate. In California, an estimated 95 percent of riparian habitat has disappeared during the last hundred years (Grupel and Elliott, 2001). In most cases the loss of riparian habitat was preceded by a degradation in habitat quality that could have been measured by a change in species abundance and habitat composition. These changes in the ecological community have the potential to function as indicators of changes in the riparian and wetland ecosystem as a whole. If appropriately selected, these bioindicators can be used as an effective means to monitor the effectiveness of watershed management activities. The following discussion identifies bioindicators that will be useful for evaluating the effectiveness of wetland and riparian habitat conservation and management activities implemented in the Otay River watershed.

A bioindicator is an ecological unit (such as an individual species or a group of species such as a vegetation community or taxonomic assemblage) that can be monitored over time and that has a correlation of its condition with the condition of other ecosystem elements. Bioindicators used for monitoring in the Otay River watershed should have the following characteristics:

- Bioindicators should be taxonomically well known and easy to identify and distinguish from other species.
- The ecology and/or general life history of the bioindicators should be well understood.
- Bioindicators should be readily surveyed and manipulated such that a field monitor can find, observe, and mark the bioindicators easily.
- Bioindicators should be specially adapted to the conditions of the target riparian or wetland system type. The more specialized the bioindicator, the more sensitive it is to changes such as pollution and habitat modification.
- Patterns observed in the bioindicators should be correlated in other related and unrelated species or components of the ecosystem.

It would be extremely beneficial to coordinate the bioindicators monitored under the ORWMP with those being monitored under the MSCP; this includes vegetation communities and individual species. The monitoring conducted for the MSCP could be very useful for evaluating progress in achieving the ORWMP's goals and minimizing additional monitoring (and cost) required under the ORWMP.

Species bioindicators are described in Sections D.8.2.3 to D.8.2.5. For vegetation communities, it is particularly important to have an up-to-date map of the vegetation communities in this watershed. Toward this end, the regional vegetation mapping conducted for the MSCP ten years ago has been updated for this watershed using sources discussed below. The updated vegetation community baseline

can provide a large-scale basis of comparison to evaluate the progress and success of different implemented strategies as well as watershed trends.

In addition to vegetation communities, there are several species that could be monitored to evaluate strategy effectiveness. Monitoring of freshwater macroinvertebrates is useful because these organisms are sensitive to the cumulative effects of a wide range of disturbances, they can respond in predictable ways to a range of pollution and stressors, they can respond quickly, they are easy to collect and analyze, they typically move small distances so their condition is reflective of the conditions affecting the sampling site, they live long enough to provide a record of environmental quality, and qualitative sampling and analysis are relatively simple. As noted in Section D.2.3, the San Diego Stream Team has collected some bioassessment data in the upper Otay River watershed. There are also several wildlife species that could serve as suitable bioindicators. What follows is a more specific discussion of various floral and faunal indicators that could be monitored to evaluate the effectiveness of one or more strategies and to identify watershed biological trends.

D.8.2.1 Vegetation Community Map Update

Since the creation of the vegetation map 10 years ago, the watershed has experienced rapid urbanization and large-scale natural changes to the landscape such as the San Diego wildfires of 2003 and the heavy rain events of late 2004 and early 2005. These types of anthropogenic and natural events can drastically alter the vegetation communities through direct removal (i.e., clearing for development, clearing by fire, or removal by high flows) and proliferation of non-native exotic species, which are opportunistic and commonly colonize disturbed areas. Therefore, it is critical to update the vegetation baseline for this watershed to prioritize and evaluate accurately the effectiveness of the protection, enhancement, restoration, and management strategies.

As discussed in Section B.6.1, the vegetation community map for this watershed was updated in late 2005. Data sources used to update the watershed vegetation map included: *Planning-Level Delineation and Geospatial Characterization of Aquatic Resources for Otay Watershed, San Diego County, California* (Lichvar and Ericsson, 2003); *Draft Habitat Restoration Plan for Otay Valley Regional Park* (County of San Diego Department of Parks and Recreation, 2005); Rancho Jamul Ecological Reserve vegetation mapping data from the California Department of Fish and Game; Hollenbeck Canyon Wildlife Area mapping data from the California Department of Fish and Game; East Otay Mesa vegetation mapping; and AirPhoto USA 2004 true color orthophotos. However, the vegetation mapping for the watershed outside of these updated areas is still based on the regional 1995 data and should be updated as soon as possible. Any additional current data sets for this watershed could be incorporated into the GIS database as they become available.

The 2005 watershed vegetation update used 2004 aerial true-color orthophotos to identify additional areas developed since the previous mapping, and integrated these data and the various data sets into the GIS database, including polygon edge mapping where practicable and cross-walking these sources to ensure category consistency. The updated GIS database allows for spatial analysis of the vegetation communities, with the power to track larger-scale changes over time. The updated vegetation map provides a more accurate and valuable watershed-level baseline for comparison after subsequent vegetation monitoring; however, as noted, data for some watershed areas are ten years old.

D.8.2.2 Vegetation Community Monitoring

Riparian and wetland vegetation communities should be used as a bioindicator to provide information for a variety of different purposes, including identifying and prioritizing management actions, tracking

the response of communities to management actions, assessing systematic vegetation community patterns that may be an expression of human-induced or natural stresses, and evaluating vegetation patterns that may help explain observed distributions and abundance of wildlife species. In addition, monitoring vegetation communities would identify the areas suitable for surveys of the site-specific faunal indicator species described later in this document.

Identifying structural diversity is important in managing riparian biodiversity and integrity for the following reasons:

- Young communities support a different fauna than mature communities.
- Healthy riparian ecosystems have mature, intermediate, and young components (i.e., age and habitat structure).
- If a mature plant community is not being replaced by younger individuals (i.e., regeneration), the vegetation type and associated species may senesce and may eventually be lost over time.

Vegetation community monitoring data should be used to evaluate the following:

- The distribution of vegetation communities, seral phases and habitat structure (i.e. presence and relative cover of herb, shrub, and tree species helps to define habitat composition structure), diversity of native flora, dominant species, percent of bare ground, presence of saplings and young plants (age structure), levels of disturbance, and change over time. Disturbance factors include relative abundance of exotic species, vehicular traffic, trampling, erosion, urban runoff, trash, habitat loss as a result of development activities, etc.
- Changes in vegetation communities related to changes in sensitive species distributions.
- Changes in vegetation communities that may require management actions.

While the updated vegetation map provides a more useful baseline for monitoring vegetation communities against, it lacks specificity on riparian and wetland structural diversity and levels of disturbance (e.g., level of disturbance, relative abundance and distribution of exotics, successional stage, etc.). Regarding the latter, identifying and tracking the level of non-native plant infestation is particularly important, as recommended in Section C.9.1.1.

Obtaining this more specific vegetation information would require conducting a field reconnaissance survey of riparian, wetland, and adjacent communities, before initiating active management activities (e.g., habitat enhancement). It is important to consider the adjacent communities because their condition can have a direct bearing on the riparian and wetland communities (e.g., non-native species in adjacent habitats could invade the riparian and wetland areas). This additional information would provide a more complete baseline for future monitoring and evaluation related to riparian and wetland communities. These data should be incorporated into the GIS database for this watershed as well.

Monitoring to update the watershed vegetation map and to evaluate changes should occur every 5 years for the watershed and more frequently (i.e., every 1 to 2 years in the initial stages of monitoring, and every 2 to 3 years thereafter) in actively managed and monitored areas (i.e., with a focus on riparian and wetland vegetation). In addition, it might be desirable to refine maps more frequently following natural and unnatural disturbance events, such as fire, flood disturbance, adjacent development, or alteration of recreational facilities and activities. Information from these surveys should be incorporated into the GIS database with appropriate attributes and reported to the USFWS and the California Natural Diversity Database (CNDDB) as appropriate for updating their databases.

There are various methods for monitoring vegetation community composition and structure. It is important to develop standard operating procedures for the watershed, such that data collection can be

easily repeated and data can be compared and analyzed from year to year and from location to location. One method that is widely used and easily replicated from year to year is the line transect method (Magurran, 1988). The method can be used to comprehensively sample vegetation to obtain information about the amount of vegetation cover for each stratum, plant species richness and relative abundances, recruitment, the proportion of invasive species, and the proportion of wetland plant species (or hydrophytes per Reed, 1988). Permanent transect locations can be marked and mapped and used for repeat sampling events and photo-monitoring. The standard operating procedures should include field datasheets and detail on how data are to be processed (i.e., recorded, entered into a database, analyzed, and reported). The use of a combination of qualitative (e.g., photo monitoring from the same vantage point) and quantitative (see transect method described above) monitoring techniques is advisable.

Overall, using riparian and wetland vegetation as a bioindicator has the following objectives:

- Document changes in the distribution or characteristics of habitats (e.g., level of exotic species, type change or conversion as a result of urban runoff) that may trigger management actions.
- Document changes in habitats that may correlate with factors such as adjacent land uses, fire, floods, etc. that may trigger management actions.

D.8.2.3 Aquatic/Transitional Habitat Species Monitoring

Aquatic species monitoring, including macroinvertebrates, is one of the most effective ways of monitoring the health of aquatic and wetlands-associated ecosystems. Because many species of aquatic macroinvertebrates require undisturbed adjacent upland areas to complete portions of their life cycle, they can also be good indicators of upland conditions. More information on the utility of monitoring these aquatic organisms and monitoring goals and methods are described in Section D.2.3 and Appendix 6.

Specific terrestrial species in close proximity to aquatic habitat may also be effective indicators of monitoring the health and function of the aquatic ecosystem. For example, the Otay tarplant (*Hemizonia conjugens*) occurs within the floodplain of the Otay River within the OVRP west of Alta Road (Cindy Burrascano, pers. comm.). This population is considered a moderate to minor density of the listed species according to the MSCP. In accordance with Table 3-5 of the MSCP Plan, 100 percent of the major population in Otay Valley is required to be avoided through sensitive design and development of the active recreation areas as described in the Otay Ranch Resource Management Plan. Therefore, monitoring the population through the planning and implementation of these recreational areas could provide valuable information regarding their edge effects on this sensitive resource, as well as provide data for trend analysis and adaptive management.

D.8.2.4 Amphibian Species Monitoring

Amphibians are well known for their sensitivity to habitat degradation caused by pollutants and changes in hydrologic conditions. They must spend at least part of their life cycle in the water, and because they tend to have highly permeable skin, they are highly vulnerable to toxins, which are readily absorbed. Eggs are particularly susceptible to pollutants, and exposure often results in abnormal development. In addition to poor water quality, amphibians are sensitive to environmental alterations that result in changes in sedimentation rate and water flow. Amphibian species often have very particular micro-habitat requirements for each life stage in order to fully develop, and any changes in these conditions can have devastating effects that are manifested very quickly. However, long-term monitoring of amphibian species is essential. Populations may fluctuate dramatically due to natural conditions, such as drought, and therefore, a drop in numbers could be due to hibernation or dormancy rather than to an

actual decline in numbers. The introduction of non-native predatory species, such as bullfrogs, game fish, and bait fish has become a significant problem for amphibians. Therefore, any monitoring of one or more amphibians as a bioindicator should also include parallel monitoring of non-native species. Amphibian species in San Diego County include four species of salamanders, three species of toads, and two species of treefrog.

Monitoring methods do not need to follow USFWS-established protocols, unless used to determine impacts to these species, but rather should be designed to yield important information about long-term population trends. Ideally, monitoring methods should be developed based on expert recommendations and established protocols, such as those protocols recommended for long-term monitoring and management of MSCP preserves.

Arroyo Toad

The arroyo toad has the potential to be a suitable bioindicator for aquatic, riparian, and adjacent upland habitat integrity. The arroyo toad breeding habitat is affected by water quality, stream hydrogeomorphology, and sediment substrate conditions. The non-breeding adjacent upland habitat must be available for toads to persist in a given area. The arroyo toad has been well-studied in recent years, so the factors adversely affecting this species are fairly well understood. Furthermore, it is an MSCP-covered species that must be monitored and managed as a part of the MSCP implementation.

The primary populations of arroyo toad in the watershed are on Dulzura Creek; however, potentially suitable habitat occurs in many areas of the watershed. Therefore, monitoring for this bioindicator should occur in all suitable habitat areas. The arroyo toad is listed as a federally endangered species and should be monitored by an experienced and permitted biologist using the following survey method:

- First, survey for and map potential and suitable arroyo toad habitat. If potential habitat occurs in the area, conduct focused night-time surveys for toads, tadpoles, and/or egg masses. In areas of potential breeding habitat, conduct surveys once every 3 years. Conduct at least three site visits between late March and late May. The survey should be conducted by an experienced biologist familiar with the male arroyo toad's breeding call and identification of toad eggs, tadpoles, and adults. Conduct surveys between 1 hour after dusk and midnight on nights lacking a full moon and nights when air temperatures are >55°F. Avoid surveying during rain, high winds, or flood flows. Surveyors must be silent during surveys so as not to disturb calling toads. Use strong flashlights to visually identify adult toads; otherwise, lighting should be kept to a minimum. Surveyors must not enter the water near mating pairs and should not handle any toads. Once toad has been detected, no further surveys should be conducted to avoid disturbing eggs and larvae.
- Survey along the bank of the watercourse 10 feet back from the water's edge. If possible, survey up one bank and back along the other, concentrating on open habitats adjacent to suitable breeding habitats. Stop, listen for calls, then proceed to the next listening point until all suitable habitat has been covered. Shine a bright light ahead to detect eye-shine, and also survey for toads at close range. When crossing the stream, cross at the downstream end of potential breeding areas or on stable substrate to avoid trampling eggs or larvae and to avoid clouding the water with silt, which can smother eggs and young.
- Each sighting of a toad, egg mass, or group of tadpoles should be entered as a separate line on a standard field form, and a GPS reading should be recorded for the location. Condition and degree of disturbance to the habitat should be recorded, and management actions to control or reduce habitat disturbance should be monitored for effectiveness.

D.8.2.5 Riparian and Wetland Bird Monitoring

The relative abundance of bird species in riparian and wetland habitats is a useful bioindicator. Riparian and wetland habitats with a diverse array of bird species including a number of habitat specialists (e.g., least Bell's vireos, southwestern willow flycatchers, yellow-breasted chats) are generally considered of

higher ecological integrity than habitats with lower diversity and only generalist species but few or no specialists. The objectives of riparian and wetland bird monitoring are to: (1) increase our knowledge of habitat use by breeding riparian birds, in general; (2) identify variables that influence the dynamics of populations of least Bell's vireos, southwestern willow flycatchers, yellow-breasted chats, and other obligate riparian bird species that are particularly sensitive to habitat degradation, nest parasitism, nest predation, and other adverse edge effects; and (3) assess the effectiveness of watershed management actions. General riparian and wetland bird monitoring data should be used to determine the distribution and abundance of these bird species populations in the watershed. Monitoring methods do not need to follow USFWS-established protocols, unless used to determine impacts to these species, but rather should be designed to yield important information about long-term population trends. Ideally, monitoring methods should be developed based on expert recommendations and established protocols, such as the orthinological society's protocols or those protocols recommended for long-term monitoring and management of MSCP preserves.

Southwestern Willow Flycatcher, Least Bell's Vireo, Cooper's Hawk, Yellow-Breasted Chat

Focused species monitoring for the southwestern willow flycatcher, least Bell's vireo, and Cooper's hawk, which are MSCP-covered species, and the yellow-breasted chat as bioindicators for riparian habitats should address the following issues:

- Number of pairs of these bird species estimated to be present in the watershed, and what factors influence their occupancy over time.
- Factors that are positively or negatively affecting these species (e.g., are recreational users negatively impacting nesting success).
- Management actions that are effective in maintaining or enhancing the population.

Monitoring for these bioindicators should be completed by experienced and permitted biologists, as necessary, and use the following survey method:

- Surveyors should establish systematic survey routes through patches of suitable habitat, such that the suitable habitat is completely covered. Survey routes should be varied relative to time of day between visits. The surveyors will visit these patches three times during April through June, with at least a 7-day interval between site visits. Taped vocalizations will be used, as needed. The number of pairs of each covered species will be recorded, and notes will be taken on the condition of the habitat (e.g., level of vehicular disturbance, trampling of habitat, relative abundance of exotic species, trash, erosion, drainage conditions, etc.).
- The observer should be skilled in identification, including knowledge of the songs and calls of birds. A USFWS Section 10(a) take permit is required to survey for the southwestern willow flycatcher, and recommended to survey for the least Bell's vireo. Surveys should begin within 1 hour after sunrise and end by 11 AM. Surveys should not be conducted under extreme conditions, i.e., during heavy rain or when the temperature is $>95°F$ or $<40°F$ or with winds >10 mph. Condition and degree of disturbance to the habitat will be recorded, and management actions to control or reduce habitat disturbance will be monitored for effectiveness.

Western Snowy Plover

The western snowy plover, a federally listed species covered by the MSCP, is a potential bioindicator for relatively undisturbed shoreline habitat at the mouth of the Otay River and nearby vicinities in San Diego Bay. Monitoring of the snowy plover as a bioindicator should address the following issues:

- Identify and monitor areas this species uses and how it changes over time.
- The status and trends in the number of breeding pairs.

- The number of breeding pairs relative to habitat availability and distribution and to the activity of mammalian and avian predators.

Monitoring for this bioindicator should use the following survey method:

- Survey all potential western snowy plover breeding habitat annually in April. Map locations supporting this species, and record the number of breeding pairs. Record condition and degree of disturbance to the habitat, and monitor management actions for effectiveness in controlling or reducing habitat disturbance.

If western snowy plover breeding habitat is present, monitor breeding activities, including hatching and fledging success.

Belding's Savannah Sparrow

The Belding's Savannah sparrow is State-listed as endangered and is covered by the MSCP. It is a potential bioindicator for high quality intact saltmarsh habitat. Monitoring of this species as a bioindicator should address the following issues:

- Identify and monitor areas this species uses and how it changes over time.
- The number of breeding pairs relative to habitat availability and distribution and to the activity of mammalian and avian predators.
- Response to efforts at reducing predation or disturbance.

Monitoring for this bioindicator should use the following survey method:

- Annually count the total number of breeding Belding's Savannah sparrow pairs in March. The surveys will consist of circuitously walking through salt marsh habitat and mapping locations of territorial birds, using existing CDFG and USFWS protocols. Note and record the condition and the degree of disturbance to the habitat, and monitor management actions for effectiveness in reducing habitat disturbance. An alternative survey method, which may be used by CDFG, requires conducting annual censuses only in areas of potential human disturbance or where a restoration project is proposed. Under this survey method, a lagoon-wide census of all potentially occupied habitat, as described above, should be conducted every 3 years.

Light-Footed Clapper Rail

The light-footed clapper rail is federally and State-listed as endangered and is covered by the MSCP. It is also potential bioindicator for high quality intact saltmarsh habitat. Monitoring of this species as a bioindicator should address the following issues:

- Identify and monitor areas this species uses and how it changes over time.
- The number of breeding pairs relative to habitat availability and distribution and to the activity of mammalian and avian predators.
- Response to efforts at reducing predation or disturbance.

Monitoring for this bioindicator should use the following survey method:

- Annually conduct spring call counts in appropriate habitat. Conduct call counts between March and early May, in early morning (until two hours after sunrise) or late afternoon (two hours before sunset). In locations where rails are relatively common, all spontaneous rail calls should be mapped. In marshes with few rails, or in long narrow channels or narrow strips of habitat, use taped "clappering" calls sparingly. No surveys should be conducted under rainy or windy conditions. "Duets" and "clappering" should be treated as a rail territory (Zembal, pers. comm.). Note and record the condition and the degree of disturbance to the habitat, and monitor management actions for effectiveness in reducing habitat disturbance. Collect data to test the effects of factors hypothesized to influence the distribution or habitat use by the birds. High tide counts may also be

appropriate to survey for rails. Observers should be stationed around the perimeter of a flooded marsh to observe all clapper rails (Zembal, pers. comm.). A USFWS Section 10(a) take permit is required to survey for light-footed clapper rail.

D.8.2.6 Exotic Species Monitoring

Invasive, exotic species may be the greatest threats to sensitive species and the ecological integrity of the watershed. Careful monitoring and management will be necessary to identify invasions or expansions of these exotic pests and hopefully to control them or minimize their impacts on native resources. Therefore, exotic species presence and abundance can be a bioindicator of an area that has been disturbed from a more natural state. In some cases, exotic species can be completely removed from a system, and in most cases, the exotic species abundance can be reduced to a level that has minimal impact to the natural system. Identifying an exotic species early before it gains a foothold and causes serious damage also provides the best opportunity to remove it from the system with the least cost.

Invasive, exotic plant species pose one of the greatest threats to the characteristics of ecosystems. These species can dominate and cause permanent damage to vegetation communities by altering natural processes and reducing biodiversity. Invasive weeds can destroy wildlife habitat; displace many threatened, endangered, or sensitive species; and result in reduced plant and animal diversity where they form monocultures.

While not studied in this watershed, direct competition between native and exotic plant species is well documented in southern California (Alberts et al., 1993). Furthermore, the successful invasion of exotic species may alter habitats and lead to displacement or extinction of native species over time. For example, exotic invasions have been shown to alter hydrological and biochemical cycles and disrupt natural fire regimes (MacDonald et al., 1988; Usher, 1988; Vitousek, 1990; D'Antonio and Vitousek, 1992; Alberts et al., 1993). While the southwestern willow flycatcher has been noted to nest in exotic tamarisk woodland where it replaced historic flycatcher habitat (i.e., riparian woodland), it is suspected that this behavior over time would produce an ecological sink resulting in a decrease of successfully nesting flycatchers over time.

Invasive or potentially invasive weed species occurring in or near the watershed that may pose threats to native species include but is not limited to tamarisk (*Tamarix* spp.), Pampas grass (*Cortaderia selloana*), eucalyptus (*Eucalyptus* spp.), giant reed (*Arundo donax*), mustard (*Brassica* spp.), African fountaingrass (*Pennisetum setaceum*), tocalote (*Centaurea melitensis*), purple falsebrome (*Brachypodium distachyon*), artichoke thistle (*Cynara cardunculus*), castor bean (*Ricinus communis*), fennel (*Foeniculum vulgare*), Garland chrysanthemum (*Chrysanthemum coronarium*) and ice plant (*Mesembryanthemum chilensis*).

Exotic animal species also can have a significant effect on biological resources, which has been well documented (e.g., Gates and Gysel, 1978; Brittingham and Temple, 1983; Wilcove, 1985; Andren and Angelstam, 1988; Langen et al., 1991; Donovan et al., 1997); most of this literature pertains to effects on wildlife species. For example, both domestic dogs and cats are known to adversely impact native wildlife, with effects ranging from harassment to disturbance of breeding activities to predation (Kelly and Rotenberry, 1993).

Disturbed habitats are often considered vulnerable to Argentine ant invasions. There is evidence that this exotic species rapidly invades disturbed areas within stands of native habitat (Erickson, 1971; Ward,1987; DeKock and Giliomee, 1989; Knight and Rust, 1990; Suarez et al., 1998). Suarez et al. (1998) found Argentine ants are most abundant along the edge of urban/wildlands interface, with

densities of ants in the natural areas decreasing with distance from the edge. They found that ant activity was highest within about 325 feet of the nearest urban edge, whereas areas sampled beyond 650 feet contained few or no Argentine ants. However, Argentine ants have also been found at distances of approximately 1,300 feet and 3,280 feet from the edge, respectively, in other urban reserves in southern California (Suarez et al., 1998).

Argentine ants appear to be confined to low elevation areas with permanent soil moisture (Erickson, 1971; Ward, 1987; Knight and Rust, 1990). Tremper (1976) reported that Argentine ants desiccate more easily and are less tolerant of high temperatures than native ants. Suarez et al. (1998) indicated that the presence of the Argentine ants in urban reserves might be dependent on water runoff from developed areas. Holway (1998) found that the rate of Argentine ant invasion is primarily dependent on abiotic conditions (e.g., soil moisture), rather than on disturbance. He suggested that disturbed areas are often a point of introduction, but encourage invasions only if they increase the availability of a limiting resource such as water. Blachly and Forschler (1996) found Argentine ants thriving in areas disturbed by human activity, but indicated that their presence is also related to added ground cover, permanent water supplies, and a simplified native ant fauna. Monitoring of the presence and density of Argentine ants in natural areas is a potential bioindicator of the edge effects from nearby urbanization. However, because Argentine ants are primarily limited by areas with sufficient soil moisture, once they invade from urban fringes into riparian and wetland habitats, it is possible that they may persist in these moist environments independent of any continued edge effect.

Invasive faunal species (e.g., Argentine ants, parasites) have the potential to negatively impact pollinator populations. Loss or limitation of pollinators may adversely affect the long-term survivability of rare plant species by reducing seed output (e.g., reproductive failure) if there is no selfing (Jennersten, 1988; Bawa, 1990). The Argentine ant is known to displace native ant species (Erickson, 1971; Ward, 1987; Holway, 1995; Human and Gordon, 1996; Suarez et al., 1998). Ants may also function as primary or secondary dispersers of seeds (Roberts and Heithaus, 1986; Louda, 1989). They have been reported to contribute to the spatial heterogeneity of seed distribution (Reichman, 1984, 1979), and they decrease seed abundance of some numerically dominant ruderal species in relation to less dominant native annual species (Inouye et al., 1980). In short, displacement of native ant species by the Argentine ant could negatively affect persistence of rare native plant species by reducing seed number and distribution.

Other non-native animals that may be a threat to sensitive species include red fox, opossum, cats, dogs, black rats, cowbirds, bullfrogs, African clawed frogs, non-native turtles, and non-native fish. Bullfrogs specifically are known to prey on aquatic animals, including several federally endangered fairy shrimp species; amphibians, including arroyo toad; and riparian birds. The presence and relative abundance of these species in natural areas throughout the watershed should be observed and recorded during field reconnaissance and monitoring of other bioindicators.

D.8.2.7 Wildlife Movement Studies

Wildlife movement is a valid indicator for the connectivity of larger blocks of open space throughout the watershed and the health and connectivity of riparian corridors. Large mammals particularly can be tracked over time to study their movement habits, specifically as these animals move along established trails and corridors and often use linear features that provide sufficient cover, such as riparian corridors. Many of these indicator species require multiple habitat types for large-scale movement. This movement is influenced by a variety of factors such as habitat quality, which is defined by the presence of water, forage, prey items, and cover (Jaegar, 2000). Topography, dispersal routes, and species-specific seasonal activity also direct large-scale movement (Carr et al., 2002). For example, mule deer

are more prone to move in areas of dense cover such as drainages (Mansfield and Miller, 1989). In addition, factors such as developed areas and roads with heavy traffic may negatively influence movement patterns and direction (Lovallo and Anderson, 1996).

Wildlife movement studies determine if there are any changes to wildlife movement over time caused by a variety of watershed changes. Monitoring methods can be relatively simple and effective if performed by experts using the same methods at distinct time intervals, taking into consideration seasonal and annual changes in movement patterns and behavior.

- Mountain lion, bobcat, and mule deer are important indicator species due to their wide-ranging movements and large home ranges, and are usually used as focal species for large-scale movement studies.
- Metrics include: presence/absence of target species (e.g., through roadkill studies); relative abundance; activity levels; movement direction; and changes over time (increase vs. decrease in mesopredators, large mammals, specialists vs. generalists, changes in movement patterns and directions, etc.).
- Monitoring methods could include a combination of annually walking tracking transects (methods perfected by the San Diego Tracking Team); performing roadkill studies at target locations; and monitoring track plates and camera stations at bi-monthly intervals. These simple methods are effective in monitoring watershed-wide wildlife movement over time, over such expensive, species specific methods as helicopter monitoring, pit tagging, and radio telemetry.

D.8.2.8 Edge Effect Monitoring

Effects on biological resources due to land uses at the edge of biological areas are commonly known as edge effects. Examples of disturbances that cause edge effects associated with residential development include noise and lighting impacts, increased erosion or sedimentation and siltation, increased human intrusion, exotic species invasion (plants and animals), and the disruption of the natural composition of native species (i.e., increasing human-adapted species at the expense of rarer and more sensitive species). The construction of access roads and utilities to serve residential development can also cause edge effects. Edge effects can affect vegetation communities, thus altering wildlife habitat and affect sensitive species. Edge effects extend the human footprint beyond the area of development; however, they are more difficult to quantify because they often are not manifested in a change in the visual landscape, and often result in gradual change over a longer period of time. Furthermore, the types of edge effects are diverse and their effects are variable.

The edge zone is the area in which land uses adjacent to open space areas have an impact on the biological value of the habitats. The edge zone varies greatly depending on the type of edge effect and the species or habitats potentially affected; therefore, it is not possible to identify a single edge zone distance for all species and habitats in all cases. As a general rule, however, the smaller an area of open space, the greater the proportion that will be affected by a given edge effect. Because some edge effects can extend for thousands of feet, there are few areas in the watershed that are not affected by at least one type of edge effect. The types of edge effects that are the most prevalent in the watershed include noise, outdoor lighting, introduction of non-native species (plants and animals, including pets), and disruption of the natural ecological community.

Monitoring of edge effects can be difficult because the types of edge effects are diverse and often change relatively slowly. Therefore, monitoring the changes in edge effects in a given area over time may not be the most effective monitoring approach. Instead, assessing the current status of various edge effects throughout the watershed using a stratified sampling scheme (e.g., comparing edge effects in urbanized, rural, and remote areas) can give a good indication of which edge effects are current problems and where.

D.8.2.9 Biological Trend Analysis

Information gained through monitoring will inform management decisions through the adaptive management process. As noted in Section D.7, adaptive management acknowledges the lack of complete knowledge and understanding of a system at the outset of management actions. Adaptive management is a means to learn more about the system through the implementation of management actions and the monitoring of management results. Management actions can then be adapted to optimize management goals by incorporating new information gained through an iterative implementation and monitoring process.

Monitoring throughout the watershed needs to be focused on obtaining information for management purposes. Habitat managers must monitor the status and trends of covered species and collect data on key environmental resources within protected areas of the watershed to select, prioritize, and measure the effectiveness of management activities. The biological indicators identified above must be monitored consistently and with sufficient level of effort to make the data useful for analysis of trends in populations and habitat condition. Given the inherent variability of natural systems, this may mean that large amounts of data are needed before any indication of a statistically significant trend can be determined. That being said, there may be many instances where common sense and local knowledge and experience can supplement the need for statistically significant trends analysis results. For example, when cause-and-effect relationships appear to be obvious and strongly correlated in space and time (e.g., removal of invasive species results in dramatic recovery of native species abundance and diversity; or increase in edge effects or other disturbance factors results in rapid species decline), then adaptive management to continue successful activities or to reverse adverse factors should be undertaken with the need to demonstrate statistically significant trends in biological condition.

D.8.3 Socioeconomic and Land Use Indicators

Specific socioeconomic variables for a region, along with characteristics of the area's existing and planned land uses, can be used as indicators to evaluate and project the health of a watershed. These variables and characteristics can be used to estimate the impervious surface cover in an area, which has been shown to affect the quality of receiving waters, such as streams, lakes, and bays (Center for Watershed Protection, 1999). Unfortunately, due to the arid, Mediterranean conditions of the San Diego region, many traditional water quality monitoring and modeling techniques using the socioeconomic and land use characteristics fail to achieve the same results as those used in wetter climates. Nonetheless, impervious surface cover in the Otay River watershed plays a large role in the health of the watershed and its water quality.

Socioeconomic characteristics, including population density and housing density, can be used to identify areas contributing substantial quantities of urban runoff due to correlations between these characteristics and impervious surface cover (Center for Watershed Protection, 1999). While this is appropriate for residential areas, commercial or industrial areas with low population and housing stock, but high impervious cover, are underrepresented for their contribution to urban runoff. Therefore, in areas with substantial amounts of commercial or industrial land uses, population and housing density should be used in conjunction with other indicators to evaluate an area's contribution to regional water quality (Center for Watershed Protection, 1999).

Land use characteristics used as indicators for watershed health take into better account all of the different land uses in an area, instead of being biased towards residential areas, as is the case with socioeconomic indicators. Land use characteristics can also identify sources of non-urban runoff, such as agricultural and recreational areas. With differentiations able to be made between land use types,

generalizations can also be made about the potential contaminants that may come from these land uses. The trade-off, however, is the greater level of effort required to use land use characteristics for water quality indicators. Maps and aerial photography must be obtained, digitized, and analyzed using a GIS where areas of different land use types can be identified and calculated.

Land cover information can be used to provide a baseline against which future planned uses can be compared. Land cover can be inferred from existing land use information. The land cover types of existing uses are broken into a variety of categories describing their general use. Although the volume and constituents of runoff from these land cover types cannot be determined from their identification, the following generalizations can be made from the cover types that can assist in the watershed evaluation (SWRCB, 2004):

- Multiple-family residential areas – high proportion of impervious surfaces contributing to runoff; contaminants likely to consist of litter, motor oil, or other car fluids;
- Single-family residential areas – with lawns, have moderate proportion of impervious surfaces contributing to runoff; contaminants likely to consist of litter, motor oil or other car fluids, animal waste, and pesticides, herbicides, and fertilizers from yards;
- Recreational areas – low proportion of impervious surfaces contributing to runoff; contaminants differ widely depending on type of facility but likely to contain fecal coliform from pets, herbicides, pesticides, and fertilizers from landscaped areas;
- Agricultural and Ranching areas – low proportion of impervious surfaces contributing to runoff; contaminants likely to contain fine sediment, fecal bacteria, herbicides, pesticides, and fertilizers;
- Roads and freeways, shopping centers, commercial, and light industrial areas – high proportion of impervious surfaces contributing to runoff; contaminants likely to consist of litter, rubber, motor oil, grease, or other car fluids.

Assumptions regarding the runoff and contaminants likely to originate from other cover types can also be made at this level of analysis. *Because these generalizations are assumptions, they should be used to assist in the identification of areas that deserve closer scrutiny in an analysis of watershed health, but would not provide any categorical conclusions*.

Neither socioeconomic data nor land use characteristics provide precise, quantitative indicators for existing water quality and watershed health or for future conditions. Both socioeconomic and land use indicators can, however, provide important information on where particular stressors are likely to occur and where quantitative studies should be focused in the watershed. Therefore, they are generally more useful in evaluating large-scale trends in the watershed as opposed to the effectiveness of specific management actions or strategies. It is recommended that assessment and calculation of these socioeconomic and land use indicators occur following the release of new population or growth forecasts or adoption of general plan updates.

It is also important to assess public awareness and attitudes about problems in the watershed and means of solving them. Societal attitudes and behaviors, after all, are what ultimately contribute to or cause many environmental problems. Changes in these attitudes and behaviors can lessen if not eliminate these problems. Public surveys can provide a useful social indicator of the effectiveness of education programs and the progress being made in changing societal sentiment and actions for the better. They can target specific groups of people or focus on specific management actions to evaluate the group's awareness and likelihood of implementing specific actions or practices.

A related indicator is tracking updates to the project review and approval processes of individual jurisdictions. For some management actions, it is critical that the responsible jurisdictions, as the local

land-use authority, ensure that projects in their portion of the watershed comply with existing land-use regulations and resource protection programs (e.g., MSCP) and implement ORWMP strategies deemed necessary.

D.8.3.1 Population and Housing Density

As a large-scale indicator, assessment of population and housing density provides a relative measurement of which sub-watershed areas are experiencing the most land-use change and associated impacts from land development. Identification of such areas allows for prioritization of more detailed analysis focused on these areas. Areas with high proportions of commercial and industrial areas and low population and housing densities can be inadvertently overlooked and should be evaluated using other methods. Population and housing density should be calculated at the sub-basin level using census tract-level data following the release of new population and housing numbers by the U.S. Census Bureau, individual jurisdictions, or the San Diego Association of Governments (SANDAG). Such an assessment could be completed for less than $2,000, assuming the data could be acquired at no cost.

D.8.3.2 Population Growth

Similar to population and housing density, regular examination of population growth estimates within the sub-watersheds identifies future areas of concern and allows for increased assessment of existing water quality conditions, greater awareness of changes to water quality and contributions to watershed conditions in these areas, and an improved ability to plan for maintaining and enhancing threatened resources. Population growth for each sub-basin should be monitored with the release of new growth forecasts by SANDAG and adoption of general plan updates. Similar to the population and housing density assessment, this assessment could be completed for less than $2,000, assuming the data could be acquired at no cost.

D.8.3.3 Land Cover Types

Identification of even basic categorizations such as “forest,” “wetland,” “agriculture,” and “intensive/ urban” land cover types and tracking the change in their area over time can be valuable for assessing whether watershed conditions have improved, declined, or remained the same. With greater detail, land cover types can also provide an indication of the contaminants introduced into the watershed. Because of rapid growth in the San Diego area, it is recommended that land cover types in the watershed and sub-basins be quantified and tracked every 2 to 3 years. The cost to complete this assessment would be expected to be less than $3,000.

D.8.3.4 Projections of Future Land Use Changes

The comparison of projected future land use to existing land uses allows for a more detailed analysis to determine which areas within sub-watersheds will change and how those changes might affect the watershed. Because the greatest proportion of the watershed occurs within the County of San Diego and the City of Chula Vista’s jurisdictions, these analyses should be performed following the adoption of updates to their general plans. The cost to complete this assessment would be expected to be less than $3,000.

D.8.3.5 Public Awareness and Attitude Surveys

This qualitative tool can indicate the effectiveness of efforts focused on education, stewardship, and changing practices. Surveys can be sent to residents, students, or any other group to gauge their awareness of certain problems and their support for remedying them. As mentioned, a key part of the

solution to most environmental problems is changing attitudes and behaviors, particularly of those who could potentially contribute to the problems or assist in solving them. Clearly, societal attitudes and behaviors can be slow to change, which can delay or limit the ultimate effectiveness of implemented activities or practices. Regardless, educating those contributing to the problem can have a positive effect if it is done in a non-confrontational and factual manner. A properly prepared survey can determine whether education efforts are effectively increasing awareness of problems and appropriate actions and practices, as well as how receptive respondents are to improving the situation. The limitations with surveys in general is that many members of the targeted group choose not to respond or do so with incomplete or inaccurate information. Limiting the frequency of the surveys (every 3 years instead of annually) could increase responsiveness (i.e., excessive requests for information can annoy potential respondents) and still capture changes in public awareness and attitudes, which can change slowly. According to the Center for Watershed Protection (1999), public awareness/attitude surveys can be completed for less than $20,000.

D.8.3.6 Update Project Review and Approval Processes

Management actions involving limits or control on land use require that the responsible jurisdictions in the watershed update their project review and approval processes, to ensure new projects comply with existing land use regulations and resource protection programs (e.g., MSCP) and those ORWMP strategies deemed necessary to implement. If these changes are not incorporated into the review and approval processes, property owners and developers are unlikely to be fully aware of these actions or changes, to implement them willingly, or to implement them effectively. The applicable jurisdictions bear these costs, which can be substantial depending on the nature and scope of the changes.

D.9 MONITORING AND EVALUATION SCHEDULE

The indicators described can be used in the monitoring of different watershed components to evaluate the effectiveness of individual strategies and to evaluate watershed trends. Watershed components can change differentially over time, and therefore, it is logical to monitor them at different times and at different frequencies. For example, socioeconomic factors and land use can change in a watershed year-to-year, but are typically evaluated less frequently than a component such as water quality, which can fluctuate significantly during the year (and is typically monitored multiple times each year). It is important, of course, to limit water quality data comparisons by time of year the data were collected (i.e., wet-weather data versus other wet-weather data; dry-weather data versus other dry-weather data). Despite the lower frequency, it is important to monitor changes in socioeconomics and land use because they can indicate where particular stresses are likely to occur throughout the watershed in the future. Essentially, socioeconomic and land use changes can affect the ultimate benefits of any of the protection, enhancement, restoration, and management strategies.

For most of the physical and biological indicators, a simple comparison of data collected before and after a management action should be sufficient to identify major changes or effects. In cases where a high level of accuracy and statistical validity are required and ample funding and time are available, monitoring could employ a Before-After/Control-Impact (BACI) design (Green, 1979; Stewart-Oaten et al., 1986; Underwood, 1994). A BACI design allows evaluators to determine with better certainty the actual effect of a specific action. For example, one could collect water samples upstream (the "control") and downstream (the "impact") of a site before and after the implementation of a particular land practice or BMP to determine what effect the change has on water quality. This approach allows one to account for baseline levels over time to assess the specific effect of an action on the system being monitored. Without a control site, there would be uncertainty whether an implemented land practice

positively affected water quality or whether the quality of the water entering the impact site improved for another reason.

Table D-7 lists for each identified strategy recommended indicators, monitoring schedule, and objectives for evaluating progress or success. This is an initial list that can easily be changed as more information is collected and needs change. It should be noted that strategy-specific water quality monitoring is proposed that would be distinct from the more general water quality monitoring strategy identified in Sections D.1 to D.5, which has its own monitoring schedule. The former would be specifically focused on evaluating the effectiveness of particular strategies, while the latter would be more useful in establishing a watershed-wide baseline and evaluating watershed trends. Similarly, biological trend analysis, edge-effect monitoring, and several of the socioeconomic and land use indicators have a broader-scale of application and are not included in the table, which focuses on strategy-specific monitoring.

D.10 POTENTIAL REMEDIAL ACTIONS

The reality of planning at the watershed scale is that some of the management actions taken or some of the tools used to evaluate their effectiveness might have limited utility. For the former, remedial actions could range from changing a strategy (components or actions), replacing a strategy, or adding new strategies to address any shortcomings of the current set of strategies. For the latter, remedial action could range from altering the monitoring schedule, the location of indicator monitoring, how the indicator is monitored or data are collected and evaluated (could include revising objectives), or replacing the indicator with one or more others.

It is important, however, to ensure enough data have been collected to determine if an indicator or strategy is a concern. There could be legitimate reasons that an indicator or strategy appears to be ineffective, such as a significant watershed change. Also, many management actions do not provide immediate results. For example, habitat restoration can take several years to achieve success criteria. In this case, the goal is to identify attributes that provide early indication that the restoration project is on a successful trajectory or warrants remedial action.

If monitoring indicates that particular indicators or strategies are ineffective, they should be brought to the attention of the Watershed Council or applicable ORWMP decision-making body for immediate consideration and action. Early action would minimize the expenditure of funds and resources on tools or approaches that are not effective or are only partially effective at protecting, enhancing, restoring, and managing the watershed's resources. Without early and responsive action, the ORWMP could depart from its purpose of serving as a "living document" that reflects and responds to the current set of conditions and concerns in the watershed.

D.11 WATERSHED MANAGEMENT PLAN UPDATES

The crux of effective watershed management planning is that it reflects the variety of conditions and issues pertaining to the watershed and is updated as-needed to meet the identified goals, such as protection, enhancement, and restoration of watershed resources. Because the watershed is a large and complex mosaic of habitats and land uses and not everything proposed is likely to be entirely effective, ORWMP reviews and updates should occur more frequently for the first several years. Once the evaluation program confirms that implemented strategies and monitoring and evaluation tools are effective in achieving the ORWMP's goals, updates can occur on a regular, less-frequent basis. Over the long-term, to ensure that watershed data are reasonably current, it is recommended that updates occur no less frequently than once every 5 years. At a minimum, the data sets (e.g., vegetation layer)

upon which the ORWMP was initially developed should be updated. Even if no other changes are made, the updates to the baseline information will help ensure that the data are reasonably current during the next review cycle.

To provide the best opportunity for the ORWMP to succeed, the following protocol is recommended:

- Semi-annual or more frequent meetings by the Watershed Council or equivalent ORWMP decision-making body during the first five years to revisit goals (i.e., to ensure they are most reflective of the interests of residents, users, and other stakeholders); implement the strategies initially determined to be feasible and most effective in preserving, enhancing, restoring, and managing the watershed's resources and otherwise meeting the ORWMP goals; and evaluate the effectiveness of implemented strategies to ascertain the adequacy of the monitoring and evaluation program as well as whether changes to the strategies are necessary.
- As-needed meetings of the Watershed Council or equivalent ORWMP decision-making body to respond to new information or changed conditions or requirements that have a significant bearing on the Otay River watershed. A recent example of such a significant event warranting an immediate meeting of this group is the San Diego wildfires of 2003. Another potential example is if monitoring results legitimately show that indicators or strategies are ineffective at achieving objectives. An example of a recurring action that could warrant consideration for updating the ORWMP is the SWRCB's triennial review of the Basin Plan. Specifically, meetings should be held as soon as possible following any Basin Plan amendments involving the water quality objectives or beneficial uses relevant to this watershed.
- Once all identified strategies are implemented and are found to be effective, the Watershed Council or equivalent ORWMP decision-making body should meet at least every five years to ensure the baseline information is kept reasonably current and that changing concerns and interests are considered and incorporated.

Table D-7 Recommended Indicators, Schedule of Monitoring, and Objectives by Strategy

Priority	Strategy	Indicator(s) to Track	Monitoring Schedule	Objectives
High	Eradicate Non-Native Flora and Fauna and Prevent Reinfestation and New Introductions	• Percent relative cover and distribution of non-native flora by Hydrologic Sub-Area (overall and individual species) • Abundance, distribution, and discernible adverse effects of non-native fauna by Hydrologic Sub-Area (overall and individual species) • Vegetation community monitoring • Abundance and distribution of riparian and wetland specialists (wildlife) • Resident awareness/attitude surveys • Update to jurisdictions' review and approval processes for projects in this watershed	• Annual for non-native flora and fauna within preserve areas and actively managed habitat areas; can reduce to every 2-3 years once pest species and upstream/upslope sources eradicated or controlled successfully • Annual for riparian and wetland specialists within preserve and actively managed areas; can reduce to every 2-3 years once pest species and upstream/upslope sources eradicated or controlled successfully • Bi-annual for non-native plant species on prohibited plant list throughout the watershed (e.g., giant reed, tamarisk, pampas grass) • Every 5 years for watershed-wide vegetation monitoring and vegetation map update • Every 5 years for abundance and distribution of riparian and wetland specialist abundance throughout the watershed • Every 3 years for resident awareness/ attitude surveys • Review prohibited plant list every 3 years (at a minimum) and update jurisdictions' plan and review processes for projects in this watershed accordingly	• Flora: focus in headwaters areas initially, working downstream and downslope until each Hydrologic Sub-Area is free of targeted non-native flora; particular emphasis should be placed on removing non-native flora within and upstream/upslope of existing and planned preserves (because these are generally the highest-functioning habitats in the watershed) • Fauna: focus on controlling if not eliminating non-native flora that have a discernible adverse effect on native species, particularly in or near areas preserved or planned for preserves • Flora and fauna: focus on increasing the abundance and distribution of riparian and wetland specialists by eradicating non-natives from and near areas with potentially suitable habitat for these species • Awareness/attitude surveys: increase awareness and support shown in responses to resident surveys • Update jurisdictions' review and approval processes within 1 year as priority pest species are identified and incorporated into the prohibited plant list
	Maintain, Enhance, and Restore Habitat Linkages and Wildlife Movement	• Conduct wildlife movement studies to update the baseline and compare with 2003 data • Monitor wildlife movement within known or historic corridors and habitat linkages	• Wildlife movement in known corridors and habitat linkages (CBI recommended) should be reassessed every 5 years at a minimum such that remedial actions may be taken to minimize effects of the changing landscape and provide additional wildlife corridors • Annually for 5 years following specific actions or activities intended to facilitate movement (e.g., culvert/bridge installation, culvert/bridge expansion, installation of wildlife fencing, habitat restoration in movement areas, etc.)	• Increase wildlife movement (specifically for large target mammals) within known and historic intra- and inter-watershed corridors and habitat linkages

Priority	Strategy	Indicator(s) to Track	Monitoring Schedule	Objectives
	Restore the Lower Otay River Floodplain to Enhance the Quality of Water Entering San Diego Bay	• Water quality monitoring of applicable San Diego Basin Plan constituents for water entering restored area and water leaving restored area before and after activity (BACI design recommended) • Bioassessments in upstream and downstream areas before and after activity (BACI design recommended) • Abundance and distribution of riparian and wetland specialists (wildlife) • Wetland and transitional habitat acres restored above pre-activity functional condition, as evaluated by the HGM Approach, the CRAM, or similar aquatic habitat assessment method	• Annual or more frequent progress tracking for at least five years following enhancement or restoration activity (semi-annual or annual for bioassessments and water quality monitoring, annual for riparian and wetland specialists monitoring and aquatic habitat assessment)	• Water quality monitoring: meet or exceed San Diego Basin Plan water quality objectives for monitored constituents (i.e., exceed for all objectives already being met) • Bioassessments: increase abundance and types of beneficial aquatic macroinvertebrates following activities • Riparian and wetland specialists (as appropriate): increase abundance and distribution of these species in suitable habitats • Increase wetland and transitional habitat acres restored above pre-activity functional condition
	Implement Setbacks or Buffers Around Aquatic Resources for New Developments	Using either a before-and-after or a BACI design, at representative locations (based on a variety of factors, including Hydrologic Sub-Area, geomorphic setting, land use types and densities, habitat types and quality, and species distribution) conduct/survey (as appropriate): • Water quality monitoring of constituents of concern for the particular land use types • Bioassessments • Vegetation community monitoring • Abundance and distribution of riparian and wetland specialists (wildlife) • Stream stability (Rosgen evaluation) Also: • Jurisdiction review and approval process update for projects in this watershed	• Semi-annual for water quality monitoring (dry and wet if practicable) • Semi-annual or annual for bioassessments • Bi-annual for vegetation community monitoring • Annual for abundance and distribution of riparian and wetland specialists • Bi-annual for stream stability	• Water quality monitoring: meet all applicable Basin Plan objectives and reduce contaminant constituents monitored, such as metals, pesticides, hydrocarbons, and fecal coliforms • Bioassessments: increase numbers and types of beneficial aquatic macroinvertebrates following activities • Vegetation community monitoring: increase vegetation community stability (i.e., fewer instances of recovery-phase growth) or discernible recovery of previously degraded habitats • Riparian and wetland specialists: increase abundance and distribution of these species in suitable habitats • Stream stability: fewer instances of channel incision, and discernible channel recovery in previously degraded streams (i.e., returning to a more stable planform) • Update jurisdictions' review and approval processes; if monitoring results indicate that setbacks/buffers should be changed, update jurisdictions' review and approval processes within 1 year of these findings

Priority	Strategy	Indicator(s) to Track	Monitoring Schedule	Objectives
	Limit Future and Remove Existing Trash and Debris	• Stream miles maintained clear of trash • Resident awareness/attitude surveys • Projections of future land use changes (which will indicate where new sources of trash are likely to originate)	• Annual stream assessment (miles maintained clear of trash) • Every 3 years for awareness/attitude surveys • For future land use projections: following adoption of general plan updates	• Upstream of the Reservoirs: remove trash and man-made debris from all aquatic habitats and preserves areas; cease all unauthorized trash and debris dumping; increase awareness and participation of residents in maintaining aquatic habitats and preserve areas free of trash and man-made debris • Remove Proctor Valley Creek from Section 303(d) Monitoring List for trash • Downstream of Reservoirs: similar objectives, but recognize that efforts are not likely to be as effective given the higher level of existing and planned urbanization (i.e., seek steady improvements over time); also, focus on retrofitting existing developments (e.g., trash racks) as-needed to control trash and debris introduction into natural areas • Future land use: ensure all new developments implement and maintain, as necessary, the most effective BMPs for trash and debris
	Protect Drinking Water Quality in the Reservoirs	• Water quality monitoring for constituents currently monitored by the City of San Diego in this watershed and implement enhanced monitoring recommended by *Water Quality Monitoring Strategy for the Otay River Watershed* (RBF Consulting, 2005a) • Jurisdiction review and approval process updates to apply to all new development in the portion of the watershed draining into the Otay Reservoirs • Projections of future land use changes in the upper watershed (which will indicate where new sources of contaminants are likely to originate)	• At a minimum, follow City of San Diego's monitoring schedule for this watershed, which varies by constituent and location • For future land use projections: following adoption of general plan updates	• Meet or exceed San Diego Basin Plan water quality objectives for all constituents monitored (i.e., exceed for all constituents that already meet objectives) • Update jurisdictions' review and approval processes to implement the City of San Diego's *Source Protection Guidelines for New Development* for all new development in the portion of the watershed draining into the Otay Reservoirs; if monitoring indicates more specific BMPs are warranted or if future land-use projections indicate that more specific BMPs should be implemented to minimize a potential contaminant threat, update the jurisdictions' review and approval processes within 1 year of these findings

Priority	Strategy	Indicator(s) to Track	Monitoring Schedule	Objectives
	Limit Impervious Surface Area	• Impervious surface area by Hydrologic Sub-Area (overall and directly connected) Monitor at representative locations (based on several factors, including Hydrologic Sub-Area, geomorphic setting, land use types and density, habitat types and quality, and riparian and wetland specialists abundance and distribution) to evaluate effectiveness of identified impervious surface thresholds: • Stream stability (Rosgen evaluation) • Water quality monitoring of the constituents of concern for the land use types in the drainage area • Bioassessments • Vegetation community monitoring • As appropriate, abundance and distribution of riparian and wetland specialists (wildlife) Also: • Jurisdiction review and approval process update for projects in this watershed	• Bi-annual for impervious surface area by Hydrologic Sub-Area (existing, as well as future projections by land-use type) At the representative locations: • Bi-annual stream stability analysis • Semi-annual for water quality monitoring (dry and wet if practicable) • Semi-annual or annual for bioassessments • Every 5 years for vegetation outside of preserve and actively managed areas; every 2 years for preserve and actively managed areas • Bi-annual for riparian and wetland specialists abundance and distribution	• Incorporate County of San Diego DPLU Watershed Planning Program's (2003) recommendations (by Hydrologic Sub-Area or "subwatershed development district") into jurisdictions' plan review and approval processes • If monitoring indicates impervious surface thresholds are ineffective at protecting aquatic resources (e.g., conversion of habitat types, loss of aquatic habitats through channel incision/widening, degradation of habitat affecting riparian and wetland specialists' abundance or distribution, changes in constituent levels so they are no longer in compliance with the San Diego Basin Plan), update jurisdictions' plan and review processes for projects in this watershed within 1 year of these findings
	Implement a Watershed-Wide Education Program to Improve Public Awareness and Stewardship	• Surveys of resident and student awareness, concerns about watershed resources, and participation in watershed stewardship activities	• Every 3 years for resident and student awareness/attitude surveys (separate surveys sent to heads-of-household and to students at schools in the watershed)	• Marked increases in resident and student awareness, participation in watershed-improvement activities, decreases in unauthorized dumping, decreases in release of exotic flora and fauna (as indirectly evidenced by few if any reintroductions of non-native species in treated areas and no introductions of new prohibited pest species in the watershed)
	Form a Watershed Council or Equivalent to Implement and Update the Watershed Management Plan	• Regular meetings and watershed management plan updates	• Meet to review and update the ORWMP at least semi-annually the first 5 years, and at least every 5 years thereafter; or more frequently as needed (e.g., following a natural or unnatural event that significantly changes the watershed, such as the San Diego wildfires of 2003)	• Short-term: regular meetings to review and update goals; prioritize, revise, and implement strategies and associated monitoring and evaluation program • Long-term: implemented strategies that effectively protect, enhance, restore, and manage watershed resources and achieve the ORWMP goals

Priority	Strategy	Indicator(s) to Track	Monitoring Schedule	Objectives
Medium	Retrofit Existing Developments as Necessary to Protect Aquatic Resources	The indicators to track depend on the specific retrofit needed, but could include (use either a before-and-after or a BACI design): • Stream stability (Rosgen evaluation) • Vegetation monitoring • Water quality monitoring of constituents of concern for the land use types in the drainage area • Bioassessments • Abundance and distribution of riparian and wetland specialists (wildlife) • Qualitative trash assessment	• Depends on retrofits considered necessary to protect aquatic resources; however, annual or more frequent monitoring at retrofit locations would likely be necessary for a minimum of 5 years (bioassessments are conducted semi-annually or annually, and water quality monitoring is often conducted two or more times per year); stream stability can be evaluated bi-annually	• Depends on the necessary retrofit, but there should be measurable improvements in one or more of the following: water quality (for constituents analyzed); channel stability; vegetation community stability (i.e., no discernible threat of habitat conversion) or discernible recovery of previously degraded vegetation communities; abundance and types of beneficial aquatic macroinvertebrates; abundance or distribution of riparian and wetland specialists in suitable habitats; or less trash and debris
	Restore Urban Creeks	• Stream miles or acres restored above pre-activity functional condition as evaluated by the HGM Approach, the CRAM, or similar aquatic habitat assessment method A simple before-and-after monitoring design should be sufficient: • Bioassessments • As appropriate, abundance and distribution of riparian and wetland specialists (wildlife) • Stream stability (Rosgen evaluation) • Water quality for constituents associated with the land use types in the drainage area	• Schedule depends on the restoration project and the regulatory agencies involved – monitoring could be quarterly or semi-annually the first 2-3 years and annually thereafter through 5 years following implementation (annual or less frequent for riparian and wetland specialists surveys)	• Increase number of acres or stream miles restored above pre-activity functional condition as measured by the HGM Approach, the CRAM, or similar aquatic habitat assessment method • Bioassessments: increase abundance and types of beneficial aquatic macroinverebrates • Riparian and wetland specialists (as appropriate): increase abundance and distribution of these species in suitable habitats • Stream stability: reestablish a stable channel planform capable of supporting riparian habitat over the long-term • Water quality monitoring: reduce contaminant constituents (e.g., metals, pesticides) and increase levels of beneficial constituents (e.g., dissolved oxygen) sufficiently to meet or exceed San Diego Basin Plan objectives (i.e., exceed for all objectives already met)

Priority	Strategy	Indicator(s) to Track	Monitoring Schedule	Objectives
	Implement Comprehensive Agricultural Land BMPs to Protect Aquatic Resources	At representative monitoring locations (based on several factors, such as Hydrologic Sub-Area, geomorphic setting, agricultural use type, habitat types and quality, and abundance and distribution of riparian and wetland specialists), use either a before-and-after or a BACI design for the following indicators (as appropriate): • Stream stability (Rosgen evaluation) • Vegetation monitoring • Water quality monitoring of constituents of concern for the particular agricultural uses in the drainage area • Bioassessments • Abundance and distribution of riparian and wetland specialists (wildlife) Also: • Owner awareness/attitude surveys	• Annual, or more frequently, as necessary for most indicators (bioassessments occur semi-annually or annually and water quality monitoring typically occurs more than once per year, depending on whether water is present); every 3 years for awareness/attitude surveys	• Stream stability: fewer instances of channel incision, and discernible channel recovery in previously degraded streams (i.e., returning to a more stable planform). • Vegetation community monitoring: increase vegetation community stability (i.e., fewer instances of recovery-phase growth) or discernible recovery of previously degraded vegetation communities • Water quality monitoring: reduce monitored contaminant constituents such as pesticides, nutrients, and fecal coliforms, and increase beneficial constituents such as dissolved oxygen to levels that meet or exceed San Diego Basin Plan objectives (i.e., exceed for all constituents that already meet objectives). • Bioassessment: increase abundance and types of beneficial aquatic macroinvertebrates following implementation of BMPs • Riparian and wetland specialists (as appropriate): increase abundance and distribution of these species in suitable habitats • Owner awareness/attitude survey: increase awareness and support for implementing the appropriate BMP programs for the agricultural uses
	Improve Existing and Create New Recreational Facilities	• Surveys to evaluate resident/user satisfaction with recreation facilities Monitor at representative locations (based on several factors, such as Hydrologic Sub-Area, geomorphic setting, habitat types and quality, and abundance and distribution of riparian and wetland specialists): • Stream stability (Rosgen evaluation) in proximity to recreational facilities • Water quality monitoring of constituents associated with recreational facilities and use (e.g., sediment, fecal coliforms, pesticides) near recreational facilities • Bioassessments in proximity to recreational facilities • Vegetation community mapping and monitoring near recreational facilities • As appropriate, abundance and distribution of riparian and wetland specialists (wildlife) near recreational facilities	• Every 3 years for resident/user survey • Bi-annual stream stability evaluation • Semi-annual water quality monitoring (dry and wet if practicable) • Semi-annual or annual bioassessments • Bi-annual vegetation community monitoring • As applicable, annual surveys for riparian and wetland specialists (wildlife)	• Satisfaction surveys: high resident/user satisfaction with recreational facilities • Stream stability: no discernible stream instability attributable to recreational facilities or use • Water quality monitoring: constituents meet or exceed San Diego Basin Plan constituents • Bioassessments: no discernible adverse changes in aquatic macroinvertebrates attributable to recreation facilities or use • Vegetation community monitoring: negligible or no vegetation community instability attributable to recreation facilities • Riparian and wetland specialists: no documented take of these species or loss of suitable habitat attributable to recreational facilities or use

Priority	Strategy	Indicator(s) to Track	Monitoring Schedule	Objectives
	Manage Tecate Cypress Forest and Oak Woodlands	• Update baseline vegetation mapping for both communities • Vegetation community monitoring for regeneration success and age structure	• Every five years or more frequently as-needed to address changing conditions	• Tecate cypress forest: maintenance of a viable Tecate cypress forest community (nearly 100 percent of this community is preserved or in planned preserves) – increased fire frequency is a primary concern • Oak woodlands: protection of oak woodlands with minimal loss of individual trees or stands, enhancement of existing oak habitat, and restoration of oak woodlands in historic oak habitat (e.g., formerly grazed areas that are now preserved)
	Achieve Consistency in Regulations in Conjunction with the Special Area Management Plan	• Regular meetings and SAMP updates	• Regularly scheduled Working Group, Watershed Council, and Cooperative Agreement participant/Executive Committee meetings to review SAMP products and evaluate progress in completing a document consistent with the ORWMP and applicable land use regulations	• Complete an implementable SAMP in approximately 2 years
Low	Preserve, Enhance, and Restore Additional Floodplain Parcels Within the Otay River Watershed	• Acres of riparian or transitional habitat protected or enhanced/restored to functional levels above pre-activity condition as evaluated by the HGM Approach, the CRAM, or similar aquatic habitat assessment method	• Annual or as required by any regulatory agencies involved (typically a 5-year maintenance and monitoring requirement for enhanced or restored aquatic areas)	• Increase acres and stream miles of floodplain preserved • Increase acres or stream miles with higher functional levels above pre-activity condition as evaluated by the HGM Approach, the CRAM, or similar aquatic habitat assessment method
	Protect, Enhance, and Restore Cultural Resources	• Numbers and extent of cultural resources preserved, enhanced, or restored	• Every 3 years	• Increase the known cultural resources preserved, enhanced, or restored in this watershed above the current inventory

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F. ACRONYMS AND ABBREVIATIONS

AGR – Agricultural Supply (a beneficial use per Basin Plan)

Al – Aluminum

Analyte - Chemical compound that is the subject of a chemical analysis

APN – Assessor's Parcel Number

As - Arsenic

BA – Biological Assessment (pursuant to the Endangered Species Act)

BACI – Before-After/Control-Impact (sampling design)

Basin Plan – Water Quality Control Plan for the San Diego Basin

BIA – Bureau of Indian Affairs

BIOL – Preservation of Biological Habitats of Special Significance (a beneficial use per Basin Plan)

BLM – Bureau of Land Management

BMI – Benthic Macroinvertebrate

BMO – Biological Mitigation Ordinance

BMP – Best Management Practice

BO – Biological Opinion

BOD – Biological Oxygen Demand

CalEPPC – California Exotic Pest Plant Council

CA SDWA – California Safe Drinking Water Act

CAFO – Concentrated Animal Feeding Operations

CBI – Conservation Biology Institute

CCP – Comprehensive Conservation Plan

CC&Rs – Covenants, Codes, and Restrictions

CDFG – California Department of Fish and Game

CDMG – California Division of Mines and Geology

CDPH – California Department of Public Health

CEQA – California Environmental Quality Act

CESA – California Endangered Species Act

CFR – Code of Federal Regulations

cfs – cubic feet per second

CGS – California Geological Survey

Chap – Chaparral

CLOMR – Conditional Letter of Map Revision (FEMA process)

CNDDB – California Natural Diversity Database

CNF – Cleveland National Forest

CNPS – California Native Plant Society

COD – Chemical Oxygen Demand

COLD – Cold Freshwater Habitat (a beneficial use per Basin Plan)

COMM – Commercial and Sport Fishing (a beneficial use per Basin Plan)

Copermittees – the 18 cities in San Diego County, the County of San Diego, and the Unified Port of San Diego

Corps – U.S. Army Corps of Engineers

County – County of San Diego

CRAM – California Rapid Assessment Method

CREEC – California Regional Environmental Education Community

CRREL – Cold Regions Research and Engineering Laboratory

CSS – Coastal Sage Scrub

Cu - Copper

CWA – Clean Water Act

CWC – California Water Code

CRREL – Cold Regions Research and Engineering Laboratory

CSC – California Species of Concern

DDT - Dichloro-Diphenyl-Trichloroethane (considered a “legacy” pesticide)

DHS – Department of Health Services

DO – Dissolved Oxygen

DWR – California Department of Water Resources

EElink – North American Association for Environmental Education

EIR – Environmental Impact Report (pursuant to the California Environmental Quality Act)

EIS – Environmental Impact Statement (pursuant to the National Environmental Policy Act)

EMC – Event Mean Concentration

ENSO – El Niño-Southern Oscillation

EPT – Ephemeroptera, Plecoptera, Trichoptera (taxa of invertebrates)

ERDC – Engineering and Research Development Center

ESA – Endangered Species Act (federal)

EST – Estuarine Habitat (a beneficial use per Basin Plan)

Fe - Iron

FE – Federal Endangered (Species)

FEMA – Federal Emergency Management Agency

FIP – Facility Implementation Plan

FIS – Flood Insurance Study

FSC – Federal Species of Concern

FT – Federal Threatened (Species)

FWM – Fresh Water Marsh

GDP – General Development Plan

GIS – Geographic Information System

GL - Grassland

GP – General Plan

Guidelines – Source-Water Protection Guidelines for New Development (City of San Diego Water Department, 2004)

HA – Hydrologic Area

HEP – Habitat Evaluation Procedure

HGM – Hydrogeomorphic (Approach)

HLIT – Habitat Loss and Incidental Take (pertains to an adopted City of Chula Vista ordinance, which implements their MSCP Subarea Plan)

HO – Hollenbeck (AQUA TERRA-nomenclature for drainage basins)

HOA – Homeowners Association

HSA – Hydrologic Sub-Area

HU – Hydrologic Unit

I – Interstate (i.e., I-5 or I-805)

IBWC – International Boundary and Water Commission

IND – Industrial Service Supply (a beneficial use per Basin Plan)

INRMP – Integrated Natural Resources Management Plan

IOD – Irrevocable Offer of Dedication

JA – Jamul (AQUA TERRA-nomenclature for drainage basins)

JEPA – Joint Exercise of Powers Agreement (the JEPA formed for developing the Otay River Watershed Management Plan; the OVRP JEPA; or any other JEPA relevant to this watershed)

JURMP – Jurisdictional Urban Runoff Management Plan

LE – Lee (AQUA TERRA-nomenclature for drainage basins)

LOMR – Letter of Map Revision (FEMA process)

LPP – Land Protection Plan

LUST – Leaking Underground Storage Tank

LY – Lyon (AQUA TERRA-nomenclature for drainage basins)

MAR – Marine Habitat (a beneficial use per Basin Plan)

MEP – Maximum Extent Practicable

Mg – Magnesium

mgd – millions of gallons per day

MHPA – Multiple-Habitat Planning Area

MIGR – Migration of Aquatic Organisms (a beneficial use per Basin Plan)

MRCD – Mission Resource Conservation District

MS4 – Municipal Separate Storm Sewer System

MSAA – Master Streambed Alteration Agreement

MSCP – Multiple Species Conservation Program

MTBE – Methyl Tertiary Butyl Ether

MUN – Municipal and Domestic Water Supply (a beneficial use per Basin Plan)

Municipal Permit - "Waste Discharge Requirements For Discharges of Urban Runoff from the Municipal Separate Storm Sewer Systems (MS4s) Draining the Watersheds of the County of San Diego, the Incorporated Cities of San Diego County, and the San Diego Unified Port District" or RWQCB Order No. 2001 01 (NPDES No. CAS0108758), adopted by the San Diego Regional Water Quality Control Board adopted in February 2001 pursuant to their Clean Water Act Section 402 authority

NAIC – North American Industry Classification System

NAV – Navigation (a beneficial use per Basin Plan)

NCCP – Natural Communities Conservation Program

N - Nitrogen

NE – (MSCP) Narrow Endemic (Species)

NEPA – National Environmental Policy Act

NF – National Forest

NMFS – National Marine Fisheries Service

NO_2 – Nitrite

NO_3 - Nitrate

NOAA – National Oceanic and Atmospheric Administration

NPDES – National Pollutant Discharge Elimination System

NPS – Non Point Source

NRCS – Natural Resources Conservation Service

NRHP – National Register of Historic Places

NRMP – Natural Resource Management Plan

NTR – National Toxics Rule

NWP – Nationwide Permit (U.S. Army Corps of Engineers)

NWR – National Wildlife Refuge

O & M – Operation and Maintenance

ORWMP – Otay River Watershed Management Plan

OVE – Otay Valley East (AQUA TERRA-nomenclature for drainage basins)

OVRP – Otay Valley Regional Park

OVRP Advisory Bodies – OVRP Joint Staff, Citizens Advisory Committee, and Policy Committee

OVRP CAC – Otay Valley Regional Park Citizens Advisory Committee

OVRP PC – Otay Valley Regional Park Policy Committee

OVRPCP – Otay Valley Regional Park Concept Plan

OWD – Otay Water District

OWPL – Otay Watershed Pollutant Loading (Tool)

PAC – Policy Advisory Committee

PAH – Polycyclic Aromatic Hydrocarbons

P - Phosphorous

Pb - Lead

PCB – Polychlorinated Biphenyls

PCC – Portland Cement Concrete

PDO – Pacific Decadal Oscillation

PL – Public Law

POM – Preserve Owner/Manager

PO_4 - Orthophosphate

Port District – San Diego Unified Port District

PROC – Industrial Process Supply (a beneficial use per Basin Plan)

RARE – Rare, Threatened, or Endangered Species (a beneficial use per Basin Plan)

RCD – Resource Conservation District

REC-1 – Contact Water Recreation (a beneficial use per Basin Plan)

REC-2 – Non-Contact Water Recreation (a beneficial use per Basin Plan)

RGP – Regional General Permit (U.S. Army Corps of Engineers)

RL – Rural Lands

RMP – Resource Management Plan

RPO – Resource Protection Ordinance

RWQCB – Regional Water Quality Control Board

SAA – Streambed Alteration Agreement

SAMP – Special Area Management Plan

SANDAG – San Diego Association of Governments

SB – Senate Bill

SDCWA – San Diego County Water Authority

SDRWQCB – San Diego Regional Water Quality Control Board (Region 9)

SDUPD – San Diego Unified Port District

SDWA – Safe Drinking Water Act (Federal)

SE – State Endangered (Species)

SFHA – Special Flood Hazard Area

SHELL – Shellfish Harvesting (a beneficial use per Basin Plan)

SHPO – State Historic Preservation Officer

SIC – Standard Industrial Classification

SP – Standard Permit (U.S. Army Corps of Engineers)

spp./sp./ssp. - species

SR – Semi-Rural Lands, State Rare Species, or State Route (depending on the context)

SRP – Subregional Plan

SUSMP – Standard Urban Storm Water Mitigation Plan

SWANCC - Solid Waste Agency of Northern Cook County (In reference to *Solid Waste Agency of Northern Cook County vs. United States Army Corps of Engineers*, No. 99 1178; U.S. Supreme Court decision issued January 9, 2001)

SWPPP – Storm Water Pollution Prevention Plan

SWRCB – State Water Resources Control Board

SWWF – Southwestern Willow Flycatcher

TAC – Technical Advisory Committee

TOC – Total Organic Carbon

TDS – Total Dissolved Solids

THPO – Tribal Historic Preservation Officer

TKN – Total Kjeldahl Nitrogen

TMDL – Total Mean Daily Load

TS – Total Sinuosity (calculated by dividing total stream length by valley length)

TSS – Total Suspended Solids

USDA – U.S. Department of Agriculture

USEPA – U.S. Environmental Protection Agency

USFWS – U.S. Fish and Wildlife Service

USGS – U.S. Geological Survey

VP – Vernal Pool

WARM – Warm Freshwater Habitat (a beneficial use per Basin Plan)

WDID – Waste Discharge Identification Number

WDR – Waste Discharge Requirement

WILD – Wildlife Habitat (a beneficial use per Basin Plan)

WOVRP – Western Otay Valley Regional Park

WOVRP NRMP – Western Otay Valley Regional Park Natural Resource Management Plan

WPO – Watershed Protection Ordinance (more formally the Watershed Protection, Stormwater Management, and Discharge Control Ordinance)

WQC – Water Quality Certification

WRS – Willow Riparian Scrub

WTP – Water Treatment Plant

WURMP – Watershed Urban Runoff Management Plan

Zn - Zinc

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Victoria Touchstone	CCP Planner, San Diego National Wildlife Refuge	U.S. Fish and Wildlife Service
Cindy Burrascano	Conservation Crew	California Native Plant Society
Ellen Shively	Conservation Chair	Sierra Club
Jim Peugh	Conservation Committee	San Diego Audubon
Don Peters	Volunteer	San Diego Audubon
Suzanne Michel	Watershed Coordinator	Southern California Wetlands Recovery

*Note: Members of either the Otay River Watershed Management Plan Policy Committee or Executive Steering Committee are shown in bold type.

Appendices

Appendix 1.

Joint Exercise of Powers Agreement for the Development of the ORWMP

JOINT EXERCISE OF POWERS AGREEMENT AMONG THE COUNTY OF SAN DIEGO, THE CITIES OF CHULA VISTA AND IMPERIAL BEACH AND THE SAN DIEGO UNIFIED PORT DISTRICT FOR THE DEVELOPMENT OF A WATERSHED MANAGEMENT PLAN FOR THE OTAY RIVER

THIS AGREEMENT, dated for convenience as of the 24th day of March, 2004, is entered into by the Cities of Chula Vista and Imperial Beach, California municipal corporations; the County of San Diego, a political subdivision of the State of California; and the San Diego Unified Port District, a public corporation, (collectively, Public Agencies).

W I T N E S S E T H

WHEREAS, the Public Agencies are each empowered by law to develop watershed management plans; and

WHEREAS, the Public Agencies desire to coordinate the development of a single Watershed Management Plan for the entire Otay River hydrologic unit of the San Diego Bay watershed for the benefit of their citizens and the public; and

WHEREAS, joint cooperation and participation among the Public Agencies will be mutually beneficial and in the public interest.

NOW, THEREFORE, the Public Agencies, agree as follows:

SECTION 1. Purpose.

This Agreement is made pursuant to the provisions of Article 1, Chapter 5, Division 7, Title 1 of the Government Code of the State of California commencing with Section 6500 relating to the joint exercise of powers common to the Public Agencies. The Public Agencies possess the powers described in the above recitals. The purpose of this Agreement is to jointly develop a Watershed Management Plan (WMP) for the Otay River hydrologic unit of the San Diego Bay watershed which is consistent with the respective Public Agencies' General Plans, meets water quality standards, protects aquatic and upland resources and provides for flood protection, public recreation and essential public facilities, such as utilities and other infrastructure. In addition, the WMP will include an implementation program describing how each signatory Public Agency could implement the WMP.

SECTION 2. Term.

This Agreement shall become effective when executed by all of the Public Agencies and shall continue in full force and effect until the WMP has been completed and adopted by each signatory Public Agency or until this Agreement is terminated by action of the Policy Committee.

SECTION 3. Adoption of Watershed Management Plan.

After the WMP has been reviewed by the Project Team, the WMP shall be presented to the Policy Committee for its consideration. The Policy Committee shall either approve the WMP or provide direction to the Project Team for making changes to the WMP. If the Policy Committee approves the WMP, it shall then be submitted to each signatory Public Agency for adoption. Each signatory Public Agency may adopt the WMP or recommend changes to the Policy Committee. Nothing in this Agreement obligates a signatory Public Agency to adopt the WMP.

SECTION 4. Boundaries.

The boundaries of the territory within which the Public Agencies shall exercise their powers under this Agreement shall be the Otay River hydrologic unit of the San Diego Bay watershed as delineated on Exhibit A attached hereto and incorporated herein. Exhibit A identifies the anticipated limits of the Otay River hydrologic unit of the San Diego Bay watershed, but the Public Agencies recognize that minor changes in the boundary of the hydrologic unit may be identified as the WMP is developed. The boundaries of the WMP shall be the same as the boundaries of the Otay River hydrologic unit.

SECTION 5. Policy Committee.

A Policy Committee is established consisting of a single representative appointed by each signatory Public Agency. The Policy Committee shall provide direction to the Project Team for administering this Agreement. The representative from the County of San Diego shall be a member of and appointed by the County Board of Supervisors. The representative from the City of Chula Vista shall be a member of and appointed by the City Council. The representative from the City of Imperial Beach shall be a member of and appointed by the City Council. The representative for the Port District shall be a member of and appointed by the District's Board of Port Commissioners. Appointment to the Policy Committee shall be for a term not to exceed the appointee's current term in office.

A quorum for the purposes of conducting business will consist of three members of the Policy Committee. In the absence of a quorum, a single member present may move to adjourn. The Policy Committee shall take action only by unanimous consensus of all Policy Committee members. Less than unanimous consent shall be no action.

If, upon recommendation of the Project Team, the Policy Committee decides that one or more consultants should be engaged to assist with developing the WMP, the Policy Committee shall recommend that each signatory Public Agency pay its "fair share" of the cost for the consultant. The Policy Committee shall determine the cost of the consultant(s) and the recommended fair share for each signatory Public Agency. Each signatory Public Agency shall then consider its recommended fair share and, if approved by the signatory Public Agency, said Public Agency shall pay that amount. All future funding shall be reviewed and approved during the normal budget process of each jurisdiction.

The Policy Committee may adopt bylaws, rules and regulations for conducting its meetings and business. The Policy Committee shall conduct regular meetings at least annually and at such other times as the Policy Committee determines or is provided for in its bylaws. Meetings of the Policy Committee shall be subject to the Ralph M. Brown Act (Gov. Code, § 54950 et seq.), which shall govern the proceedings, noticing and general activities of the Policy Committee.

SECTION 6. Stakeholder Committee.

The Policy Committee may establish, and appoint members to, a Stakeholder Committee. The purpose of the Stakeholder Committee is to advise the Policy Committee and Project Team on the development of the WMP. Stakeholder Committee members shall serve at the pleasure of the Policy Committee for a term to be set by the Policy Committee. A quorum for the purpose of conducting business shall be a simple majority of the members of the Stakeholder Committee. In the absence of a quorum, a single member may move to adjourn. The Policy Committee may determine how often the Stakeholder Committee shall meet.

Meetings of the Stakeholder Committee shall be subject to the Ralph M. Brown Act (Gov. Code, § 54950 et seq.), which shall govern the proceedings, noticing and general activities of the Stakeholder Committee.

SECTION 7. Withdrawal From Agreement.

Upon provision of 30-days advanced written notice to all of the other signatory agencies, a signatory Public Agency may withdraw from this Agreement. If a signatory Public Agency withdraws from

this Agreement after that signatory Public Agency has approved its fair share payment of consultant costs, the Public Agency's withdrawal shall not relieve the Public Agency from paying its full fair share.

SECTION 8. Limitation on Powers and Designation of Lead Agency.

The powers of the Public Agencies under this Agreement shall be subject to those legal restrictions which the County of San Diego has upon the manner of exercising said power pursuant to Government Code Section 6509.

The County of San Diego agrees to act as lead agency for the purpose of scheduling meetings, providing notice of meetings, preparing agendas, recording minutes, maintaining records, entering into and administering contracts approved by the Policy Committee, pursuant to provisions herein, and reporting to the Regional Water Quality Control Board and other appropriate federal and state agencies the progress on and status of the WMP. The County of San Diego shall inform the Policy Committee regarding all actions taken by the County as the Lead Agency.

SECTION 9. Privileges and Immunities.

All of the privileges and immunities from liability, exemptions from laws, ordinances and rules, all pension, relief, disability, workers' compensation, and other benefits which apply to the activity of officers, agents, or employees of any of the Public Agencies when performing their respective functions within their territorial limits, shall apply to them to the same degree and extent while engaged in the performance of any of their functions and duties extra-territorially under this Agreement.

SECTION 10. Records and Accounts.

The Public Agencies shall be strictly accountable for all funds and shall report all receipts and disbursements made by the Public Agencies in developing the WMP. Expenditures made by each signatory Public Agency related to this Agreement shall made be in accordance with the respective signatory Public Agency's rules and regulations.

SECTION 11. Notices.

Any notice or notices provided or required by this Agreement to be given or served upon the Public Agencies may be given by depositing the same in the United States mail, postage prepaid, addressed to or to such address as the Public Agencies may subsequently specify in writing.

Walter F. Ekard	Chief Administrative Officer	County of San Diego	1600 Pacific Highway, Room 209	San Diego, CA	92101
David D. Rowlands Jr	City Manager	City of Chula Vista	276 Fourth Avenue	Chula Vista, CA	91910
Gary Brown	Interim City Manager	City of Imperial Beach	825 Imperial Beach Boulevard	Imperial Beach, CA	91932
Bruce Hollingsworth	President/CEO/Executive Director	San Diego Unified Port District	P.O. Box 120488	San Diego, CA	92112-0488

SECTION 12. Governing Law.

This Agreement shall in every respect be binding on the parties hereto and their respective successors and assigns. This Agreement shall be governed by the laws of the State of California.

SECTION 13. Provisions Required by Law.

Each and every provision of law and clause required by law to be inserted in this Agreement shall be deemed to be inserted herein and the Agreement shall be read and enforced as though it were included herein, and if for any reason any such provision is not inserted, or is not correctly stated, then upon application of any signatory Public Agency the Agreement shall forthwith be physically amended to make such insertion or correction.

SECTION 14. Partial Invalidity.

If any provision of this Agreement or the application thereof to any person or circumstances shall to any extent be invalid or unenforceable, the remainder of this Agreement, or the application of such provision to persons or circumstances other than those as to which it is invalid or unenforceable, shall not be affected thereby, and each provision of this Agreement shall be valid and shall be enforced to the fullest extent permitted by law.

SECTION 15. Future Implementing Agreements.

The Public Agencies acknowledge that additional agreements may be necessary in the future to implement some parts of the WMP. This Agreement does not require any signatory Public Agency to either adopt or implement the WMP after adoption.

SECTION 16. Cooperation in Review of Plans and Projects Affecting Study Area.

Each signatory Public Agency shall, in writing, inform the other parties to this Agreement of all plans and projects proposed in the signatory Public Agency's jurisdiction that may substantially affect the proposed WMP. In addition, each signatory Public Agency shall allow adequate opportunity whenever possible for the other parties to this Agreement to review and provide comments on any such plans and projects, and shall, in good faith, consider any comments received from the other parties to this Agreement. Plans and documents not subject to disclosure under the Public Records Act shall be exempt from this provision.

SECTION 17. Special Area Management Plan.

The Public Agencies acknowledge that the County of San Diego, the cities of Imperial Beach and Chula Vista and the Army Corps of Engineers have executed a Cooperative Agreement for the development of a Special Area Management Plan (SAMP) for the Otay Watershed. Generally, the SAMP is to be a comprehensive plan for identifying, conserving, restoring and managing the aquatic resources in the Otay Watershed. The Public Agencies do not expect the WMP to conflict with the SAMP. However, if a potential or actual conflict between the two plans arises, the conflict shall be presented to the Policy Committee. The Policy Committee shall work to resolve the conflict in a way that will be consistent with both this Agreement and the memorandum of understanding for the SAMP.

If the Policy Committee cannot resolve the conflict in a way that is consistent with both this Agreement and the Cooperative Agreement, the Policy Committee shall refer the conflict to the Executive Committee established under the Cooperative Agreement and request the Executive Committee to recommend a resolution of the conflict. The Policy Committee shall consider the conflict and the recommendation from the Executive Committee, if any, and shall seek to resolve the conflict in a way that is as consistent as possible with both this Agreement and the Cooperative Agreement.

SECTION 18. Entire Agreement.

This Agreement contains the entire understanding of the parties. No party is relying on any other representation, written or oral. No term or provision of this Agreement may be changed, waived, discharged or terminated unless the same be in writing, signed by all of the Public Agencies.

IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be executed and attested by their proper officers thereunto duly authorized, as of the date first above written.

COUNTY OF SAN DIEGO

By: _____
Chief Administrative Officer

Dated: 3/24/04

CITY OF CHULA VISTA

By: _____
Mayor

Dated: 18 February 2004

Attest: Donna Norris
City Clerk

SAN DIEGO UNIFIED PORT DISTRICT

By: Bruce Hollingsworth
President/CEO/Executive Director

Dated: 02/6/04

APPROVED AS TO FORM 2.6.04 ATTORNEY

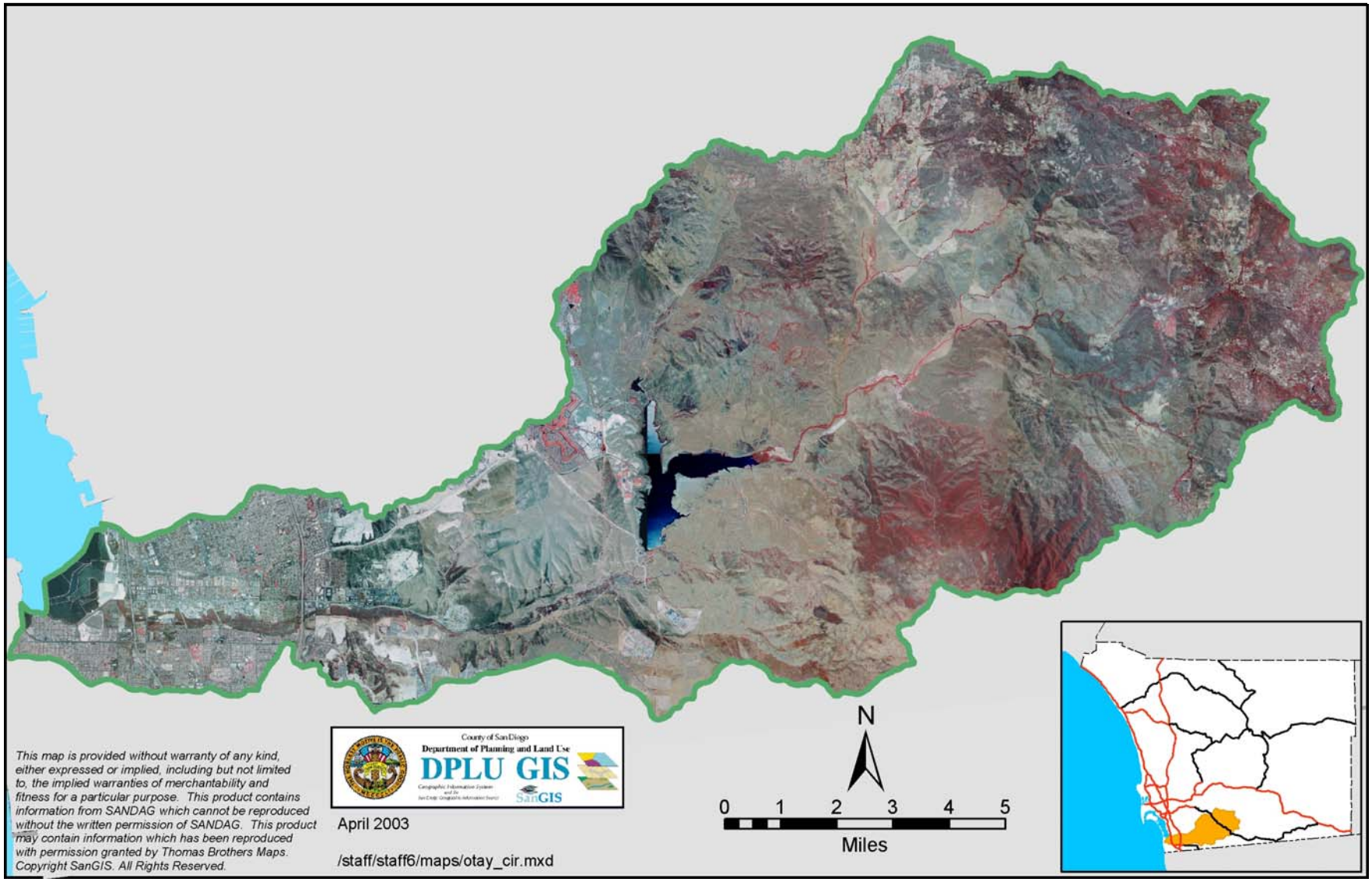
CITY OF IMPERIAL BEACH

By: _____
Mayor

Dated: 3-17-04

Attest: Jacqueline M. Hull
City Clerk

EXHIBIT A. Otay River hydrologic unit.



ORIGINAL

FIRST AMENDMENT TO
JOINT EXERCISE OF POWERS AGREEMENT
AMONG THE COUNTY OF SAN DIEGO,
THE CITIES OF SAN DIEGO, CHULA VISTA AND IMPERIAL BEACH
AND THE SAN DIEGO UNIFIED PORT DISTRICT
FOR THE DEVELOPMENT OF A WATERSHED
MANAGEMENT PLAN FOR THE OTAY RIVER

THIS FIRST AMENDMENT, dated for convenience as of the 7th day of Dec, 2004, is entered into by the Cities of San Diego, Chula Vista and Imperial Beach, California municipal corporations; the County of San Diego, a political subdivision of the State of California; and the San Diego Unified Port District, a public corporation, (collectively, Public Agencies).

Whereas, the Cities of Chula Vista and Imperial Beach, the County of San Diego and the San Diego Unified Port District previously entered into a Joint Exercise of Powers Agreement (JEPA) for the development of a watershed management plan for the Otay River; and

Whereas, the City of San Diego now wishes to participate in the development of the watershed management plan and to become a party to the JEPA; and

Whereas, adding the City of San Diego as a party to the JEPA necessitates amending several provisions in the JEPA.

NOW, THEREFORE, the Public Agencies agree to amend the JEPA as follows:

1. The first paragraph of Section 5, Policy Committee, is amended to read as follows:

A Policy Committee is established consisting of a single representative appointed by each signatory Public Agency. The Policy Committee shall provide direction to the Project Team for administering this Agreement. The representative from the County of San Diego shall be a member of and appointed by the County Board of Supervisors. The representative from the City of San Diego shall be a member of and appointed by the City Council. The representative from the City of Chula Vista shall be a member of and appointed by the City Council. The representative from the City of Imperial Beach shall be a member of and appointed by the City Council. The representative for the Port District shall be a member of and appointed by the District's Board of Port Commissioners. Appointment to the Policy Committee shall be for a term not to exceed the appointee's current term in office.

2. Section 2, Notices, is amended to read as follows:

Any notice or notices provided or required by this Agreement to be given or served upon the Public Agencies may be given by depositing the same in the United States mail, postage prepaid, addressed to or to such address as the Public Agencies may subsequently specify in writing.

Walter F. Ekard	Chief Administrative Officer	County of San Diego	1600 Pacific Highway, Room 209	San Diego, CA	92101
P. Lamont Ewell	City Manager	City of San Diego	202 C Street	San Diego, CA	92101
David D. Rowlands Jr	City Manager	City of Chula Vista	276 Fourth Avenue	Chula Vista, CA	91910
Gary Brown	City Manager	City of Imperial Beach	825 Imperial Beach Boulevard	Imperial Beach, CA	91932

DOCUMENT NO. RR-299929
FILED DEC 07 2004
OFFICE OF THE CITY CLERK
SAN DIEGO, CALIFORNIA

Bruce Hollingsworth	President/CEO/Executive Director	San Diego Unified Port District	P.O. Box 120488	San Diego, CA	92112-0488

3. All other provisions, terms and conditions in the JEPA remain in full force and effect.

IN WITNESS WHEREOF, the parties hereto have caused this First Amendment to be executed and attested by their proper officers thereunto duly authorized, as of the date first above written.

COUNTY OF SAN DIEGO

By: _____
Chief Administrative Officer

Dated: 6/6/05

CITY OF CHULA VISTA

By: _____
Mayor

Dated: 29 Apr 05

Attest: _____
City Clerk

SAN DIEGO UNIFIED PORT DISTRICT

By: Bruce Hollingsworth
President/CEO/Executive Director

Dated: 6/8/05

CITY OF IMPERIAL BEACH

By: _____
Mayor

Dated: 5-24-05

Attest: _____
City Clerk

CITY OF SAN DIEGO

By: _____
City Manager

Dated: 12-21-04

Attest: Joyce Lane
City Clerk

Approved as to form and legality
this 3rd day of January 2005
MICHAEL J. AGUIRRE, City Attorney

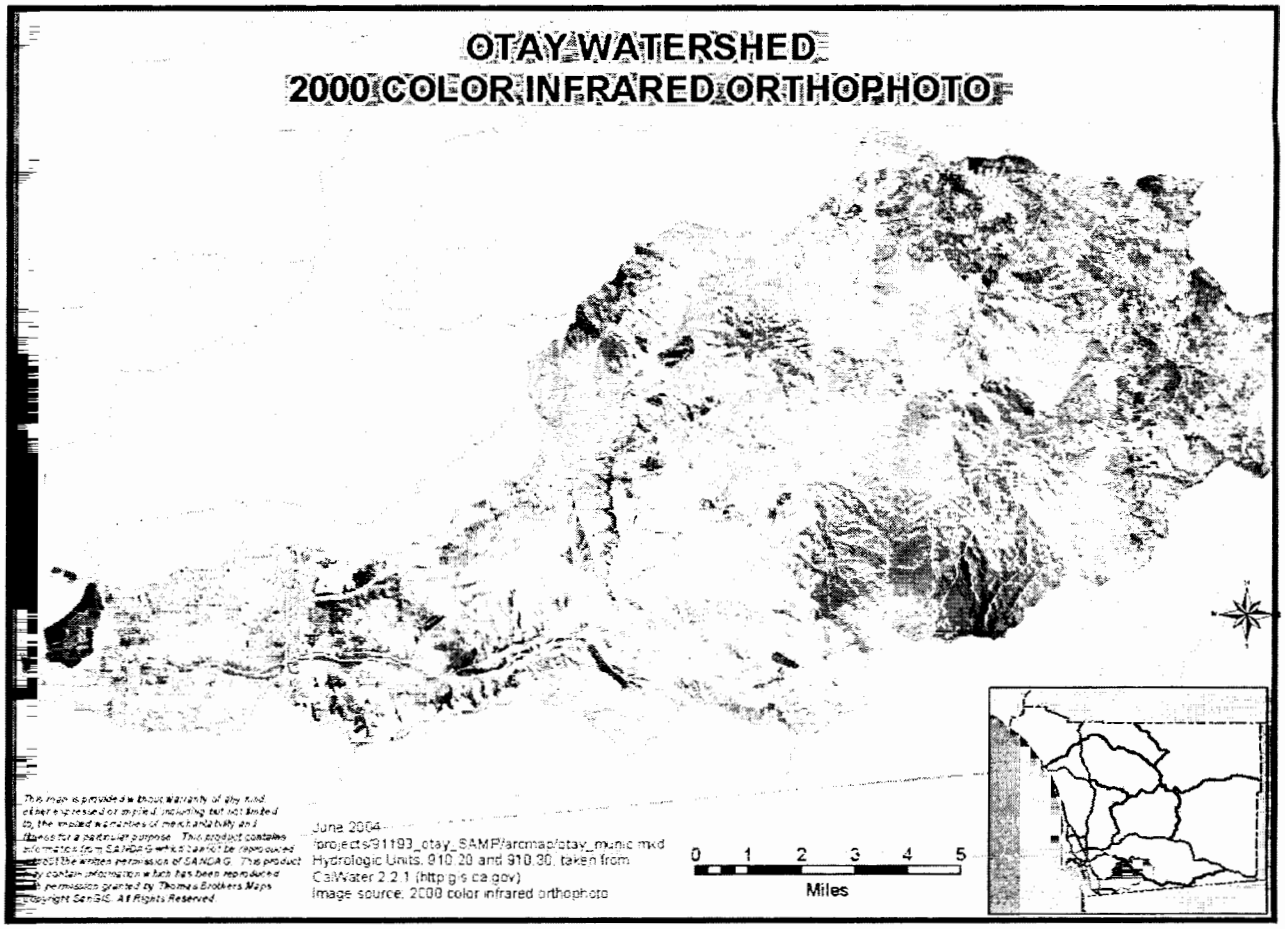
By _____
Deputy City Attorney

APPROVED AS TO FORM:

A Moore
Ann Moore, City Attorney
CITY OF CHULA VISTA

R-299929

OTAY WATERSHED
2000 COLOR INFRARED ORTHOPHOTO



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June 2004
/projects/91193_otay_SAMP/arcmap/otay_munic.mxd
Hydrologic Units: 910.20 and 910.30, taken from
CalWater 2.2.1 (http.gis.ca.gov)
Image source: 2000 color infrared orthophoto

(R-2005-205)

RESOLUTION NUMBER R- 299929

ADOPTED ON DEC 07 2004

BE IT RESOLVED, by the Council of the City of San Diego, that the City Manager or his designee is authorized to execute, for and on behalf of the City, the First Amendment to the Joint Exercise of Powers Agreement Among the County of San Diego and other agencies, for the Development of a Watershed Management Plan for the Otay River [First Amendment], under the terms and conditions set forth in the First Amendment on file in the office of the City Clerk as Document No. RR-299929, together with any modifications or amendments which do not increase the cost to the City and which the City Manager shall deem reasonably necessary from time to time in order to carry out the purposes and intent of the agreement.

BE IT FURTHER RESOLVED, that the City Auditor and Comptroller is authorized to transfer and expend an amount not to exceed $75,000 in Fiscal Year 2005 from Water Revenue Fund 41500, for the purpose of providing funds for the First Amendment.

BE IT FURTHER RESOLVED, that the City Auditor and Comptroller, upon advice from the administering department, is authorized to transfer excess funds, if any, to the appropriate reserves.

APPROVED: CASEY GWINN, City Attorney

By Lori W. Girard
Lori W. Girard
Deputy City Attorney

LWG:pev
10/13/04
Aud.Cert: AC2500170
Or.Dept:Water
R-2005-205

Passed and adopted by the Council of The City of San Diego on December 7, 2004, by the following vote:

YEAS:	**PETERS, ZUCCHET, ATKINS, MAIENSCHEIN, FRYE, MADAFFER, AND MAYOR MURPHY.**
NAYS:	**NONE.**
NOT PRESENT:	**INZUNZA.**
VACANT:	**DISTRICT FOUR.**

AUTHENTICATED BY:

DICK MURPHY

Mayor of The City of San Diego, California

CHARLES G. ABDELNOUR

City Clerk of The City of San Diego, California

(Seal)

By: **GIL SANCHEZ**, Deputy

I HEREBY CERTIFY that the above and foregoing is a full, true and correct copy of RESOLUTION NO. **R-299929**, passed and adopted by the Council of The City of San Diego, California on **December 7, 2004**.

CHARLES G. ABDELNOUR

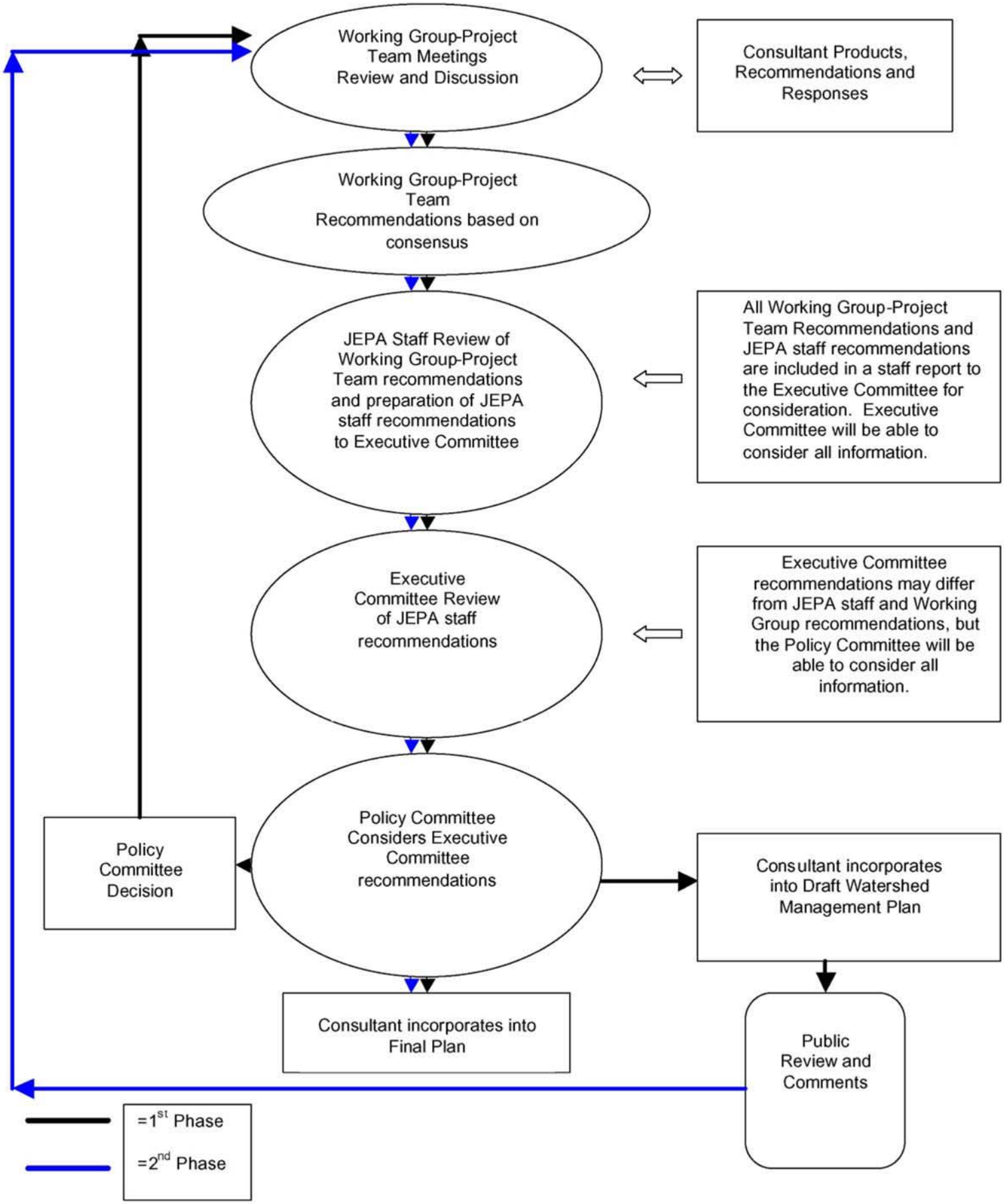
City Clerk of The City of San Diego, California

(SEAL)

By: _____, Deputy

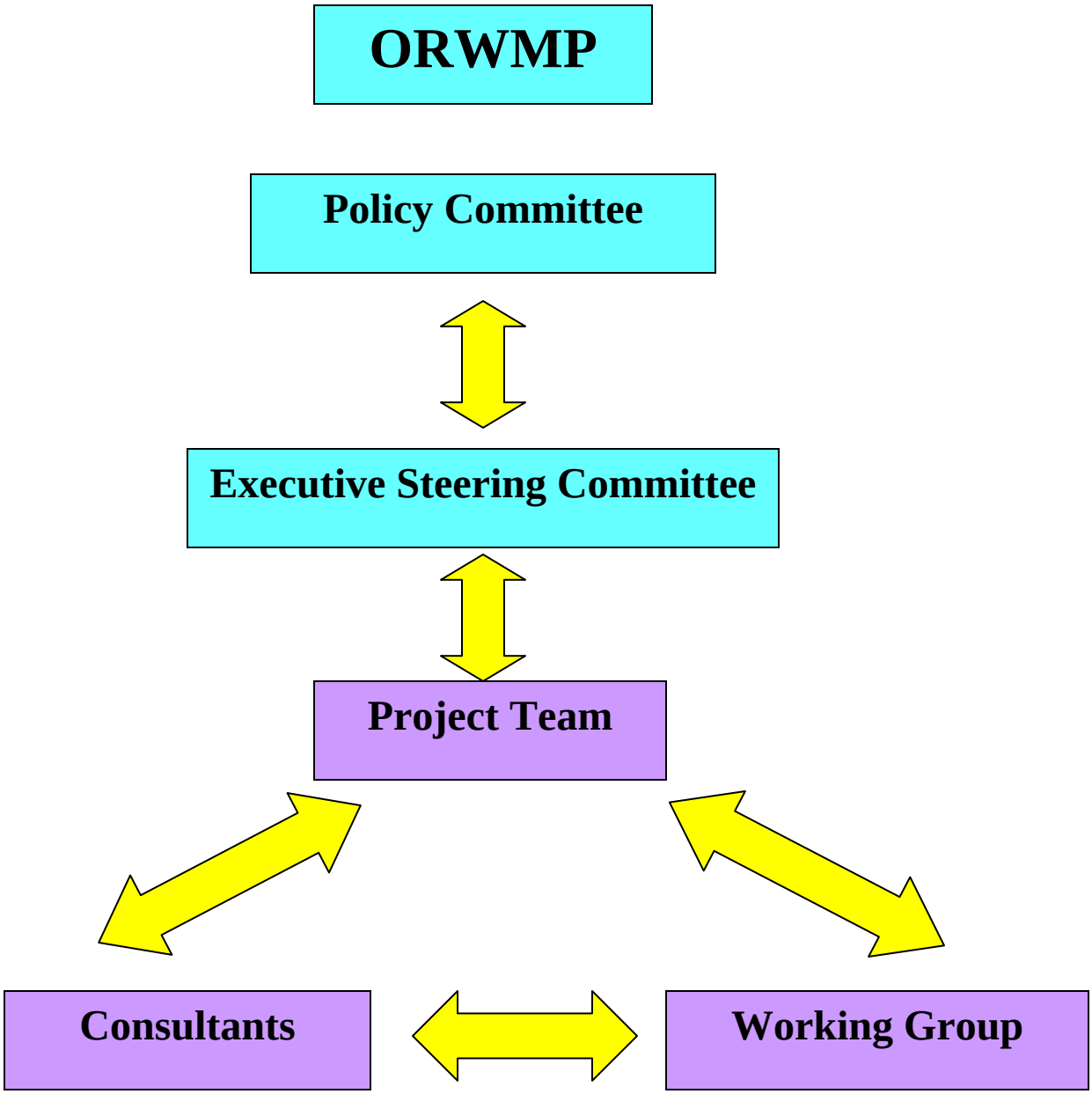
Appendix 2.
Otay River Watershed Working Group-Project Team Roles in Process

DRAFT OTAY RIVER WATERSHED WORKING GROUP-PROJECT TEAM ROLE IN PROCESS



MSCP/Tboaz

10/4/2004


ORWMP
Policy Committee
Executive Steering Committee
Project Team
Consultants
Working Group

POLICY COMMITTEE

Supervisor Greg Cox,
County of San Diego, District 1
Commissioner William A. Hall,
Unified Port of San Diego
Councilmember John McCann,
City of Chula Vista
Councilmember Mayda Winter,
City of Imperial Beach
City of San Diego Representative
City of San Diego

EXECUTIVE COMMITTEE

Executive Commitee Co-Chair, Bob Copper,
Deputy Chief Administrative Officer, County of San Diego
Jim Sandoval,
Planning Director, City of Chula Vista
Gary Brown,
City Manager, City of Imperial Beach
Richard Mendes,
Deputy City Manager, City of San Diego
Bruce B. Hollingsworth, President/CEO,
Unified Port of San Diego

PROJECT TEAM

Trish Boaz, County of San Diego
Cheryl Monzon, County of San Diego
Marilyn Ponseggi, City of Chula Vista
Marissa Lundstedt, City of Chula Vista
Josie Gabriel, City of Chula Vista
Bob Collins, City of San Diego
Rick Fox, City of San Diego
Karen Helyer, Port of San Diego
Hank Levien, City of Imperial Beach

CONSULTANTS

Aspen Environmental Group

WORKING GROUP

FEDERAL GOVERNMENT
Janaye Byergo, Bureau of Land Management
Victoria Touchstone, US Fish and WIldlife Service - San Diego National Wildlife Refuge
STATE GOVERNMENT -
Jonathan Hardy, Senator Denise Ducheny
Bruce Posthumus, San Diego Regional Water Quality Control Board
LOCAL GOVERNMENT
Ron Kelley, County of San Diego - Supervisor Greg Cox, District 1
Tom Oberbauer, County of San Diego
Joe DeStefano, County of San Diego
Khorso Aminpour, City of Chula Vista
NON-PROFIT/CONSERVATION ORGANIZATIONS
Mark Tucker, Wildlands Inc.
Tim Huntley, Wildlands Inc.
Suzanne Michel, State Coastal Conservancy - So Cal Wetlands Recovery Project

PRIVATE CITIZENS
Nancy Hughes, Mediator
Theresa Acerro, Private Citizen
Gale Moriarity, Equestrian
Frank Ohrmund, Private Citizen
COMMUNITY
Jack Bransford, Otay Valley River Park
Wayne Dickey, Otay Valley River Park
John Willet, Otay Valley River Park
BUILDING INDUSTRY
Todd Galarneau, McMillian Communities
Jon Rilling, Otay Land Companies
ENVIRONMENTAL
Cindy Burrascano, California Native Plant Society
Mike McCoy, SWIA
Don Peters, San Diego Audobon Society
Jim Peugh, San Diego Audobon Society
Ellen Shively, Sierra Club
UTILITIES
Beverly Blessent, San Diego Gas & Electric

GUIDELINES FOR THE OTAY WATERSHED WORKING GROUP

MEMBERSHIP STRUCTURE AND ROLE:

The Working Group is open to all individuals and should represent a broad cross-section of interests and groups from the Otay River Watershed. Individuals will become members of an interest group that best represents their goals and objectives. In order to meet the goal of maintaining an equal number of representatives for each interest group, the Working Group shall solicit approximately four representatives and one alternative for each interest group. The Policy Committee may select additional interest group representatives, as it deems necessary.

This Working Group shall serve in an advisory capacity to both the Otay River Watershed Management Plan (ORWMP) and the Special Area Management Plan (SAMP). The Working Group will, among other things, provide review and input to the Project Team on the preparation of a Watershed Management Plan for the Otay River. This Group or a subgroup will also provide review and input to the Project Team on the SAMP.

The Project Team consists of staff from the jurisdictions involved in the ORWMP and the SAMP. In addition to receiving input from the Working Group, the Project Team may decide to meet separately with individuals or subgroups of the Working Group as necessary to provide information to or receive input on specific issues.

The Policy Committee is identified in the Joint Exercise of Powers Agreement (JEPA) for the ORWMP. The Policy Committee shall consist of a single representative appointed by each signatory Public Agency and shall provide direction to the Project Team for administering the JEPA.

An Executive Steering Committee shall be established for the ORWMP and shall consist of a single representative from each of the signatory agencies participating in the ORWMP. In the event that issues arise in the Working Group for which consensus cannot be reached, the issues shall be elevated to the Executive Steering Committee for decision and/or direction.

SELECTION PROCESS:

Potential members of the Working Group will be solicited through several methods. The first method will be through on-line input received from a survey located on the Project Clean Water web site

(www.projectcleanwater.org/html/ws_otay.html). Secondly, members will be solicited through participation in several public meetings. In order to reach the largest possible audience, potential members will be notified through the Project Clean Water web site, by invitation to specific target groups and property owners with an interest in the Otay River Watershed and lastly, through advertisement in a general newspaper

After solicitation of potential members, a public meeting will be held to establish the five interest groups that will make up the Working Group. Interested individuals attending this meeting will select one of the following interest groups to join:

- Property Owner
    - This group shall include but not be limited to large public property owners, large private property owners and small private property owners.
- Business / Building
    - This group shall include but not be limited to building industry representatives, industrial industry representatives and local business groups.
- Environmental
    - This group shall include but not be limited to water quality groups, habitat and species protection groups and land preservation groups.
- Recreational
    - This group shall include but not be limited to equestrian groups, bicycle groups and hiking groups.
- Resource Agencies
    - This group shall include but not be limited to the U.S. Fish and Wildlife Service, U.S. Fish and Wildlife Service Refuges, California Department of Fish and Game, Bureau of Land Management, Environmental Protection Agency, Regional Water Quality Control Board, and the Army Corps of Engineers.
- Additional group if necessary
    - A new group shall be created if a significant number of interested parties are not included under the above five groups.

The Working Group representatives will be expected to adhere to the guidelines contained in this document. In the event an interest group is not able to recommend a representative and/or alternate, the Project Team will make a recommendation to the Policy Committee for whom to appoint as the representative and/or alternate for that interest group. The Policy Committee will consider but not be limited to the recommendations of the Project Team or the interest groups in their appointment of representatives.

GENERAL FUNCTIONS AND DUTIES:

The Working Group is a committee of people that will fulfill the roles of the Stakeholder Committee identified in the Joint Exercise of Powers Agreement for the ORWMP as well as that of the Working Group identified in the Cooperative Agreement for the SAMP. The Working Group will serve primarily to identify and discuss issues and concerns, opportunities and constraints, and objectives related to the ORWMP and the SAMP. In addition, they will review information and provide comments from select area-wide studies. These studies would include but not be limited to: environmental baseline studies, function and values report, water quality analysis and modeling techniques. As a result the Working Group is expected to function as a consensus system on all issues so as to provide guidance to the Project Team, the Executive Steering Committee and the Policy Committee that will result in the development of achievable goals, objectives, policies and implementation strategies for the ORWMP and SAMP. In the event that issues arise for which consensus cannot be reached, the issues shall be elevated to the Executive Steering Committee for decision and/or direction.

The duties of the Working Group are:

- To identify a chairperson who will co-chair meetings of the group and represent the group at other meetings, hearings or other public events.
- To work toward consensus with all members on all issues.
- To assist in the identification of solutions that work.
- To review and provide input on key issues and objectives related to the environment, agriculture and economic development within the watershed.
- To review and provide feedback on the Goals, Objectives and Policies of the ORWMP.
- To provide periodic reports on the status and outcome of issues raised by the Working Group to various committees of the ORWMP and the SAMP.
- To provide recommendations on the ORWMP to the Policy Committee.
- In the event that there are conflicts, actual or perceived, between the ORWMP and SAMP, recommendations shall be made to the Policy Committee for appropriate resolution.

The duties of the Representatives are:

- The representatives of the interests groups in the Working Group shall be recognized and serve at the pleasure of the Policy Committee and for a term set by the Policy Committee. In the event that the Policy Committee sets no term of service the term shall be for the duration of the development of the plan.
- Representatives will communicate issues back to the interest group(s) that they represent.
- Representative attendance at meetings is critical to the functioning of the Working Group. Any representative of an interest group, who cannot

attend a meeting, should notify the Chair or the Project Manager prior to the meeting.

- When the representative cannot attend, the designated alternate representative should come in his/her place.
- If a representative is unable to continue in their duties as a representative of their interest group, the designated alternate representative should take his/her place, if no alternate representative is available, then the Project Team and/or the Policy Committee should choose a new alternate representative.

OPERATION OF MEETINGS:

- All meetings will be presided over by the Co-Chairperson(s) representing the Working Group and the Project Team.
- Meetings will be held, at minimum, on a quarterly basis and as frequent as necessary to achieve consensus.
- Meetings will be open to the public and notices will be either mailed to interested parties, posted in a public location and on the Otay River Watershed Plan website www.projectcleanwater.org/html/ws_otay.html or advertised in a paper of general circulation per requirements of the Brown Act.
- Decision-making and any recommendations by the Working Group will be by consensus.
- A simple majority of representatives will constitute a quorum for conduct of business. In the absence of a quorum, a single representative may move to adjourn.

Public Meetings Held

DATE	TYPE OF MEETING	LOCATION
June 26, 2003	Public Meeting	Heritage of the Americas Museum 12110 Cuyamaca College Dr. West El Cajon, CA 92019
August 13, 2003	Public Meeting	John Lippitt Public Works Center 1800 Maxwell Road Chula Vista, CA 91911
June 22, 2004	Working Group – Project Team	John Lippitt Public Works Center
July7, 2004	Working Group – Project Team	John Lippitt Public Works Center
August 4, 2004	Working Group – Project Team	John Lippitt Public Works Center
September 1, 2004	Working Group – Project Team	John Lippitt Public Works Center
October 6, 2004	Working Group – Project Team	John Lippitt Public Works Center
November 3, 2004	Working Group – Project Team	John Lippitt Public Works Center
December 1, 2004	Working Group – Project Team	John Lippitt Public Works Center
December 13, 2004	Policy Committee Meeting	County Administration Building 1600 Pacific Highway, Room 302/303 San Diego, CA 92101
January 5, 2005	Working Group – Project Team	John Lippitt Public Works Center
January 21, 2005	Otay River Watershed Tour	Otay River Watershed Boundary
February 2, 2005	Working Group – Project Team	John Lippitt Public Works Center
March 2, 2005	Working Group – Project Team	John Lippitt Public Works Center
April 6, 2005	Working Group – Project Team	John Lippitt Public Works Center
May 4, 2005	Working Group – Project Team	John Lippitt Public Works Center
June 1, 2005	Working Group – Project Team	John Lippitt Public Works Center
June 17, 2005	Otay Valley Regional Park Community Advisory Committee – ORWMP Project Overview	Montgomery-Waller Recreation Center 3020 Coronado Ave. San Diego, CA 92154
June 23, 2005	Policy Committee Meeting	County Administration Building 7th Floor (Tower) Room

July 26, 2005	Jamul/Dulzura Community Planning Group – Presentation of the Draft ORWMP July 2005	Oak Grove Middle School 14344 Olive Vista Lane Jamul, CA 91935
July 28, 2005	South County Building Industry Advisory Group – Presentation of the Draft ORWMP July 2005	The Corky McMillin Companies 2727 Hoover Avenue National City, CA
August 10, 2005	Otay Nester Community Planning Group – Presentation of the Draft ORWMP July 2005	Nestor Fellowship Hall 1120 Nestor Way San Diego , CA 92154
August 17, 2005	Otay Mesa Community Planning Group – Presentation of the Draft ORWMP July 2005	Café Vallarta 2335 Roll Dr. San Diego, CA 92154
October 5, 2005	Working Group-Project Team Meeting	John Lippitt Public Works Center
November 9, 2005	Working Group-Project Team Meeting	John Lippitt Public Works Center
December 7, 2005	Working Group-Project Team Meeting	John Lippitt Public Works Center
January 4, 2006	Working Group-Project Team Meeting	John Lippitt Public Works Center
January 17, 2006	Executive Committee Meeting	County Administration Building 1600 Pacific Highway, Room 302/303 San Diego, CA 92101
March 10, 2006	Policy Committee Meeting	County Administration Building 1600 Pacific Highway, Room 302/303 San Diego, CA 92101

Appendix 3.
Otay Watershed Pollutant Loading Tool: Development and Application

OTAY WATERSHED POLLUTANT LOADING TOOL: Development and Application

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January 27, 2005

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SECTION 1.0

INTRODUCTION

1.1 BACKGROUND

AQUA TERRA Consultants (ATC) utilized PLOAD, a GIS-based tool within the EPA BASINS model (EPA, 2001a), to estimate annual loads for a list of user-specified pollutants within each subbasin in the Otay River Watershed. The model calculates annual nonpoint loads using the EPA's Simple Method approach,[1] which employs runoff coefficients and event mean concentrations (EMCs) to calculate the annual loads (EPA, 2001b). Point sources and best management practices (BMPs), which can reduce nonpoint and/or point source loads in a specified area, may optionally be included in the analysis. The basic model output includes the area and load for each land use within each subbasin, along with subbasin total loads and annual mean concentrations.

Due to a limitation in the PLOAD implementation within BASINS, that requires the use of a single value for precipitation in all subbasins, AQUA TERRA programmed the PLOAD calculations within an Excel spreadsheet to allow the precipitation to vary by subbasin throughout the watershed. We refer to this spreadsheet as the Otay Watershed Pollutant Loading (OWPL) Tool.

1.2 THIS REPORT

This report describes the development of the OWPL Tool, the equations that perform the loading calculations, the data used to describe the Otay Watershed, and the initial results of the OWPL Tool calculations for the selected constituents. This report is a Final Review Draft subject to review by the WMP Project Team and San Diego County. The current version of the OWPL Tool spreadsheet includes the capability to represent BMPs applied to the watershed; those capabilities will be used to assess and evaluate selected BMP implementation scenarios, as part of the remaining efforts under Task 3 to develop the Otay River WMP.

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[1] The Simple Method is an empirical approach developed for estimating pollutant export from urban development sites. The Simple Method has been endorsed by EPA as a viable screening tool for NPDES stormwater projects.

SECTION 2.0

MODELING METHODOLOGY FOR LOADING CALCULATION

PLOAD allows the user to choose between two methods for calculating nonpoint pollutant loads: the Export Coefficient Method or the Simple Method. Despite its name, the latter method actually requires more detailed input and uses a more complicated algorithm than the former. The Simple Method was chosen for the OWPL Tool because most of the required input data was deemed to be available. The remedial effects of BMPs on nonpoint source loading are based upon their removal efficiencies and area of influence. Point source loadings are taken directly from a user-specified table that explicitly lists the annual loading rate for each constituent. Descriptions of the equations used to calculate pollutant loads are provided in this section.

2.1 EXPORT COEFFICIENT AND SIMPLE METHODS

The Export Coefficient Method calculates the loads for each specified pollutant type by subbasin using the following equation:

$$L_P = \Sigma_U(L_{PU} * A_U) \quad (1)$$

Where: L_P = Pollutant load, lbs/yr

L_{PU} = Pollutant loading rate for land use type u, lbs/acre/year;

A_U = Area of land use type u, acres

Pollutant loading rates must be defined by the user for each land use and each pollutant. Annual loads are simply the product of the loading rate and the land area for each land use.

The Simple Method, implemented in the OWPL Tool, requires two equations in order to calculate the loads for each specified pollutant type; one equation is used to calculate the runoff coefficient so that a runoff volume is determined, and then the an event mean concentration (EMC) for each pollutant and land use is used to determine the annual load associated with that runoff .

First, the runoff coefficient for each land use type is derived with the following equation:

$$R_{VU} = 0.05 + (0.009 * I_U) \quad (2)$$

Where: R_{VU} = Runoff coefficient for land use type u, $inches_{runoff}/inches_{rain}$

I_U = Percent imperviousness

Then, the pollutant loads are calculated with the following equation:

$$L_P = \Sigma_U (P * P_J * R_{VU} * C_U * A_U * 2.72 / 12) \quad (3)$$

Where: L_P = Pollutant load, lbs/yr

P = Precipitation, inches/year

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P_J = Ratio of storms producing runoff (default = 0.9)

R_{VU} = Runoff coefficient for land use type u, $inches_{run}/inches_{rain}$

C_U = Event mean concentration for land use type u, milligrams/liter

A_U = Area of land use type u, acres

2.72 = conversion from [mg/L] to [lb/ac-ft] for pollutant concentration

12 = conversion from [in] to [ft] for precipitation

Pollutant loading rates for each constituent and land use are then calculated by OWPL and PLOAD by dividing the annual load by the land use area for each subbasin.

2.2 BMP COMPUTATIONS

In PLOAD, after the raw pollutant loads are calculated using the either the Export Coefficient or Simple Methods, three equations are used to calculate the remedial effects of BMPs (if they are included in the analysis) on those loads:

First, the percentage of the subbasins area serviced by BMPs is determined using the following equation:

$$\%AS_{BMP} = (AS_{BMP}/A_B) \times 100 \quad (4)$$

Where: $\%AS_{BMP}$ = Percent area serviced by the BMP

AS_{BMP} = Area serviced by the BMP, acres (input by user)

A_B = Area of subbasin, acres

Next, the pollutant loads for each BMP are calculated:

$$L_{BMP} = (L_P * (\%AS_{BMP})/100) * (1 - \%EFF_{BMP}/100) \quad (5)$$

Where: L_{BMP} = BMP load, lbs/yr

L_P = Raw subbasin load, lbs/yr (i.e. without BMPs)

%EFF = Percent load reduction of BMP

The raw subbasin pollutant loads are derived from the results of the Export Coefficient or Simple Methods, while the percent load reduction comes from the BMP efficiency tables.

Finally, the total pollutant loads accounting for BMPs are computed by subbasin. Each subbasin load is a cumulative total of areas that *are* and *are not* influenced by BMPs.

$$L = (\Sigma_{BMP} (L_{BMP})) + L_P * (A_B - (\Sigma_{AS} (AS_{BMP}))/ A_B \quad (6)$$

In the OWPL Tool, the same calculations are performed for each land use, with the user supplying the areas of each land use within each subbasin serviced by a BMP (i.e. AS_{BMP}), and the BMP removal efficiency for each pollutant (i.e. %EFF). The Tool currently allows up to 10 different BMPs to be defined and used in the calculations.

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SECTION 3.0

OTAY WATERSHED INPUT DATA AND CHARACTERIZATION

PLOAD employs ArcView to digitally overlay the subbasin and land use coverages in order to calculate the contributing area for each land use within each subbasin. The additional required numeric data are provided in tabular form via Excel (e.g. % impervious, EMCs, point sources, BMP removal efficiencies) or as a single datum via the user interface (precipitation, ratio of storms producing runoff). The OWPL Tool requires the same input data entirely in a tabular, i.e. spreadsheet, format. GIS processing is done separately and the resulting data is also provided in to the OWPL Tool as an input spreadsheet. In this section we describe the input data required, followed by the specific values and data sources used for the Otay Watershed.

3.1 MODEL INPUT REQUIREMENTS

PLOAD requires both GIS coverages and numeric data as input to the model, as summarized in the following lists:

1) GIS Coverages
   a) Delineated subwatersheds
   b) Land use distribution

2) Numeric Data (based on execution of Simple Method)
   a) Event Mean Concentrations (EMCs) by land use for each constituent, mg/L (bacterial constituents, organisms/100 mL)
   b) % impervious for each land use
   c) average annual precipitation, in/yr
   d) ratio of storms producing runoff (default = 0.9)

3) Supplemental/Optional – (depending on scenarios evaluated)
   a) Best Management Practices (BMPs)
      i) Table with removal efficiencies for each constituent
      ii) GIS coverage (point or polygon) of application area

   b) Point Sources
      i) Table with quantity of each constituent input to stream, lbs/yr
      ii) GIS coverage (point) of point source locations

The OWPL Tool requires the same input data as PLOAD, but all the GIS coverages must be preprocessed by the user, and provided in separate spreadsheets within the Tool. Thus, the land use categories and areas, the BMP services areas by land use category, and the point source loads and locations are all provided in separately designated spreadsheets within the Tool.

3.2 INPUT DATA AND SOURCES

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3.2.1 Subbasin Coverage

For planning purposes, the San Diego Association of Governments (SANDAG) has divided the Otay Watershed into eight hydrologic subareas (HSAs) ranging in size from 815 to 31992 acres; Figure 3.1 shows the subbasin delineation and Table 3.1 provides the land areas, along with the precipitation ranges for the HSAs. Traveling easterly upstream from the Otay River outlet, the HSAs are Otay Valley, Proctor, Savage, Hollenbeck, Jamul, Lee, Engineer Springs, and Lyon. The GIS coverage for these subbasins was mapped by the California Department of Forestry under specifications provided by the California Department of Water Resources (http://www.sandag.cog.ca.us/resources/maps_and_gis/gis_downloads/downloads/metadata/hydrobdoc.htm).

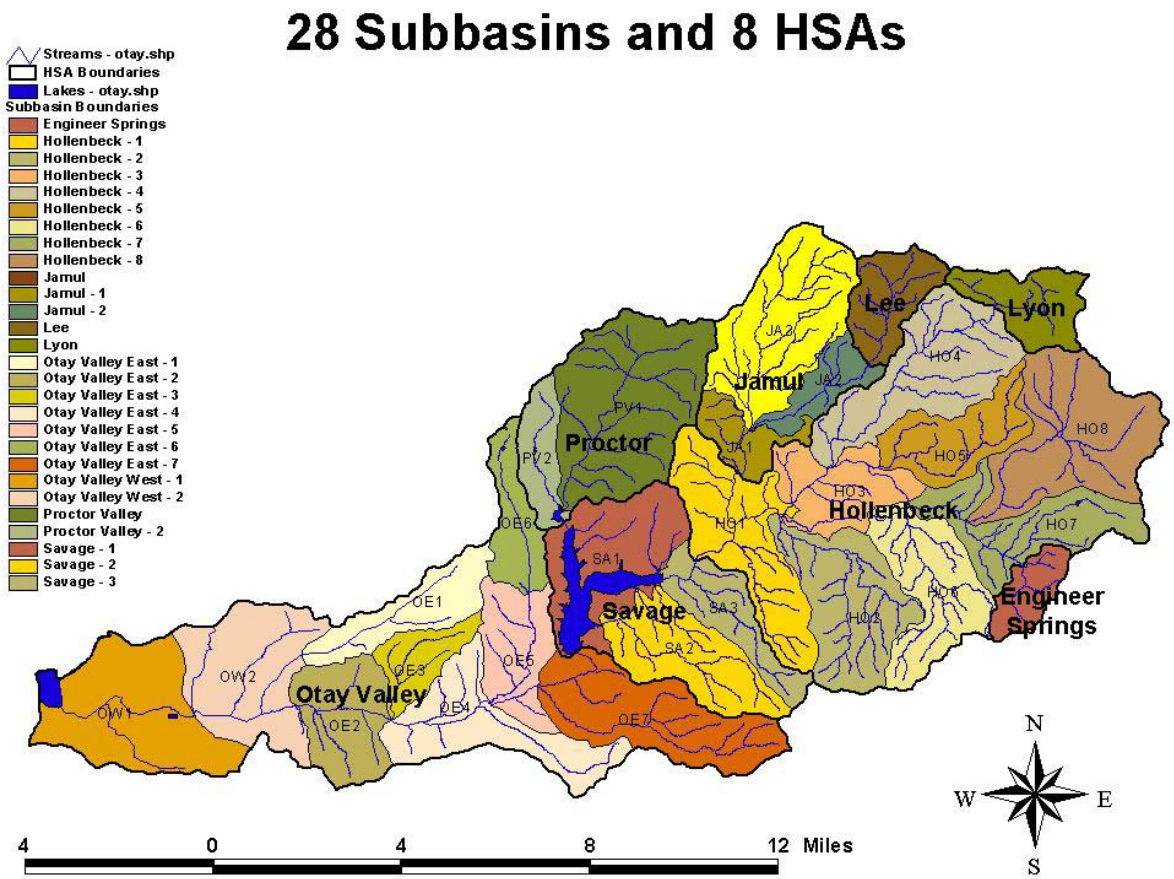

Figure 3.1 Otay Watershed Subbasin Delineation

Table 3.1 Land Areas and Precipitation for the 8 HSA Subbasins

HSA Subbasin	Area (ac)	Mean (in)	Min (in)	Max (in)
Otay West	9781	10.08	9.62	10.76
Otay East	19970	11.58	10.19	16.67
Proctor	7743	12.82	11.37	15.84
Savage	10189	13.12	11.01	18.26
Hollenbeck	31992	14.35	11.21	19.38
Jamul	7947	12.61	11.59	14.21
Lee	2445	15.05	12.97	16.26
Engineer Springs	815	11.70	11.46	11.95
Lyon	2038	17.67	16.48	19.29
Overall Watershed:	92921	12.96	9.62	19.38

For this pollutant loading assessment, the Otay Watershed was further subdivided into a total of 28 planning unit subbasins ranging in size from 815 to 6725 acres; these areas are shown in Table 3.2, along with the precipitation ranges. This further subdivision was based on a previous delineation performed by the Engineer Research and Development Center (ERDC) of the U.S. Army Corps of Engineers. The ERDC coverage resulted in 212 subbasins and was developed for a more detailed spatial assessment and was based on an initial field reconnaissance, aerial photos, and topographic maps (Smith, 2004). The 28 ATC planning unit subbasins were generally aggregated from the 212 ERDC subbasins, but the boundaries do not correspond in all cases. The ERDC boundaries were overlain with a 10-meter resolution digital elevation model (DEM) and it was discovered that those boundaries failed to follow prominent ridge lines in several instances. Those boundary lines were subsequently adjusted based on the topography information from the DEM. Additionally, Otay Valley was divided into eastern and western segments along the hydrologic boundary closest to Interstate 5. The delineation and nomenclature assigned to the subbasins is also displayed in Figure 3.1.

3.2.2 Precipitation

A GIS grid layer of precipitation in the watershed was provided by Joel Michaelsen in the Department of Geography at UCSB. This grid was overlain with the subbasin coverage to render an average annual precipitation value for each subbasin. Table 3.2 shows the annual precipitation mean, minimum, and maximum for each of the 28 subbasins; Figure 3.2 graphically shows the variation across the watershed. The precipitation ranges from a mean of 9.8 inches at the western end, near the Otay's outlet to San Diego Bay, to almost 18 inches in the upper watershed. This significant precipitation range is the primary reason the OWPL Tool was developed, since PLOAD only allows a single mean precipitation across the watershed. Table 3.1 shows the precipitation values for the HSA areas.

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Table 3.2 Land Area and Precipitation for the 28 Otay Subbasins

Planning Unit	Area (ac)	Mean (in)	Min (in)	Max (in)
OW1	4891	9.81	9.62	10.18
OW2	4891	10.34	9.92	10.76
OE1	2445	11.27	10.63	11.75
OE2	3057	10.62	10.19	10.96
OE3	1426	11.07	10.58	11.58
OE4	3464	11.06	10.45	11.87
OE5	2649	11.17	10.68	11.69
OE6	2038	11.69	11.41	12.45
OE7	4891	13.04	10.81	16.67
PV1	6725	12.91	11.37	15.84
PV2	1019	12.20	11.67	13.23
SA1	4483	11.73	11.01	13.66
SA2	3260	14.04	12.08	17.10
SA3	2445	14.43	11.99	18.26
HO1	4687	13.79	11.44	17.35
HO2	4483	15.29	11.70	19.19
HO3	2445	12.23	11.85	12.99
HO4	4891	14.34	12.04	19.38
HO5	2649	14.11	12.03	18.26
HO6	3260	12.56	11.21	14.99
HO7	3668	13.46	11.64	17.87
HO8	5909	16.62	12.50	18.83
JA1	1426	12.86	11.59	14.14
JA2	1630	12.15	11.63	12.91
JA3	4891	12.69	11.62	14.21
LE1	2445	15.05	12.97	16.26
ES1	815	11.70	11.46	11.95
LY1	2038	17.67	16.48	19.29

3.2.3 Impervious Cover

For the Simple Calculation Method used in the OWPL Tool, a percent impervious surface factor table must be provided for each land use category throughout the watershed. As shown in Section 2, it is used to calculate the runoff coefficient for each land use type. The runoff coefficient is used with the annual average rainfall to calculate the total stormwater runoff for each land use within each subbasin. Impervious surface values for land uses within the Otay Watershed were obtained from San Diego County's white paper titled "Watershed Development Districts and Impervious Cover Thresholds" (CoSDDPLU, 2003). Table 2-1 from that report, titled, Typical Percent Impervious Coverage, provided initial values that were then reviewed and adjusted as shown in Table 3.3.

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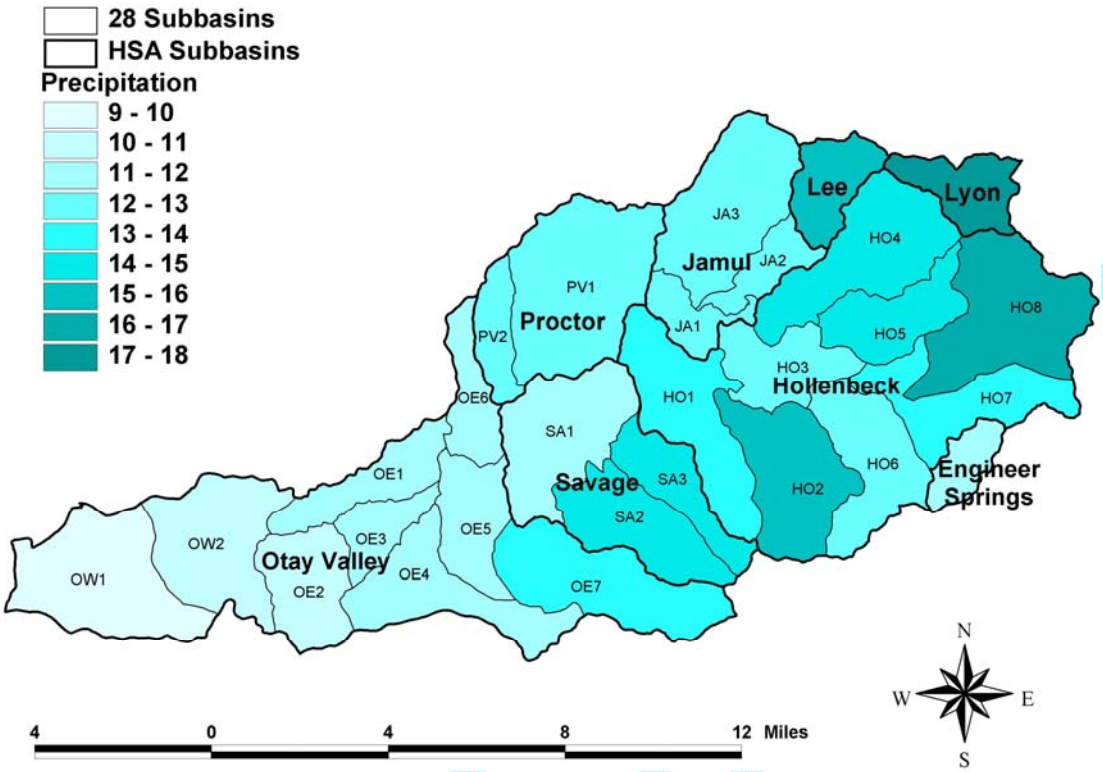

Figure 3.2 Precipitation Range across the Otay Watershed

Table 3.3 Impervious Cover for Land Uses in the Otay Watershed

White Paper		OWPL Tool	
Land Use Type	% Imp	OWPL Land Use	% Imp
Single-Family Residential (1 to 10 acres)	15 [a]	LD Res	15
Single-Family Residential (< 1 acre)	34 [a]	Mid-HD Res	40
Multi-Family Residential, Group Quarters, Hotels	68 [b]		
Industrial	91 [b]	Industrial	91
Transportation	100 [c]	Transportation	95
Airports	100 [c]		
Commercial	92 [b]	Commercial	90
Commercial Recreation	91 [c]		
Office	92 [c]		
Schools	80 [b]	Schools	80
Agriculture	0 [c]	Agriculture	2
Parks	0 [b]	Open	5
Vacant	0		
Under Construction	0	---	---
Hospital	80 [c]	Public Facilities	80
---	N/A	Public Utilities	80

[a] Based on 2002 impervious surface pilot study in the San Diego River Watershed conducted by DPLU-GIS.
[b] Adopted from Wong et al. (1997), Los Angeles County Department of Public Works, Santa Monica Bay Drainage Study
[c] Adopted from Sleavin et al. (2000), Measuring IS for Non-Point Source Pollution Modeling

The White paper land use categories of 'Group Quarters and Hotels' were actually aggregated and moved to the Commercial category, and not included in Mid-HD Residential. Single-family Residential accounts for 75% of the land aggregated into Mid-HD Residential, while 17% is Multi-Family Residential, and 8% is Mobile Home Parks. The Mobile Home Parks category was assumed to have the same impervious factor as Multi-Family Residential. A weighted average of 42.5% based on the three white paper land uses grouped into Mid-HD Residential was rounded down to 40% due to the extent of single family dwellings. The agriculture lands were assigned a value of 2% impervious to be more consistent with runoff expectations.

The Transportation value was decreased from 100% to 95% in order to account for road and rail rights-of-way surrounding impervious road surfaces. The Open value was increased from 0% to 5% in order to account for large expanses of exposed bedrock and shale. No information regarding impervious factors for the Public Utilities category could be found so its value was set to that of Public Facilities. Although a small amount of school and residential area was identified as being under construction, these areas were lumped into their respective categories without special consideration considering the temporary nature of construction.

3.2.4 Event Mean Concentrations (EMCs)

The EMC values selected for the Otay Watershed were derived from a variety of sources discovered during a literature review. Initially, very little data on the Otay was found, so comparable data within California and similar climatic regions were used as the only alternative. Following our initial estimation of values, San Diego Water Department (SDWD) provided data from recent sampling on both the Otay and Cottonwood watersheds (D. Daft, 2004, personal communication). Based on this more recent local data, selected EMC values were adjusted to reflect the ranges evident in the SDWD data.

Tables 3.4. 3.5, and 3.6 document the values and sources of the EMC data for each constituent/land use combination, by summarizing the data sources used and selections made to determine the specific EMC values input to the calculations. Table 3.4 contains the final input EMC values by constituent and land use. Table 3.5 notes which data sources were used as guidelines to determine each value. The priority given to each data source corresponds with its numerical ID, with 1 being the highest priority and 5 the lowest (Data source 6, referenced in the preceding paragraph, is an exception to this rule and was given highest priority). Engineering judgment was used to supersede exact literature values when deemed appropriate to maintain expected variation between land uses. Also, there was not always an exact value available for each constituent/land use combination. In these instances, values for constituents were estimated based upon an expected relation to other land uses. Table 3.6 summarizes all available values identified from the literature review. When a single value is listed, that value was reported as an EMC. When a value is followed by a range in parentheses, the first value is the algebraic mean of all samples, and the range reflects the minimum and maximum values. The SDWD data is not shown in Table 3.6 because the values were not defined by land use type, but the data we used to develop the final EMCs.

Data for TDS EMCs were very limited since TDS was not a constituent commonly measured and reported in the other data sources reviewed. The TDS values in Table 3.4 vary from 3000 mg/l for agricultural lands to 500 mg/l for recreation/open lands, with the urban categories in the range of 500 to 1000 mg/l. These values and ranges were derived from data from SDWD, Ventura County (Larry Walker Associates, 2004) and the Nevada side of the Lake Tahoe region (Carollo Engineers, 2002).

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Table 3.4 Constituent Event Mean Concentrations per Land Use

Land Use Code	BOD_5 (mg/L)	TSS (mg/L)	TDS (mg/L)	NO23-N (mg/L)	NH3-N (mg/L)	TKN (mg/L)	TN (mg/L)	PO4-P (mg/L)	TP (mg/L)	T_CU (mg/L)	T_ZN (mg/L)	T_PB (mg/L)	OIL_GREASE (mg/L)	FEC_COLI (orgs/100 mL)
Agriculture	15	1500	3000	10	1.79	4.8	14.8	0.095	0.65	0.115	0.238	0.09075	0.5	5000
Commercial	34.5	70	750	0.58	0.91	3.37	3.95	0.09	0.205	0.035	0.168	0.0183	3.65	9240
Light Industrial	21	230	1000	0.86	0.48	3.07	3.93	0.07	0.22	0.031	0.399	0.0261	1.87	6550
Low Density Res.	18	50	500	0.83	0.22	2	2.83	0.08	0.13	0.15	0.056	0.015	0.68	8050
High Density Res.	38.25	100	750	1.04	0.36	2.8	3.84	0.1	0.195	0.2	0.084	0.01935	1.36	10900
Public Facility	9.15	70	500	0.58	0.91	3.37	3.95	0.09	0.205	0.035	0.168	0.0183	3.65	9240
Public Utility	21	230	1000	0.86	0.48	3.07	3.93	0.07	0.22	0.031	0.399	0.0261	1.87	6550
Rec/Open Space	3	165	375	1.11	0.1	0.81	1.92	0.025	0.055	0.012	0.028	0.00345	0.1	2180
Schools	22.5	100	500	0.63	0.26	1.62	2.25	0.1	0.155	0.022	0.084	0.015	1.36	8050
Transportation	7.5	75	625	0.75	0.23	1.81	2.56	0.1	0.22	0.052	0.196	0.033	3.19	1000

Notes: Public Facility values are set equal to those of Commercial
Public Utility values are set equal to those of Light Industrial

Table 3.5 Sources Used to Determine Event Mean Concentrations

Land Use Category	BOD-5	TSS	TDS	NO2	NO3	NH3	TKN	TN	PO4	TP	T-Cu	T-Zn	T-Pb	F-coli	Oil/ Grease
Agriculture	6,5	2	6	2**	2	2	***	***	6,2	6***	1,5	6,1	6,2	5	****
Commercial	6,5	1	6	1	1	1	1	1	6,2	6,1	1	6,1	6,1	1	6,1
Light Industrial	6,5	1	6	1	1	1	1	1	6,2	6,1	1	6,1	6,1	1	6,1
Low Density Res.	6,5*	1*	6	1*	1*	1*	1*	1*	6,2*	6,1*	1,2	6,1*	6,1*	1*	6,1*
Mid-High Density Res.	6,5	1	6	1	1	1	1	1	6,2	6,1	1,2	6,1	6,1	1	6,1
Public Facility	6,5	1	6	1	1	1	1	1	6,2	6,1	1	6,1	6,1	1	6,1
Public Utility	6,5	1	6	1	1	1	1	1	6,2	6,1	1	6,1	6,1	1	6,1
Rec/Open Space	6,5	1	6	1	1	1	1	1	6,2	6,1	1	6,1	6,1	1	****
Schools	6*****	1	6	1	1	1	1	1	6*****	6,1	1	6,1	6,1	6*****	6*****
Transportation	6,5	1	6	1	1	1	1	1	6,3,4	6,1	1	6,1	6,1	1	6,1

* Low Density Res. values were estimated based upon values for other land uses, primarily Mid-High Density Res.
** Estimated as 10% of NO3 value for Agriculture
*** Proportioned to other N/P species based upon King Co work
**** Limited/no data available; assumed to be negligible and set to very low value
***** Value set to that of Mid-High Density Res.

1 = LACDPW, 2000
2 = Ackerman and Schiff, 2003
3 = Kayhanian et al, 2003
4 = Kayhanian et al, 2002
5 = Raird et al, 1996
6 = D. Daft, 2004, San Diego Water Department

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Table 3.6 Available Sources of Event Mean Concentration Data

Constituent	Source	Land Use Category									
		Ag	Com	Ind	LD Res	HD Res	Pub Fac	Pub Util	Rec/Open	School	Trans
BOD-5 (mg/L)	LACDPW, 2000										
	Ackerman and Schiff, 2003										
	Kayhanian et al, 2003										
	Kayhanian et al, 2002	4	23	14							
	Raird et al, 1996		67	229	25.5					N?M	
TSS (mg/L)	LACDPW, 2000	2068 (625-7,680)	118 (1-2,240)	174 (1-2,796)		105			165	103	75
	Ackerman and Schiff, 2003				102 (1-760)				28.8 (1-8,728)		
	Kayhanian et al, 2003										148.1 (1-5100)
	Kayhanian et al, 2002		55.5	60.5							230.9 (2-29,000)
	Raird et al, 1996				41				70		73.5
TDS (mg/L)	LACDPW, 2000										
	Ackerman and Schiff, 2003										
	Kayhanian et al, 2003										
	Kayhanian et al, 2002										
	Raird et al, 1996		0.14	0.09							
NO2 (mg/L)	LACDPW, 2000					0.09			0.05	0.08	0.09
	Ackerman and Schiff, 2003										
	Kayhanian et al, 2003										0.1 (0.05-1.7)
	Kayhanian et al, 2002										
	Raird et al, 1996		0.58	0.86							
NO3 (mg/L)	LACDPW, 2000	10.0 (1.66-25.1)	0.11 (0.009-1.62)	0.066 (0.005-0.41)		1.04			1.11	0.63	0.75
	Ackerman and Schiff, 2003				0.118 (0.006-6.54)				0.02 (0.021-0.049)		
	Kayhanian et al, 2003										1.1 (0.01-14.7)
	Kayhanian et al, 2002	1.6 **	0.26 **	0.3 **							1.2 (0.03-48)
	Raird et al, 1996		0.91	0.48	0.23 **				0.54 **		0.56 **
NH3 (mg/L)	LACDPW, 2000	1.79 (<0.1-8.10)	0.70 (<0.05-12.2)	0.38 (<0.05-3.24)		0.36			0.08	0.26	0.23
	Ackerman and Schiff, 2003				0.53 (<0.05-6.19)				0.091 (0.072-2.09)		
	Kayhanian et al, 2003										1.1 (0.08-6.4)
	Kayhanian et al, 2002										
	Raird et al, 1996		3.37	3.07							
TKN (mg/L)	LACDPW, 2000					2.8			0.81	1.62	1.81
	Ackerman and Schiff, 2003										
	Kayhanian et al, 2003										2.0 (0.1-57)
	Kayhanian et al, 2002	1.7	1.1	0.99							2.7 (0.08-57)
	Raird et al, 1996				1.5				0.96		1.5
TN (mg/L)	LACDPW, 2000		4.09*	4.02*		3.93*			1.97*	2.33*	2.65*
	Ackerman and Schiff, 2003										
	Kayhanian et al, 2003										3.3*
	Kayhanian et al, 2002										
	Raird et al, 1996	3.3*	1.36*	1.29*	1.73*				1.5*		2.06*
PO4	LACDPW, 2000										

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(mg/L)	Ackerman and Schiff, 2003 Kayhanian et al, 2003 Kayhanian et al, 2002 Raird et al, 1996	0.57 (0.32-0.75)	0.55 (0.02-3.10)	0.41 (0.02-1.60)	0.60 (0.16-1.4)					0.1 (0.01-1.03) 0.43 (0.01-6.0)
TP (mg/L)	LACDPW, 2000 Ackerman and Schiff, 2003 Kayhanian et al, 2003 Kayhanian et al, 2002 Raird et al, 1996	1.3	0.41 0.32	0.44 0.28	0.39 0.57			0.11 0.12	0.31	0.44 0.3 (0.01-10) 0.68 (0.01-37.5) 0.22
T_Cu (ug/L)	LACDPW, 2000 Ackerman and Schiff, 2003 Kayhanian et al, 2003 Kayhanian et al, 2002 Raird et al, 1996	225 (55.5-750) 2	34.8 32.64 (<0.1-320) 15	31.0 46.2 (4.0-990) 15	15.3 25.2 (4.0-210) 15			31.0 22.9 (2.0-305) N/M	21.5	51.9 13.5 (1-121) 53 (0.2-9500) 11
T_Zn (ug/L)	LACDPW, 2000 Ackerman and Schiff, 2003 Kayhanian et al, 2003 Kayhanian et al, 2002 Raird et al, 1996	345 (3.30-1,150) 16	239 233 (25-2,130) 180	566 326 (1.2-5,970) 245	80 141 (0.073-1,610) 80			39 45 (13-651) N/M	124	279 72.7 (3-1,017) 227 (2.5-4800) 60
T_Pb (ug/L)	LACDPW, 2000 Ackerman and Schiff, 2003 Kayhanian et al, 2003 Kayhanian et al, 2002 Raird et al, 1996	60.48 (5.0-161) 2	11.53 12.22 (<1-248) 13	14.87 17.4 (<1-188) 15	0.39 0.57			N/M 2.27 (<0.1-202) 2	4.53	9.08 5.4 (0.2-414) 86 (0.1-2300) 11
Oil/Grease (mg/L)	LACDPW, 2000 Ackerman and Schiff, 2003 Kayhanian et al, 2003 Kayhanian et al, 2002 Raird et al, 1996		3.65	1.87	15.3 25.2 (4.0-210) 15			N/M		3.19 10.6 (1-226)
F_Coli (org/100 mL)	LACDPW, 2000 Ackerman and Schiff, 2003 Kayhanian et al, 2003 Kayhanian et al, 2002 Raird et al, 1996		1.07E+06	6.53E+05	80 141 (0.073-1,610) 80			2.18E+03		1.34E+06 6086 (2-205,000)

* taken as total of NO2, NO3, and TKN
** actually NO2+NO3
N/M : not meaningful, not enough data above detection limit

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SECTION 4.0

OTAY WATERSHED POLLUTANT LOADINGS

4.1 SUMMARY POLLUTANT CONCENTRATIONS

This section provides the results of the OWPL Tool based on the input data and EMCs discussed in Section 3.0. Table 4.1 summarizes the mean pollutant concentrations and ranges calculated by the Tool compared to reported values for selected constituents from the Otay River Watershed Assessment Technical Report (Aspen, 2004) and the SDWD data. The current OWPL Tool mean values and ranges are clearly consistent with most of the mean values and within the ranges shown for the other data sources. The only major exception in this table is for Fecal Coliforms, with the reported mean values of 1805 and 120 org/100 ml being considerably lower than the OWPL mean of 4100. However, the SDWD data for the Otay and Cottonwood are considerably lower than most literature values, as shown in Table 3.6. We attempted to attain a mid range between the low SDWD values and the more common literature values, recognizing that Fecal Coliform data commonly demonstrate ranges than often span three to four orders of magnitude.

Table 4.1 Comparison of OWPL Results with Otay Report EMC values and SDWD Data

Constituent	Aspen (2004) Report EMC Value	SDWD Otay Data Mean and Range	SDWD Cottonwood Data Mean and Range	OWPL Mean and Range
BOD-5 (mg/L)	13			11.4 (3.0 – 22.7)
TSS (mg/L)	87	16.5 (0.5-657)	213.1 (0.5-2990)	146 (101 – 235)
TDS (mg/L)		405 (10-803)	664 (10-2260)	554 (375 – 800)
NO23 (mg/L)		0.4 (0-2.86)	1.58 (0.01-13.63)	1.0 (0.9 – 1.6)
NH3 (mg/L)				0.24 (0.1 – 0.4)
TKN (mg/L)	1.15			1.6 (0.8 – 2.4)
TN (mg/L)		0.65 (0.078-2.72)	3.63 (0.169-15.7)	2.7 (1.9 – 3.5)
PO4 (mg/L)		0.04 (0-1.03)	0.04 (0.01-0.13)	0.06 (0.03 – 0.09)
TP (mg/L)		0.07 (0.035-0.582)	0.1 (0.035-0.455)	0.13 (0.06 – 0.20)
T-Cu (ug/L)	21	39.48 (1-359)	56.12 (20-100)	51 (12 – 101)
T-Zn (ug/L)	115	55.64 (4-400)	409 (409-409)	110 (30 – 270)
T-Pb (ug/L)	22.1	13.35 (1-100)	328.2 (105-865)	14 (3 – 24)
Oil/Grease (mg/L)				1.14 (0.1 – 2.2)
F-coli (orgs/100 ml)		1804.92 (8-20000)	119.5 (19-220)	4100 (1940 – 6360)

4.2 ESTIMATED RUNOFF AND POLLUTANT LOADINGS

Tables 4.2 through 4.16 show the individual tables provided in the OWPL Tool as the calculated output from the spreadsheet. The following tables are provided in order shown below:

Table 4.2 Watershed Summary Loads by Land Use
Table 4.3 Percent (%) of Watershed Summary Loads by Land Use
Table 4.4 Watershed Summary Loading Rates by Land Use
Table 4.5 Constituent Concentrations by Subbasin

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Table 4.6 Total Runoff (ac-ft/yr) by Subbasin
Table 4.7 Normalized Runoff (in/yr) by Subbasin
Table 4.8 Total Suspended Solids Loads (lbs/yr) by Subbasin
Table 4.9 Total Suspended Solids Loading Rates (lbs/yr) by Subbasin
Table 4.10 BOD-5 Loads (lbs/yr) by Subbasin
Table 4.11 BOD-5 Loading Rates (lbs/yr) by Subbasin
Table 4.12 Total Dissolved Solids Loads (lbs/yr) by Subbasin
Table 4.13 Total Dissolved Solids Loading Rates (lbs/yr) by Subbasin
Table 4.14 Total Nitrogen Loads (lbs/yr) by Subbasin
Table 4.15 Total Nitrogen Loading Rates (lbs/yr) by Subbasin
Table 4.16 Total Phosphorus Loads (lbs/yr) by Subbasin
Table 4.17 Total Phosphorus Loading Rates (lbs/yr) by Subbasin

Note that the runoff and annual load tables for each constituent (as opposed to the loading rate tables) show the '% of watershed" runoff and loads attributed to each land use and point source.

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Table 4.2 Watershed Summary Loads by Land Use

1/27/2005 9:05 **NO BMPs APPLIED**

CONSTITUENT	Land Use										Pt Src Loads	Subbasin Total
	AG	COM	HD_RES	IND	LD_RES	PUB_FAC	PUB_UTIL	REC/OPEN	SCHOOL	TRANS		
BOD_5 (lbs/yr)	4365	29389	150243	55933	38428	6198	8916	54798	20762	47102	0	416134
TSS (lbs/yr)	436473	59631	392793	612598	106744	47413	97647	3013914	92276	471017	0	5330508
TDS (lbs/yr)	872947	638901	2945948	2663471	1067443	338668	424553	6849805	461380	3925141	0	20188254
NO23 (lbs/yr)	2909.8	494.1	4085.0	2290.6	1772.0	392.9	365.1	20275.4	581.3	4710.2	0.0	37876.4
NH3 (lbs/yr)	520.9	775.2	1414.1	1278.5	469.7	616.4	203.8	1826.6	239.9	1444.5	0.0	8789.4
TKN (lbs/yr)	1397	2871	10998	8177	4270	2283	1303	14796	1495	11367	0	58956
TN (lbs/yr)	4307	3365	15083	10467	6042	2675	1668	35071	2076	16077	0	96832
PO4 (lbs/yr)	27.6	76.7	392.8	186.4	170.8	61.0	29.7	456.7	92.3	628.0	0.0	2122.0
TP (lbs/yr)	189.1	174.6	765.9	586.0	277.5	138.9	93.4	1004.6	143.0	1381.6	0.0	4754.8
T_CU (lbs/yr)	33.46	29.82	785.59	82.57	320.23	23.71	13.16	219.19	20.30	326.57	0.00	1854.60
T_ZN (lbs/yr)	69.3	143.1	329.9	1062.7	119.6	113.8	169.4	511.5	77.5	1230.9	0.0	3827.7
T_PB (lbs/yr)	26.41	15.59	76.01	69.52	32.02	12.40	11.08	63.02	13.84	207.25	0.00	527.12
OIL_GREASE (lbs/yr)	145.5	3109.3	5342.0	4980.7	1451.7	2472.3	793.9	1826.6	1255.0	20033.9	0.0	41410.9
FEC_COLI (orgs/yr)	6.60E+12	3.57E+13	1.94E+14	7.91E+13	7.79E+13	2.84E+13	1.26E+13	1.81E+14	3.37E+13	2.85E+13	0.00E+00	6.77E+14
FLOW (acre-ft/yr)	107.0	313.2	1444.1	979.2	784.9	249.0	156.1	6715.5	339.2	2308.9	0.0	13397.1

Table 4.3 Percent (%) of Total Watershed Loads by Land Use

1/27/2005 9:05 **NO BMPs APPLIED**

CONSTITUENT	Land Use										Pt Src Loads	Subbasin Total
	AG	COM	HD_RES	IND	LD_RES	PUB_FAC	PUB_UTIL	REC/OPEN	SCHOOL	TRANS		
BOD_5	1.05%	7.06%	36.10%	13.44%	9.23%	1.49%	2.14%	13.17%	4.99%	11.32%	0.00%	100.00%
TSS	8.19%	1.12%	7.37%	11.49%	2.00%	0.89%	1.83%	56.54%	1.73%	8.84%	0.00%	100.00%
TDS	4.32%	3.16%	14.59%	13.19%	5.29%	1.68%	2.10%	33.93%	2.29%	19.44%	0.00%	100.00%
NO23-N	7.68%	1.30%	10.79%	6.05%	4.68%	1.04%	0.96%	53.53%	1.53%	12.44%	0.00%	100.00%
NH3-N	5.93%	8.82%	16.09%	14.55%	5.34%	7.01%	2.32%	20.78%	2.73%	16.43%	0.00%	100.00%
TKN	2.37%	4.87%	18.65%	13.87%	7.24%	3.87%	2.21%	25.10%	2.54%	19.28%	0.00%	100.00%
TN	4.45%	3.47%	15.58%	10.81%	6.24%	2.76%	1.72%	36.22%	2.14%	16.60%	0.00%	100.00%
PO4-P	1.30%	3.61%	18.51%	8.79%	8.05%	2.87%	1.40%	21.52%	4.35%	29.60%	0.00%	100.00%
TP	3.98%	3.67%	16.11%	12.32%	5.84%	2.92%	1.96%	21.13%	3.01%	29.06%	0.00%	100.00%
T_CU	1.80%	1.61%	42.36%	4.45%	17.27%	1.28%	0.71%	11.82%	1.09%	17.61%	0.00%	100.00%
T_ZN	1.81%	3.74%	8.62%	27.76%	3.12%	2.97%	4.43%	13.36%	2.03%	32.16%	0.00%	100.00%
T_PB	5.01%	2.96%	14.42%	13.19%	6.08%	2.35%	2.10%	11.96%	2.63%	39.32%	0.00%	100.00%
OIL_GREASE	0.35%	7.51%	12.90%	12.03%	3.51%	5.97%	1.92%	4.41%	3.03%	48.38%	0.00%	100.00%
FEC_COLI	0.97%	5.27%	28.67%	11.68%	11.51%	4.19%	1.86%	26.66%	4.97%	4.21%	0.00%	100.00%
FLOW	0.80%	2.34%	10.78%	7.31%	5.86%	1.86%	1.17%	50.13%	2.53%	17.23%	0.00%	100.00%

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Table 4.4 Watershed Summary Loading Rates by Land Use 1/27/2005 9:05 **NO BMPs APPLIED**

CONSTITUENT	Land Use										Pt Src Loads	Subbasin Total
	AG	COM	HD_RES	IND	LD_RES	PUB_FAC	PUB_UTIL	REC/OPEN	SCHOOL	TRANS		
BOD_5 (lbs/ac/yr)	2.5	57.8	31.4	37.0	9.3	15.9	34.2	0.7	35.5	14.5	4.5	4.5
TSS (lbs/ac/yr)	250	117	82	405	26	122	375	40	158	145	57	57
TDS (lbs/ac/yr)	500	1256	616	1762	257	868	1629	90	789	1207	217	217
NO23 (lbs/ac/yr)	1.67	0.97	0.85	1.52	0.43	1.01	1.40	0.27	0.99	1.45	0.41	0.41
NH3 (lbs/ac/yr)	0.30	1.52	0.30	0.85	0.11	1.58	0.78	0.02	0.41	0.44	0.09	0.09
TKN (lbs/ac/yr)	0.8	5.6	2.3	5.4	1.0	5.8	5.0	0.2	2.6	3.5	0.6	0.6
TN (lbs/ac/yr)	2.5	6.6	3.2	6.9	1.5	6.9	6.4	0.5	3.6	4.9	1.0	1.0
PO4 (lbs/ac/yr)	0.02	0.15	0.08	0.12	0.04	0.16	0.11	0.01	0.16	0.19	0.02	0.02
TP (lbs/ac/yr)	0.11	0.34	0.16	0.39	0.07	0.36	0.36	0.01	0.24	0.42	0.05	0.05
T_CU (lbs/ac/yr)	0.019	0.059	0.164	0.055	0.077	0.061	0.051	0.003	0.035	0.100	0.020	0.020
T_ZN (lbs/ac/yr)	0.04	0.28	0.07	0.70	0.03	0.29	0.65	0.01	0.13	0.38	0.04	0.04
T_PB (lbs/ac/yr)	0.015	0.031	0.016	0.046	0.008	0.032	0.043	0.001	0.024	0.064	0.006	0.006
OIL_GREASE (lbs/ac/yr)	0.08	6.11	1.12	3.30	0.35	6.34	3.05	0.02	2.15	6.16	0.45	0.45
FEC_COLI (orgs/ac/yr)	3.78E+09	7.02E+10	4.06E+10	5.24E+10	1.88E+10	7.27E+10	4.84E+10	2.38E+09	5.76E+10	8.76E+09	7.29E+09	7.29E+09
FLOW (in/ac/yr)	0.74	7.39	3.62	7.78	2.27	7.66	7.19	1.06	6.96	8.52	1.73	1.73

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Table 4.5 Constituent Concentrations by Subbasin

1/27/2005 9:05 NO BMPs APPLIED

Model Segment	BOD_5 (mg/L)	TSS (mg/L)	TDS (mg/L)	NO23 (mg/L)	NH3 (mg/L)	TKN (mg/L)	TN (mg/L)	PO4 (mg/L)	TP (mg/L)	T_CU (mg/L)	T_ZN (mg/L)	T_PB (mg/L)	OIL_GREASE (mg/L)	FEC_COLI (orgs/100 mL)
Engineer Springs	8.5	171	543	1.32	0.22	1.5	2.8	0.05	0.12	0.061	0.07	0.014	0.69	3.94E+03
HO1	3.9	165	409	1.09	0.12	0.9	2.0	0.03	0.07	0.014	0.05	0.005	0.26	2.33E+03
HO2	3.0	165	376	1.11	0.10	0.8	1.9	0.03	0.06	0.012	0.03	0.004	0.11	2.18E+03
HO3	3.4	157	398	1.08	0.11	0.9	2.0	0.03	0.07	0.016	0.04	0.006	0.39	2.07E+03
HO4	4.9	146	408	1.05	0.12	1.0	2.1	0.04	0.08	0.030	0.04	0.007	0.41	2.70E+03
HO5	5.7	170	469	1.23	0.16	1.1	2.4	0.04	0.09	0.037	0.05	0.009	0.45	2.96E+03
HO6	3.0	165	375	1.11	0.10	0.8	1.9	0.03	0.06	0.012	0.03	0.004	0.11	2.18E+03
HO7	4.6	235	556	1.61	0.22	1.2	2.8	0.04	0.11	0.025	0.05	0.011	0.37	2.50E+03
HO8	7.5	133	451	1.05	0.16	1.3	2.3	0.05	0.10	0.053	0.05	0.010	0.59	3.63E+03
Hollenbeck	4.9	161	430	1.14	0.14	1.0	2.2	0.04	0.08	0.028	0.05	0.007	0.36	2.72E+03
JA1	3.0	165	375	1.11	0.10	0.8	1.9	0.03	0.06	0.012	0.03	0.003	0.10	2.18E+03
JA2	4.7	211	519	1.46	0.19	1.1	2.6	0.04	0.10	0.027	0.05	0.010	0.41	2.49E+03
JA3	10.8	146	538	1.16	0.22	1.5	2.7	0.06	0.13	0.067	0.07	0.015	0.88	4.52E+03
Jamul	9.0	157	515	1.20	0.20	1.4	2.6	0.05	0.11	0.054	0.07	0.013	0.71	3.95E+03
Lee	9.1	137	478	1.12	0.18	1.4	2.5	0.05	0.10	0.068	0.05	0.011	0.51	4.38E+03
Lyon	7.7	162	516	1.23	0.21	1.4	2.6	0.05	0.11	0.052	0.07	0.013	0.76	3.59E+03
OVE1	15.8	122	608	0.90	0.26	1.9	2.8	0.08	0.16	0.067	0.14	0.020	1.67	4.78E+03
OVE2	16.8	179	800	0.89	0.37	2.4	3.3	0.07	0.19	0.044	0.27	0.023	1.81	5.20E+03
OVE3	9.0	186	583	1.03	0.23	1.6	2.6	0.04	0.11	0.019	0.15	0.011	0.69	3.65E+03
OVE4	9.4	231	727	1.44	0.40	2.0	3.5	0.06	0.17	0.031	0.17	0.020	1.44	4.06E+03
OVE5	5.5	154	434	1.08	0.20	1.2	2.3	0.04	0.09	0.026	0.06	0.008	0.70	3.13E+03
OVE6	15.9	103	605	0.90	0.24	1.9	2.8	0.08	0.18	0.083	0.13	0.022	1.95	4.35E+03
OVE7	5.0	153	433	1.02	0.26	1.4	2.4	0.04	0.09	0.017	0.07	0.007	0.82	3.63E+03
OVW1	21.5	117	711	0.86	0.37	2.4	3.2	0.09	0.20	0.083	0.18	0.023	2.18	6.02E+03
OVW2	22.7	101	691	0.86	0.36	2.4	3.2	0.09	0.20	0.101	0.15	0.024	2.24	6.36E+03
Otay Valley	17.4	134	667	0.94	0.34	2.1	3.1	0.08	0.18	0.069	0.16	0.021	1.85	5.31E+03
PV1	6.0	158	426	1.09	0.13	1.1	2.2	0.03	0.07	0.030	0.05	0.006	0.30	3.00E+03
PV2	5.3	151	443	1.04	0.14	1.1	2.1	0.04	0.09	0.025	0.07	0.009	0.66	2.40E+03
Proctor	5.9	156	429	1.09	0.14	1.1	2.1	0.04	0.08	0.029	0.05	0.007	0.37	2.89E+03
SA1	3.8	152	412	1.06	0.12	1.0	2.0	0.04	0.08	0.019	0.05	0.008	0.55	2.06E+03
SA2	3.0	165	375	1.11	0.10	0.8	1.9	0.03	0.06	0.012	0.03	0.003	0.10	2.18E+03
SA3	4.0	146	429	1.03	0.13	1.0	2.1	0.04	0.09	0.020	0.06	0.010	0.75	1.94E+03
Savage	3.6	155	405	1.07	0.12	0.9	2.0	0.03	0.07	0.017	0.05	0.007	0.46	2.06E+03
Watershed Average	11.4	146	554	1.04	0.24	1.6	2.7	0.06	0.13	0.051	0.11	0.014	1.14	4.10E+03

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Table 4.6 Total Runoff (ac-ft/yr) by Subbasin

1/27/2005 9:05 **NO BMPs APPLIED**

Model Segment	Land Use										Pt Src Loads	Subbasin Total	% of HSA Total	% of Watershed Total
	AG	COM	HD_RES	IND	LD_RES	PUB_FAC	PUB_UTIL	REC/OPEN	SCHOOL	TRANS				
Engineer Springs	4.9		0.2		37.3	1.2	0.1	69.2		15.2		128.2	100.0%	1.0%
HO1				19.0				417.3		12.7		448.9	13.2%	3.4%
HO2								439.3		1.1		440.4	12.9%	3.3%
HO3								213.1		22.0		235.0	6.9%	1.8%
HO4	0.0				56.0			436.1		42.2		534.4	15.7%	4.0%
HO5	6.2				41.0			222.1		24.3		293.6	8.6%	2.2%
HO6								310.1		0.5		310.7	9.1%	2.3%
HO7	20.2	0.5	0.7		9.4	1.6		280.3		22.7		335.5	9.9%	2.5%
HO8	5.0				211.4	2.4		501.9		85.8		806.5	23.7%	6.0%
Hollenbeck	31.5	0.5	0.7	19.0	317.9	4.0		2820.1		211.4	0.0	3405.1	100.0%	25.4%
JA1								116.0				116.0	12.8%	0.9%
JA2	5.4				5.8		0.2	101.1		10.5		123.1	13.6%	0.9%
JA3	17.0	3.3	13.6		200.8	3.5	6.1	286.8	43.3	93.1		667.5	73.6%	5.0%
Jamul	22.4	3.3	13.6		206.6	3.5	6.3	503.9	43.3	103.6	0.0	906.6	100.0%	6.8%
Lee	4.2				103.7			149.3		16.1		273.3	100.0%	2.0%
Lyon	9.1	2.9			72.5	5.7		191.2		44.5		325.9	100.0%	2.4%
OVE1		0.5	102.7	39.9	1.0	2.9	9.2	129.1	57.7	154.8		497.9	7.6%	3.7%
OVE2	0.1	7.4	54.6	424.4		10.3		130.1		134.2		761.2	11.6%	5.7%
OVE3				48.2	0.6		3.4	103.6				155.8	2.4%	1.2%
OVE4	28.0			117.3	0.4	58.9	1.4	213.3		74.4		493.7	7.5%	3.7%
OVE5	1.2		9.9			21.1		182.0		16.5		230.7	3.5%	1.7%
OVE6			120.7				3.6	90.7	22.5	204.0		441.6	6.7%	3.3%
OVE7	0.7				0.4	91.3	26.2	404.7		1.6		525.0	8.0%	3.9%
OVW1	2.1	175.6	474.3	237.3	1.6	5.6	52.6	120.9	109.5	558.8		1738.3	26.5%	13.0%
OVW2	1.4	122.9	634.8	92.6	0.9	44.4	32.8	55.5	106.1	620.8		1712.2	26.1%	12.8%
Otay Valley	33.5	306.5	1397.0	959.8	4.9	234.5	129.2	1430.0	295.9	1765.1	0.0	6556.3	100.0%	48.9%
PV1	1.4		26.8		40.5		16.2	543.7		14.5		643.0	81.0%	4.8%
PV2			4.5		0.5		4.4	118.7		23.2		151.3	19.0%	1.1%
Proctor	1.4		31.2		40.9		20.6	662.4		37.8	0.0	794.3	100.0%	5.9%
SA1			1.3		1.1			345.4		58.0		405.8	40.3%	3.0%
SA2								329.7				329.7	32.7%	2.5%
SA3				0.5				214.2		57.3		271.9	27.0%	2.0%
Savage			1.3	0.5	1.1			889.3		115.2	0.0	1007.4	100.0%	7.5%
Land Use Total	107.0	313.2	1444.1	979.2	784.9	249.0	156.1	6715.5	339.2	2308.9	0.0	13397.1		
% of Watershed Total	0.8%	2.3%	10.8%	7.3%	5.9%	1.9%	1.2%	50.1%	2.5%	17.2%	0.0%			

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Table 4.7 Normalized Runoff (in/yr) by Subbasin

1/27/2005 9:05 **NO BMPs APPLIED**

Model Segment	Land Use										Subbasin w/o Pt Src	Subbasin w/ Pt Src
	AG	COM	HD_RES	IND	LD_RES	PUB_FAC	PUB_UTIL	REC/OPEN	SCHOOL	TRANS		
Engineer Springs	0.68		4.08		1.84	7.66	7.66	0.94		9.00	1.25	1.25
HO1				10.18				1.11		10.60	1.19	1.19
HO2								1.23		11.76	1.24	1.24
HO3								0.99		9.41	1.08	1.08
HO4	0.83				2.26			1.16		11.03	1.32	1.32
HO5	0.82				2.22			1.14		10.85	1.31	1.31
HO6								1.01		9.66	1.02	1.02
HO7	0.78	9.84	4.69		2.12	8.81		1.09		10.35	1.15	1.15
HO8	0.96				2.61	10.88		1.34		12.79	1.73	1.73
Hollenbeck	0.81	9.84	4.69	10.18	2.47	9.94		1.15		11.33	1.29	1.29
JA1								1.04			1.04	1.04
JA2	0.70				1.91		7.95	0.98		9.35	1.07	1.07
JA3	0.73	9.28	4.42		2.00	8.31	8.31	1.02	8.31	9.76	1.58	1.58
Jamul	0.73	9.28	4.42		1.99	8.31	8.29	1.02	8.31	9.72	1.40	1.40
Lee	0.87				2.37			1.22		11.58	1.58	1.58
Lyon	1.02	12.92			2.78	11.57		1.43		13.59	1.88	1.88
OVE1		8.24	3.93	8.33	1.77	7.38	7.38	0.91	7.38	8.67	2.48	2.48
OVE2	0.61	7.76	3.70	7.84		6.95		0.86		8.17	3.18	3.18
OVE3				8.17	1.74		7.24	0.89			1.27	1.27
OVE4	0.64			8.17	1.74	7.24	7.24	0.89		8.51	1.57	1.57
OVE5	0.65		3.89			7.31		0.90		8.60	1.09	1.09
OVE6			4.07				7.65	0.94	7.65	8.99	2.91	2.91
OVE7	0.75				2.05	8.53	8.53	1.05		10.03	1.31	1.31
OVW1	0.57	7.17	3.42	7.25	1.54	6.42	6.42	0.79	6.42	7.55	3.83	3.83
OVW2	0.60	7.56	3.60	7.64	1.63	6.77	6.77	0.83	6.77	7.95	4.52	4.52
Otay Valley	0.63	7.34	3.60	7.74	1.68	7.56	6.99	0.92	6.80	8.03	2.65	2.65
PV1	0.75		4.50		2.03		8.45	1.04		9.93	1.16	1.16
PV2			4.25		1.92		7.99	0.99		9.39	1.21	1.21
Proctor	0.75		4.46		2.03		8.35	1.03		9.59	1.17	1.17
SA1			4.09		1.85			0.95		9.03	1.09	1.09
SA2								1.13			1.13	1.13
SA3				10.66				1.17		11.10	1.44	1.44
Savage			4.09	10.66	1.85			1.06		9.95	1.18	1.18
Land Use Average	0.74	7.39	3.62	7.78	2.27	7.66	7.19	1.06	6.96	8.52	1.73	1.73

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Table 4.8 Total Suspended Solids Loads (lbs/yr) by Subbasin

1/27/2005 9:05 **NO BMPs APPLIED**

Model Segment	Land Use										Pt Src Loads	Subbasin Total	% of HSA Total	% of Watershed Total
	AG	COM	HD_RES	IND	LD_RES	PUB_FAC	PUB_UTIL	REC/OPEN	SCHOOL	TRANS				
Engineer Springs	19943		63		5077	233	42	31064		3106		59528	100.0%	1.1%
HO1				11858				187267		2583		201708	13.5%	3.8%
HO2								197148		225		197373	13.2%	3.7%
HO3								95618		4486		100104	6.7%	1.9%
HO4	63				7622			195710		8617		212012	14.2%	4.0%
HO5	25478				5577			99656		4965		135676	9.1%	2.5%
HO6								139191		112		139303	9.3%	2.6%
HO7	82456	92	201		1283	311		125816		4632		214791	14.4%	4.0%
HO8	20369				28748	460		225261		17506		292344	19.6%	5.5%
Hollenbeck	128367	92	201	11858	43230	770		1265668		43126	0	1493312	100.0%	28.0%
JA1								52064				52064	13.4%	1.0%
JA2	22168				790		141	45392		2137		70629	18.2%	1.3%
JA3	69290	623	3693		27310	672	3797	128702	11785	18999		264872	68.3%	5.0%
Jamul	91458	623	3693		28100	672	3938	226158	11785	21137	0	387564	100.0%	7.3%
Lee	17230				14100			67010		3282		101621	100.0%	1.9%
Lyon	37056	559			9855	1088		85827		9080		143464	100.0%	2.7%
OVE1		103	27933	24936	140	548	5730	57961	15707	31587		164646	6.9%	3.1%
OVE2	383	1412	14859	265531		1960		58402		27375		369921	15.5%	6.9%
OVE3				30176	82		2103	46475				78836	3.3%	1.5%
OVE4	114153			73408	48	11212	865	95736		15182		310604	13.0%	5.8%
OVE5	5011		2681			4023		81691		3356		96761	4.1%	1.8%
OVE6			32840				2276	40698	6127	41616		123557	5.2%	2.3%
OVE7	3013				57	17376	16417	181636		326		218825	9.2%	4.1%
OVW1	8449	33437	129005	148476	220	1073	32907	54254	29792	113990		551603	23.1%	10.3%
OVW2	5661	23405	172670	57913	118	8458	20504	24927	28865	126642		469164	19.7%	8.8%
Otay Valley	136669	58357	379989	600441	665	44650	80803	641778	80491	360074	0	2383918	100.0%	44.7%
PV1	5749		7278		5503		10120	244008		2965		275624	81.6%	5.2%
PV2			1212		65		2744	53291		4739		62050	18.4%	1.2%
Proctor	5749		8490		5568		12864	297299		7704	0	337674	100.0%	6.3%
SA1			356		151			155015		11822		167345	39.5%	3.1%
SA2								147978				147978	34.9%	2.8%
SA3				299				96116		11687		108102	25.5%	2.0%
Savage			356	299	151			399109		23509	0	423425	100.0%	7.9%
Land Use Total	436473	59631	392793	612598	106744	47413	97647	3013914	92276	471017	0	5330508		
% of Watershed Total	8.2%	1.1%	7.4%	11.5%	2.0%	0.9%	1.8%	56.5%	1.7%	8.8%	0.0%			

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Table 4.9 Total Suspended Solids Loading Rates (lbs/ac/yr) by Subbasin

1/27/2005 9:05 **NO BMPs APPLIED**

Model Segment	Land Use										Subbasin w/o Pt Src	Subbasin w/ Pt Src
	AG	COM	HD_RES	IND	LD_RES	PUB_FAC	PUB_UTIL	REC/OPEN	SCHOOL	TRANS		
Engineer Springs	230		92		21	121	399	35		153	48	48
HO1				531				42		180	44	44
HO2								46		200	46	46
HO3								37		160	38	38
HO4	282				26			43		188	44	44
HO5	277				25			43		184	51	51
HO6								38		164	38	38
HO7	265	156	106		24	140		41		176	62	62
HO8	327				30	173		50		217	52	52
Hollenbeck	275	156	106	531	28	158		43		193	47	47
JA1								39			39	39
JA2	239				22		415	37		159	51	51
JA3	249	147	100		23	132	433	38	188	166	52	52
Jamul	247	147	100		23	132	432	38	188	165	50	50
Lee	296				27			45		197	49	49
Lyon	347	205			31	184		53		231	69	69
OVE1		131	89	434	20	117	385	34	167	147	68	68
OVE2	209	123	84	409		110		32		139	129	129
OVE3				426	20		378	33			54	54
OVE4	217			426	20	115	378	33		145	82	82
OVE5	220		88			116		34		146	38	38
OVE6			92				399	35	173	153	68	68
OVE7	256				23	135	445	39		170	46	46
OVW1	193	114	78	378	17	102	335	30	146	128	101	101
OVW2	203	120	82	398	18	107	353	31	153	135	103	103
Otay Valley	216	116	82	403	19	120	364	35	154	136	80	80
PV1	254		102		23		441	39		169	42	42
PV2			96		22		416	37		160	41	41
Proctor	254		101		23		435	39		163	42	42
SA1			93		21			35		153	37	37
SA2								42			42	42
SA3				556				44		189	48	48
Savage			93	556	21			40		169	41	41
Land Use Average	250	117	82	405	26	122	375	40	158	145	57	57

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Table 4.10 BOD-5 Loads (lbs/yr) by Subbasin

1/27/2005 9:05 **NO BMPs APPLIED**

Model Segment	Land Use										Pt Src Loads	Subbasin Total	% of HSA Total	% of Watershed Total
	AG	COM	HD_RES	IND	LD_RES	PUB_FAC	PUB_UTIL	REC/OPEN	SCHOOL	TRANS				
Engineer Springs	199		24		1828	30	4	565		311		2961	100.0%	0.7%
HO1				1083				3405		258		4746	10.4%	1.1%
HO2								3585		22		3607	7.9%	0.9%
HO3								1739		449		2187	4.8%	0.5%
HO4	1				2744			3558		862		7165	15.8%	1.7%
HO5	255				2008			1812		496		4571	10.1%	1.1%
HO6								2531		11		2542	5.6%	0.6%
HO7	825	45	77		462	41		2288		463		4200	9.2%	1.0%
HO8	204				10349	60		4096		1751		16459	36.2%	4.0%
Hollenbeck	1284	45	77	1083	15563	101		23012		4313	0	45477	100.0%	10.9%
JA1								947				947	4.3%	0.2%
JA2	222				284		13	825		214		1558	7.1%	0.4%
JA3	693	307	1413		9832	88	347	2340	2652	1900		19570	88.7%	4.7%
Jamul	915	307	1413		10116	88	360	4112	2652	2114	0	22075	100.0%	5.3%
Lee	172				5076			1218		328		6795	100.0%	1.6%
Lyon	371	275			3548	142		1560		908		6804	100.0%	1.6%
OVE1		51	10684	2277	50	72	523	1054	3534	3159		21404	6.9%	5.1%
OVE2	4	696	5684	24244		256		1062		2737		34683	11.2%	8.3%
OVE3				2755	30		192	845				3822	1.2%	0.9%
OVE4	1142			6702	17	1466	79	1741		1518		12665	4.1%	3.0%
OVE5	50		1025			526		1485		336		3422	1.1%	0.8%
OVE6			12561				208	740	1379	4162		19049	6.2%	4.6%
OVE7	30				21	2271	1499	3302		33		7156	2.3%	1.7%
OVW1	84	16479	49345	13557	79	140	3005	986	6703	11399		101778	32.9%	24.5%
OVW2	57	11536	66046	5288	42	1106	1872	453	6495	12664		105559	34.1%	25.4%
Otay Valley	1367	28762	145346	54823	239	5836	7378	11669	18111	36007	0	309537	100.0%	74.4%
PV1	57		2784		1981		924	4437		296		10480	82.8%	2.5%
PV2			464		23		250	969		474		2180	17.2%	0.5%
Proctor	57		3248		2004		1175	5405		770	0	12660	100.0%	3.0%
SA1			136		54			2818		1182		4191	42.7%	1.0%
SA2								2691				2691	27.4%	0.6%
SA3				27				1748		1169		2944	30.0%	0.7%
Savage			136	27	54			7257		2351	0	9825	100.0%	2.4%
Land Use Total	4365	29389	150243	55933	38428	6198	8916	54798	20762	47102	0	416134		
% of Watershed Total	1.0%	7.1%	36.1%	13.4%	9.2%	1.5%	2.1%	13.2%	5.0%	11.3%	0.0%			

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Table 4.11 BOD-5 Loading Rates (lbs/ac/yr) by Subbasin

1/27/2005 9:05 **NO BMPs APPLIED**

Model Segment	Land Use										Subbasin w/o Pt Src	Subbasin w/ Pt Src
	AG	COM	HD_RES	IND	LD_RES	PUB_FAC	PUB_UTIL	REC/OPEN	SCHOOL	TRANS		
Engineer Springs	2.3		35.3		7.5	15.9	36.4	0.6		15.3	2.4	2.4
HO1				48.5				0.8		18.0	1.0	1.0
HO2								0.8		20.0	0.8	0.8
HO3								0.7		16.0	0.8	0.8
HO4	2.8				9.2			0.8		18.8	1.5	1.5
HO5	2.8				9.1			0.8		18.4	1.7	1.7
HO6								0.7		16.4	0.7	0.7
HO7	2.6	76.9	40.7		8.6	18.3		0.7		17.6	1.2	1.2
HO8	3.3				10.7	22.6		0.9		21.7	2.9	2.9
Hollenbeck	2.8	76.9	40.7	48.5	10.1	20.6		0.8		19.3	1.4	1.4
JA1								0.7			0.7	0.7
JA2	2.4				7.8		37.9	0.7		15.9	1.1	1.1
JA3	2.5	72.6	38.4		8.1	17.2	39.5	0.7	42.4	16.6	3.9	3.9
Jamul	2.5	72.6	38.4		8.1	17.2	39.5	0.7	42.4	16.5	2.8	2.8
Lee	3.0				9.7			0.8		19.7	3.3	3.3
Lyon	3.5	101.0			11.3	24.0		1.0		23.1	3.3	3.3
OVE1		64.4	34.1	39.6	7.2	15.3	35.1	0.6	37.6	14.7	8.9	8.9
OVE2	2.1	60.7	32.1	37.3		14.4		0.6		13.9	12.1	12.1
OVE3				38.9	7.1		34.5	0.6			2.6	2.6
OVE4	2.2			38.9	7.1	15.0	34.5	0.6		14.5	3.4	3.4
OVE5	2.2		33.8			15.2		0.6		14.6	1.4	1.4
OVE6			35.3				36.4	0.6	39.0	15.3	10.5	10.5
OVE7	2.6				8.4	17.7	40.6	0.7		17.0	1.5	1.5
OVW1	1.9	56.1	29.7	34.5	6.3	13.3	30.6	0.5	32.8	12.8	18.7	18.7
OVW2	2.0	59.1	31.2	36.3	6.6	14.0	32.2	0.6	34.5	13.5	23.2	23.2
Otay Valley	2.2	57.4	31.2	36.8	6.8	15.7	33.3	0.6	34.7	13.6	10.4	10.4
PV1	2.5		39.0		8.3		40.2	0.7		16.9	1.6	1.6
PV2			36.9		7.8		38.0	0.7		16.0	1.5	1.5
Proctor	2.5		38.7		8.3		39.7	0.7		16.3	1.6	1.6
SA1			35.5		7.5			0.6		15.3	0.9	0.9
SA2								0.8			0.8	0.8
SA3				50.7				0.8		18.9	1.3	1.3
Savage			35.5	50.7	7.5			0.7		16.9	1.0	1.0
Land Use Average	2.5	57.8	31.4	37.0	9.3	15.9	34.2	0.7	35.5	14.5	4.5	4.5

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Table 4.12 Total Dissolved Solids Loads (lbs/yr) by Subbasin

1/27/2005 9:05 **NO BMPs APPLIED**

Model Segment	Land Use										Pt Src Loads	Subbasin Total	% of HSA Total	% of Watershed Total
	AG	COM	HD_RES	IND	LD_RES	PUB_FAC	PUB_UTIL	REC/OPEN	SCHOOL	TRANS				
Engineer Springs	39887		476		50768	1664	181	70601		25882		189457	100.0%	0.9%
HO1				51557				425607		21525		498689	12.5%	2.5%
HO2								448064		1874		449939	11.3%	2.2%
HO3								217314		37386		254700	6.4%	1.3%
HO4	127				76218			444796		71807		592948	14.9%	2.9%
HO5	50956				55772			226492		41371		374591	9.4%	1.9%
HO6								316344		932		317275	8.0%	1.6%
HO7	164913	986	1507		12830	2220		285945		38602		507002	12.7%	2.5%
HO8	40739				287477	3283		511957		145887		989342	24.8%	4.9%
Hollenbeck	256734	986	1507	51557	432297	5503		2876518		359385	0	3984486	100.0%	19.7%
JA1								118327				118327	9.3%	0.6%
JA2	44336				7898		615	103164		17812		173825	13.7%	0.9%
JA3	138580	6674	27700		273102	4796	16509	292506	58924	158329		977120	77.0%	4.8%
Jamul	182916	6674	27700		281000	4796	17124	513996	58924	176141	0	1269271	100.0%	6.3%
Lee	34461				140995			152294		27346		355097	100.0%	1.8%
Lyon	74112	5985			98545	7773		195062		75664		457141	100.0%	2.3%
OVE1		1104	209499	108419	1401	3913	24914	131731	78535	263226		822740	6.9%	4.1%
OVE2	766	15131	111445	1154481		14001		132731		228122		1656676	13.9%	8.2%
OVE3				131201	822		9142	105626				246791	2.1%	1.2%
OVE4	228306			319166	477	80089	3762	217582		126514		975896	8.2%	4.8%
OVE5	10021		20104			28737		185661		27969		272493	2.3%	1.3%
OVE6			246301				9897	92494	30634	346801		726128	6.1%	3.6%
OVE7	6026				571	124117	71380	412808		2716		617617	5.2%	3.1%
OVW1	16898	358249	967539	645548	2197	7663	143075	123303	148962	949919		3363354	28.3%	16.7%
OVW2	11322	250773	1295028	251797	1179	60412	89150	56652	144325	1055349		3215987	27.0%	15.9%
Otay Valley	273338	625257	2849916	2610612	6646	318932	351319	1458587	402456	3000616	0	11897680	100.0%	58.9%
PV1	11499		54585		55032		44001	554565		24708		744389	80.3%	3.7%
PV2			9093		646		11928	121116		39488		182271	19.7%	0.9%
Proctor	11499		63678		55677		55929	675680		64196	0	926660	100.0%	4.6%
SA1			2671		1514			352307		98520		455011	41.0%	2.3%
SA2								336314				336314	30.3%	1.7%
SA3				1302				218446		97391		317138	28.6%	1.6%
Savage			2671	1302	1514			907066		195910	0	1108462	100.0%	5.5%
Land Use Total	872947	638901	2945948	2663471	1067443	338668	424553	6849805	461380	3925141	0	20188254		
% of Watershed Total	4.3%	3.2%	14.6%	13.2%	5.3%	1.7%	2.1%	33.9%	2.3%	19.4%	0.0%			

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Table 4.13 Total Dissolved Solids Loading Rates (lbs/ac/yr) by Subbasin

1/27/2005 9:05 **NO BMPs APPLIED**

Model Segment	Land Use										Subbasin w/o Pt Src	Subbasin w/ Pt Src
	AG	COM	HD_RES	IND	LD_RES	PUB_FAC	PUB_UTIL	REC/OPEN	SCHOOL	TRANS		
Engineer Springs	460		693		208	868	1735	80		1275	154	154
HO1				2308				95		1502	110	110
HO2								105		1666	105	105
HO3								84		1333	97	97
HO4	564				256			98		1563	122	122
HO5	554				251			97		1537	140	140
HO6								86		1369	86	86
HO7	529	1673	798		240	999		92		1467	145	145
HO8	653				296	1233		114		1812	177	177
Hollenbeck	551	1673	798	2308	280	1126		98		1605	126	126
JA1								88			88	88
JA2	478				217		1803	83		1324	126	126
JA3	499	1577	752		226	942	1883	87	942	1383	193	193
Jamul	494	1577	752		226	942	1880	87	942	1377	163	163
Lee	592				268			103		1640	171	171
Lyon	695	2196			315	1311		121		1926	220	220
OVE1		1401	668	1887	201	836	1672	77	836	1228	341	341
OVE2	417	1319	629	1778		788		73		1157	576	576
OVE3				1853	197		1642	76			168	168
OVE4	435			1853	197	821	1641	76		1206	259	259
OVE5	439		662			829		77		1218	108	108
OVE6			693				1735	80	867	1274	399	399
OVE7	512				232	967	1934	89		1421	129	129
OVW1	386	1220	581	1643	175	728	1456	67	728	1069	618	618
OVW2	406	1285	612	1731	184	767	1534	71	767	1126	707	707
Otay Valley	432	1247	612	1754	190	856	1584	78	771	1137	401	401
PV1	507		765		230		1915	89		1407	112	112
PV2			723		218		1811	84		1330	122	122
Proctor	507		759		230		1892	88		1359	114	114
SA1			695		209			81		1279	102	102
SA2								96			96	96
SA3				2416				99		1573	140	140
Savage			695	2416	209			90		1410	108	108
Land Use Average	500	1256	616	1762	257	868	1629	90	789	1207	217	217

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Table 4.14 Total Nitrogen Loads (lbs/yr) by Subbasin

1/27/2005 9:05 **NO BMPs APPLIED**

Model Segment	Land Use										Pt Src Loads	Subbasin Total	% of HSA Total	% of Watershed Total
	AG	COM	HD_RES	IND	LD_RES	PUB_FAC	PUB_UTIL	REC/OPEN	SCHOOL	TRANS				
Engineer Springs	197		2		287	13	1	361		106		968	100.0%	1.0%
HO1				203				2179		88		2470	12.2%	2.6%
HO2								2294		8		2302	11.4%	2.4%
HO3								1113		153		1266	6.3%	1.3%
HO4	1				431			2277		294		3003	14.9%	3.1%
HO5	251				316			1160		169		1896	9.4%	2.0%
HO6								1620		4		1623	8.0%	1.7%
HO7	814	5	8		73	18		1464		158		2539	12.6%	2.6%
HO8	201				1627	26		2621		598		5073	25.1%	5.2%
Hollenbeck	1267	5	8	203	2447	43		14728		1472	0	20172	100.0%	20.8%
JA1								606				606	9.5%	0.6%
JA2	219				45		2	528		73		867	13.6%	0.9%
JA3	684	35	142		1546	38	65	1498	265	649		4920	77.0%	5.1%
Jamul	902	35	142		1590	38	67	2632	265	721	0	6393	100.0%	6.6%
Lee	170				798			780		112		1860	100.0%	1.9%
Lyon	366	32			558	61		999		310		2325	100.0%	2.4%
OVE1		6	1073	426	8	31	98	674	353	1078		3747	6.8%	3.9%
OVE2	4	80	571	4537		111		680		934		6916	12.6%	7.1%
OVE3				516	5		36	541				1097	2.0%	1.1%
OVE4	1126			1254	3	633	15	1114		518		4663	8.5%	4.8%
OVE5	49		103			227		951		115		1445	2.6%	1.5%
OVE6			1261				39	474	138	1420		3332	6.1%	3.4%
OVE7	30				3	981	281	2114		11		3419	6.2%	3.5%
OVW1	83	1887	4954	2537	12	61	562	631	670	3891		15289	27.8%	15.8%
OVW2	56	1321	6631	990	7	477	350	290	649	4323		15093	27.4%	15.6%
Otay Valley	1348	3293	14592	10260	38	2520	1381	7468	1811	12291	0	55000	100.0%	56.8%
PV1	57		279		311		173	2839		101		3761	81.1%	3.9%
PV2			47		4		47	620		162		879	18.9%	0.9%
Proctor	57		326		315		220	3459		263	0	4640	100.0%	4.8%
SA1			14		9			1804		404		2230	40.7%	2.3%
SA2								1722				1722	31.5%	1.8%
SA3				5				1118		399		1522	27.8%	1.6%
Savage			14	5	9			4644		802	0	5474	100.0%	5.7%
Land Use Total	4307	3365	15083	10467	6042	2675	1668	35071	2076	16077	0	96832		
% of Watershed Total	4.4%	3.5%	15.6%	10.8%	6.2%	2.8%	1.7%	36.2%	2.1%	16.6%	0.0%			

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Table 4.15 Total Nitrogen Loading Rates (lbs/ac/yr) by Subbasin

1/27/2005 9:05 **NO BMPs APPLIED**

Model Segment	Land Use										Subbasin w/o Pt Src	Subbasin w/ Pt Src
	AG	COM	HD_RES	IND	LD_RES	PUB_FAC	PUB_UTIL	REC/OPEN	SCHOOL	TRANS		
Engineer Springs	2.3		3.5		1.2	6.9	6.8	0.4		5.2	0.8	0.8
HO1				9.1				0.5		6.2	0.5	0.5
HO2								0.5		6.8	0.5	0.5
HO3								0.4		5.5	0.5	0.5
HO4	2.8				1.4			0.5		6.4	0.6	0.6
HO5	2.7				1.4			0.5		6.3	0.7	0.7
HO6								0.4		5.6	0.4	0.4
HO7	2.6	8.8	4.1		1.4	7.9		0.5		6.0	0.7	0.7
HO8	3.2				1.7	9.7		0.6		7.4	0.9	0.9
Hollenbeck	2.7	8.8	4.1	9.1	1.6	8.9		0.5		6.6	0.6	0.6
JA1								0.5			0.5	0.5
JA2	2.4				1.2		7.1	0.4		5.4	0.6	0.6
JA3	2.5	8.3	3.9		1.3	7.4	7.4	0.4	4.2	5.7	1.0	1.0
Jamul	2.4	8.3	3.9		1.3	7.4	7.4	0.4	4.2	5.6	0.8	0.8
Lee	2.9				1.5			0.5		6.7	0.9	0.9
Lyon	3.4	11.6			1.8	10.4		0.6		7.9	1.1	1.1
OVE1		7.4	3.4	7.4	1.1	6.6	6.6	0.4	3.8	5.0	1.6	1.6
OVE2	2.1	6.9	3.2	7.0		6.2		0.4		4.7	2.4	2.4
OVE3				7.3	1.1		6.5	0.4			0.7	0.7
OVE4	2.1			7.3	1.1	6.5	6.5	0.4		4.9	1.2	1.2
OVE5	2.2		3.4			6.5		0.4		5.0	0.6	0.6
OVE6			3.5				6.8	0.4	3.9	5.2	1.8	1.8
OVE7	2.5				1.3	7.6	7.6	0.5		5.8	0.7	0.7
OVW1	1.9	6.4	3.0	6.5	1.0	5.8	5.7	0.3	3.3	4.4	2.8	2.8
OVW2	2.0	6.8	3.1	6.8	1.0	6.1	6.0	0.4	3.5	4.6	3.3	3.3
Otay Valley	2.1	6.6	3.1	6.9	1.1	6.8	6.2	0.4	3.5	4.7	1.9	1.9
PV1	2.5		3.9		1.3		7.5	0.5		5.8	0.6	0.6
PV2			3.7		1.2		7.1	0.4		5.4	0.6	0.6
Proctor	2.5		3.9		1.3		7.4	0.4		5.6	0.6	0.6
SA1			3.6		1.2			0.4		5.2	0.5	0.5
SA2								0.5			0.5	0.5
SA3				9.5				0.5		6.4	0.7	0.7
Savage			3.6	9.5	1.2			0.5		5.8	0.5	0.5
Land Use Average	2.5	6.6	3.2	6.9	1.5	6.9	6.4	0.5	3.6	4.9	1.0	1.0

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Table 4.16 Total Phosphorus Loads (lbs/yr) by Subbasin

1/27/2005 9:05 **NO BMPs APPLIED**

Model Segment	Land Use										Pt Src Loads	Subbasin Total	% of HSA Total	% of Watershed Total
	AG	COM	HD_RES	IND	LD_RES	PUB_FAC	PUB_UTIL	REC/OPEN	SCHOOL	TRANS				
Engineer Springs	8.6		0.1		13.2	0.7	0.0	10.4		9.1		42.2	100.0%	0.9%
HO1				11.3				62.4		7.6		81.3	11.1%	1.7%
HO2								65.7		0.7		66.4	9.1%	1.4%
HO3								31.9		13.2		45.0	6.2%	0.9%
HO4	0.0				19.8			65.2		25.3		110.4	15.1%	2.3%
HO5	11.0				14.5			33.2		14.6		73.3	10.0%	1.5%
HO6								46.4		0.3		46.7	6.4%	1.0%
HO7	35.7	0.3	0.4		3.3	0.9		41.9		13.6		96.2	13.2%	2.0%
HO8	8.8				74.7	1.3		75.1		51.4		211.4	28.9%	4.4%
Hollenbeck	55.6	0.3	0.4	11.3	112.4	2.3		421.9		126.5	0.0	730.7	100.0%	15.4%
JA1								17.4				17.4	6.1%	0.4%
JA2	9.6				2.1		0.1	15.1		6.3		33.2	11.7%	0.7%
JA3	30.0	1.8	7.2		71.0	2.0	3.6	42.9	18.3	55.7		232.6	82.1%	4.9%
Jamul	39.6	1.8	7.2		73.1	2.0	3.8	75.4	18.3	62.0	0.0	283.1	100.0%	6.0%
Lee	7.5				36.7			22.3		9.6		76.1	100.0%	1.6%
Lyon	16.1	1.6			25.6	3.2		28.6		26.6		101.7	100.0%	2.1%
OVE1		0.3	54.5	23.9	0.4	1.6	5.5	19.3	24.3	92.7		222.4	7.1%	4.7%
OVE2	0.2	4.1	29.0	254.0		5.7		19.5		80.3		392.8	12.5%	8.3%
OVE3				28.9	0.2		2.0	15.5				46.6	1.5%	1.0%
OVE4	49.5			70.2	0.1	32.8	0.8	31.9		44.5		229.9	7.3%	4.8%
OVE5	2.2		5.2			11.8		27.2		9.8		56.3	1.8%	1.2%
OVE6			64.0				2.2	13.6	9.5	122.1		211.4	6.7%	4.4%
OVE7	1.3				0.1	50.9	15.7	60.5		1.0		129.5	4.1%	2.7%
OVW1	3.7	97.9	251.6	142.0	0.6	3.1	31.5	18.1	46.2	334.4		929.0	29.5%	19.5%
OVW2	2.5	68.5	336.7	55.4	0.3	24.8	19.6	8.3	44.7	371.5		932.3	29.6%	19.6%
Otay Valley	59.2	170.9	741.0	574.3	1.7	130.8	77.3	213.9	124.8	1056.2	0.0	3150.1	100.0%	66.3%
PV1	2.5		14.2		14.3		9.7	81.3		8.7		130.7	78.0%	2.7%
PV2			2.4		0.2		2.6	17.8		13.9		36.8	22.0%	0.8%
Proctor	2.5		16.6		14.5		12.3	99.1		22.6	0.0	167.5	100.0%	3.5%
SA1			0.7		0.4			51.7		34.7		87.4	43.0%	1.8%
SA2								49.3				49.3	24.3%	1.0%
SA3				0.3				32.0		34.3		66.6	32.8%	1.4%
Savage			0.7	0.3	0.4			133.0		69.0	0.0	203.4	100.0%	4.3%
Land Use Total	189.1	174.6	765.9	586.0	277.5	138.9	93.4	1004.6	143.0	1381.6	0.0	4754.8		
% of Watershed Total	4.0%	3.7%	16.1%	12.3%	5.8%	2.9%	2.0%	21.1%	3.0%	29.1%	0.0%			

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Table 4.17 Total Phosphorus Loading Rates (lbs/ac/yr) by Subbasin

1/27/2005 9:05 **NO BMPs APPLIED**

Model Segment	Land Use										Subbasin w/o Pt Src	Subbasin w/ Pt Src
	AG	COM	HD_RES	IND	LD_RES	PUB_FAC	PUB_UTIL	REC/OPEN	SCHOOL	TRANS		
Engineer Springs	0.10		0.18		0.05	0.36	0.38	0.01		0.45	0.03	0.03
HO1				0.51				0.01		0.53	0.02	0.02
HO2								0.02		0.59	0.02	0.02
HO3								0.01		0.47	0.02	0.02
HO4	0.12				0.07			0.01		0.55	0.02	0.02
HO5	0.12				0.07			0.01		0.54	0.03	0.03
HO6								0.01		0.48	0.01	0.01
HO7	0.11	0.46	0.21		0.06	0.41		0.01		0.52	0.03	0.03
HO8	0.14				0.08	0.51		0.02		0.64	0.04	0.04
Hollenbeck	0.12	0.46	0.21	0.51	0.07	0.46		0.01		0.57	0.02	0.02
JA1								0.01			0.01	0.01
JA2	0.10				0.06		0.40	0.01		0.47	0.02	0.02
JA3	0.11	0.43	0.20		0.06	0.39	0.41	0.01	0.29	0.49	0.05	0.05
Jamul	0.11	0.43	0.20		0.06	0.39	0.41	0.01	0.29	0.48	0.04	0.04
Lee	0.13				0.07			0.02		0.58	0.04	0.04
Lyon	0.15	0.60			0.08	0.54		0.02		0.68	0.05	0.05
OVE1		0.38	0.17	0.42	0.05	0.34	0.37	0.01	0.26	0.43	0.09	0.09
OVE2	0.09	0.36	0.16	0.39		0.32		0.01		0.41	0.14	0.14
OVE3				0.41	0.05		0.36	0.01			0.03	0.03
OVE4	0.09			0.41	0.05	0.34	0.36	0.01		0.42	0.06	0.06
OVE5	0.10		0.17			0.34		0.01		0.43	0.02	0.02
OVE6			0.18				0.38	0.01	0.27	0.45	0.12	0.12
OVE7	0.11				0.06	0.40	0.43	0.01		0.50	0.03	0.03
OVW1	0.08	0.33	0.15	0.36	0.05	0.30	0.32	0.01	0.23	0.38	0.17	0.17
OVW2	0.09	0.35	0.16	0.38	0.05	0.31	0.34	0.01	0.24	0.40	0.20	0.20
Otay Valley	0.09	0.34	0.16	0.39	0.05	0.35	0.35	0.01	0.24	0.40	0.11	0.11
PV1	0.11		0.20		0.06		0.42	0.01		0.50	0.02	0.02
PV2			0.19		0.06		0.40	0.01		0.47	0.02	0.02
Proctor	0.11		0.20		0.06		0.42	0.01		0.48	0.02	0.02
SA1			0.18		0.05			0.01		0.45	0.02	0.02
SA2								0.01			0.01	0.01
SA3				0.53				0.01		0.55	0.03	0.03
Savage			0.18	0.53	0.05			0.01		0.50	0.02	0.02
Land Use Average	0.11	0.34	0.16	0.39	0.07	0.36	0.36	0.01	0.24	0.42	0.05	0.05

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BMP REPRESENTATION AND OPERATION

AQUA TERRA Consultants (ATC) developed the OWPL Tool as an Excel workbook to perform constituent loading calculations, based on the PLOAD methodology, for a variety of constituents in the Otay Watershed. This section discusses the incorporation of the capability to represent BMP impacts on watershed loadings, which is an option in PLOAD.

BMP capabilities were incorporated into the calculations consistent with the PLOAD methodology, and were designed to be implemented within the constraints of a spreadsheet application. As noted in Section 2, BMP impacts are calculated as a reduction in the raw pollutant loads determined in a previous operation of the workbook. The effects of BMPs on those loads are calculated for each land use and BMP according to the following equation:

$$L_{BMP} = L_P - [L_P * AS_{BMP} * (\%EFF_{BMP}/100)]$$

Where:
L_{BMP} = BMP-reduced load, lbs/yr
L_P = Raw pollutant load, lbs/yr
AS_{BMP} = Fraction of area serviced by the BMP
%EFF = Percent load reduction of BMP

To perform a new set of calculations that represents a BMP scenario, the user follows these steps:

1) Make a copy of the original workbook and rename it with a title that describes the BMP scenario
2) Open the workbook and edit the I_BMP sheet (discussed below) to include the desired BMPs and needed information. Each BMP has its own separate Removal Efficiency factors, and an Application Area table is used to define where each BMP is applied; templates for these two tables are shown in Table 5.1. The user must provide the following information:
    a. Name/type of BMP
    b. Subbasin where it is located
    c. Areas of each land use that it services
    d. Removal efficiencies for each WQ constituent
3) Execute the "PLoadRun" macro either by selecting Tools-Macro-Macros-PLoadRun from the main menu or by typing 'control-p'
4) Save the workbook under its new name
5) Compare the Raw loads to the BMP-reduced loads in order to show the BMP impacts. This can be done by comparing the two load tables generated by the Tool. Note that the output spreadsheets identify when a run is performed with BMPs by including the phrase 'BMPs APPLIED' shown in red in the upper right corner of the spreadsheet.

The OWPL Tool allows specification of up to 10 different BMPs within a single operation of the workbook. In addition, multiple BMPs can be applied to the same land use within the same subbasin, and their effects will be cumulative. However, not more than 100% of the land use category will be treated. That is, the tool does not allow multiple BMPs to be applied to the same parcel of land. To

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represent that condition the user must separately calculate the combined Removal Efficiency of all the BMPs and their application areas, and then represent that as a single effective BMP within the Tool.

Table 5.1 Sample Template for the I_BMP Spreadsheet of the OWPL Tool

BMP Name	Detention Basins	Agricultural Practices								
Constituent	Removal Efficiency (%)	Removal Efficiency (%)	Removal Efficiency (%)	Removal Efficiency (%)	Removal Efficiency (%)	Removal Efficiency (%)	Removal Efficiency (%)	Removal Efficiency (%)	Removal Efficiency (%)	Removal Efficiency (%)
BOD_5	10	20								
TSS	80	50								
TDS	60	40								
NO23-N	20	30								
NH3-N	20	30								
TKN	15	30								
TN	15	30								
PO4-P	20	30								
TP	15	30								
T_CU	40	10								
T_ZN	30	10								
T_PB	40	10								
OIL_GREASE	60	0								
FEC_COLI	10	50								
FLOW	10	50								

Areas Table

Application Areas by Subbasin	BMP Applied	AG	COM	HD_RES	IND	LD_RES	PUB_FAC	PUB_UTIL	REC/OPEN	SCHOOL	TRANS	TOTAL AREA
ES1	2	43.4										43.4
HO1	1				11.2				2249.0		7.2	2267.3
HO2	1								2135.1		0.6	2135.7
HO3	1								1294.4		14.0	1308.5
HO4	1	0.1				149.1			2259.1		23.0	2431.2
HO4	2	0.1				149.1			2259.1		23.0	2431.2
HO5	1	45.9				110.9			1169.6		13.5	1339.9
HO6	1								1834.4		0.3	1834.7
HO7	1	155.8	0.3	0.9		26.7	1.1		1547.4		13.2	1745.4
HO7	2	155.8										155.8
HO8	1	31.2				485.2	1.3		2243.4		40.3	2801.3
HO8	2	31.2										31.2
JA1	2											0.0
JA2	2	46.4										46.4
JA3	2	138.9										138.9
LE1	2	29.1										29.1
LY1	2	53.4										53.4
OVE1	1		0.4	156.8	28.7	3.5	2.3	7.4	851.3	47.0	107.1	1204.6
OVE2	1	0.9	5.7	88.6	324.7		8.9		910.6		98.6	1438.0
OVE3	1				35.4	2.1		2.8	695.3			735.5
OVE4	1	262.5			86.1	1.2	48.8	1.1	1432.4		52.5	1884.6
OVE5	1	11.4		15.2			17.3		1210.4		11.5	1265.8
OVE6	1			177.8				2.9	576.2	17.7	136.1	910.6
OVE7	1	5.9				1.2	64.2	18.5	2306.5		1.0	2397.2
OVW1	1	21.9	146.9	832.0	196.4	6.3	5.3	49.1	915.3	102.3	444.1	2719.6
OVW2	1	13.9	97.6	1057.3	72.7	3.2	39.4	29.1	399.2	94.1	468.4	2274.9
PV1	1	11.3		35.7		119.6		11.5	3128.7		8.8	3315.5
PV2	1			6.3		1.5		3.3	722.9		14.8	748.8
SA1	1			1.9		3.6			2187.2		38.5	2231.2
SA2	1								1744.9			1744.9
SA3	1				0.3				1102.5		31.0	1133.8
	Total:	1059.2	250.9	2372.5	755.6	1063.2	188.6	125.7	35174.7	261.0	1547.2	42798.6

I_Area / I_Precip / I_EMC / I_Imp / I_Pt_Src / I_BMP / O_FLOW

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Appendix 4.
Draft Technical Memorandum:
Storm Water Management BMPs for the Otay River Watershed

DRAFT TECHNICAL MEMORANDUM

Storm Water Management BMPs for the Otay River Watershed

RBF Consulting, Jones & Stokes Associates, TAIC, and AQUA TERRA Consultants
July 2005

1 OBJECTIVE

The objective of this memorandum is to provide a technical basis for evaluating potential options to improve water quality in the Otay River watershed. Specifically, this memorandum identifies and describes appropriate storm water Best Management Practices (BMPs) that might be applied to the Otay River watershed. This memo also includes discussion of possible constraints to applying these BMPs, as well as the potential effectiveness for various constituents of concern.

Selected BMPs that were evaluated were based upon general BMP types documented in standard references such as San Diego County's Standard Urban Stormwater Mitigation Plan (SUSMP), the City of San Diego Water Department's *Source Water Protection Guidelines for New Development* (Guidelines), and guidance documents published by the U.S. Environmental Protection Agency (USEPA). The most appropriate or applicable BMPs are recommended based on general assumptions of the soils and hydrology of the Otay River watershed and the San Diego region, and general feasibility based on factors such as existing natural resources (including wetlands and aquatic resources), future land uses, and effectiveness with respect to constituents of concern.

In Section 2 of this memo a general background on structural and non-structural storm water BMPs is provided. Section 3 describes constituent removal efficiency and feasibility for BMPs, and Section 4 relates how specific land use types affect storm water pollution. In Section 5, appropriate and applicable BMPs for the Otay River watershed are recommended based on land uses and the watershed setting. To assess the potential effectiveness of these BMPs for particular contaminants of concern in the watershed, a modeling tool was utilized. Section 6 describes the methodology, data input, and output of the modeling tool. Lastly, Section 7 describes future land uses, as outlined in county and city general plan documents, and the potential application and effectiveness of BMPs to improve water quality of the nine subbasins comprising the Otay River watershed.

2 STORM WATER BMPS – GENERAL DESCRIPTION

Storm water management BMPs are generally categorized as either structural or non-structural. These can be further subdivided into (1) site design BMPs; (2) source control BMPs; and (3) treatment control BMPs. Site design and source control BMPs are primarily non-structural BMPs that attempt to prevent the generation of storm water pollutants. Treatment-control BMPs are structural measures that target anticipated potential storm water pollutants by reducing pollutants in storm water the maximum extent practicable.

2.1 NON-STRUCTURAL (SITE DESIGN AND SOURCE CONTROL) BMPS

Non-structural BMPs include site design and source control BMPs. Site design BMPs aim to conserve natural areas and minimize impervious cover, especially impervious areas "directly connected" to receiving waters, in order to maintain or reduce increases in peak flow velocities from the project site. The USEPA (2002) has listed several site design BMPs that can be implemented on development projects. Table 1 lists site-design BMP alternatives that might be applied to a project site.

Table 1 Site Design BMP Alternatives

Buffer Zones	Open Space Design
Narrower Residential Streets	"Green" Parking
Alternative Turnarounds	Alternative Pavers
Urban Forestry	Conservation Easements
Eliminating Curbs And Gutters	Landscape Design

Source-control BMPs are activities, practices, and procedures (primarily non-structural) that are designed to prevent urban runoff pollution. Examples of source-control BMPs include porous hardscape, the use of xeriscape and native landscape methods, and the minimization of pesticides and fertilizers. These measures either reduce the amount of runoff from the site or prevent contact between potential pollutants and storm water. Also, source-control BMPs are often the best method to address non-storm (dry-weather) flows. Table 2 lists source-control BMP alternatives and indicates the practices that might be applied to a project site.

Table 2 Source-Control BMP Alternatives

Storm Drain Stenciling and Signage	Homeowner Outreach
Material and Trash Storage Area Design	Lawn and Gardening Practices
Efficient Irrigation Systems	Water Conservation
Low-Irrigation Landscape Design	Hazardous Waste Management
On-Lot Treatment Measures	Trash Management
Riprap or Other Flow Energy Dissipation	Outreach for Commercial Activities

Site design and source-control BMPs can be applied to virtually any developed land use, and can also be applied to "open-space" land uses such as parks and recreational facilities. Regulatory programs such as the San Diego County SUSMP and City of San Diego Water Department's Guidelines require implementation of site design and source control BMPs on all significant development sites. Because site design and source control BMPs are non-structural in nature, it is often difficult to assign a value to the effectiveness of a particular BMP with respect to particular constituents of concern.

Moreover, siting and location considerations for particular types of projects or developments can occur at the watershed scale, prior to applying specific on-site design or source control practices. Such a comprehensive watershed approach in locating projects at the outset can be a very effective planning tool in reducing adverse storm water effects.

2.1.1 Non-Structural BMPs for the Otay River Watershed

The following discussion elaborates on types of non-structural BMPs recommended for application on the Otay River watershed.

2.1.1.1 Education and Outreach

One source-control BMP for residential sites is pollution prevention outreach. The key to a successful outreach campaign is to target a message to a specific audience, such as homeowners. At the sale of the property or lease-signing, the homeowner or tenant can be presented with a brochure to encourage them to develop and implement source-control BMPs. Another strategy is to attach brochures as non-binding but informative parts of private road maintenance or structural BMP maintenance agreements that might be used for ensuring the maintenance of the structural treatment control measures. Primary areas of source-control BMPs for homeowners include:

Lawn and Garden Activities. Lawn and garden activities can result in contamination of storm water through pesticide, soil, and fertilizer runoff. Proper landscape management, however, can effectively

reduce water use and contaminant runoff and enhance the aesthetics of a property. Environmentally friendly landscape management can protect the environment through careful planning and design, routine soil analysis, appropriate plant selection, use of practical turf areas, water use efficiency, use of mulches, and appropriate maintenance. Additional activities that benefit water resources include maintaining healthy plants and lawns and composting lawn wastes. Healthy plants are less susceptible to diseases and insects and therefore require minimal use of pest control measures. To promote healthy plants, it is often beneficial to till composted material into the soil. Recycling of garden wastes by composting is also effective at reducing waste, although compost bins and piles should not be located next to waterways or storm drains because leachate from compost materials can cause contamination.

Water Conservation Practices. By making minor changes in water use habits, each household can reduce its water consumption while saving money on water and sewage bills. Homeowners can be made aware of practices like checking regularly for plumbing leaks and checking for water leaks by monitoring their water meters when no water is being used (such as when they go on vacation).

Pet Waste Management. When pet waste is not properly disposed of, it can wash into nearby water bodies or can be carried by runoff into storm drains. Homeowners should be encouraged to dispose of pet waste with regular trash, bury it in their yards, or flush it down the toilet. San Diego County prefers that pet waste be flushed. Alternatives to flushing include placing pet waste in the trash or burying it at least 3 feet in the ground.

Trash Management. Homeowners should be informed about their options for recycling and waste disposal, as well as the consequences of littering. It is especially important to inform residents of proper disposal procedures for household hazardous wastes.

Table 3, on the following page, is an example of an educational BMP program targeted to homeowners.

2.1.1.2 Stream Setbacks (Policy BMP)

Stream setbacks are most commonly applied to preserve and enhance the riparian corridor alongside streams and to enhance stream functioning (e.g., water quality, channel habitat complexity, sediment transport). Stream setback regulations prohibit or limit construction and other disruptive activities within a specified distance adjacent to creeks. Stream setbacks are applicable in the land development and redevelopment process. Therefore, they have a relatively greater effect in developing watersheds than in those already built-out.

Typically, stream setbacks occur within two or more bands parallel to the creek. The criteria for establishing the width of a water quality zone can depend upon the location of the creek within the watershed, its environmental sensitivity, the extent of the floodplain, local topography, vegetative and habitat character of the riparian zone, and other characteristics. Setback areas may be individually small and relatively insignificant. However, cumulatively, they are significant in protecting water quality, reducing flood flows, and providing habitat. The width of stream setbacks necessary to protect riparian functions varies, according to research conducted nationwide, as shown in Table 4 on the following page. Though benefits are seen in modest setback distances greater than 35 ft, narrow stream setback areas are greatly enhanced through occasional broad buffers (100-300 ft) where greater habitat functions can occur across the stream/floodplain continuum. The most protective regulations can require stream bank setbacks from all waters. Stream setbacks based on this definition could extend protection to stream headwaters, vegetated shallows, pools and riffles. The recommended setback widths to protect general stream functions shown in Table 4 are summarized below. More specific setback distances to provide these specific functions for the Otay River watershed would need to be refined:

- 33 to over 200 feet for sediment and nutrient reduction;

Table 3 Basic Homeowner Outreach Program

- Do not release or dispose of liquids or other materials to the storm drain system
- Report illegal dumping of any substance (liquids, trash, household toxics) to the County's 24-hour hotline
- Utilize the County Household Toxics Program for disposal of household toxics
- Keep lawn clippings and other landscaping waste out of gutters and streets by placing it with trash for collection or by composting it
- Clean up and properly dispose of pet waste. It is best to flush pet waste. Alternatives to flushing are placing into trash or burying it in your yard (at least 3-ft deep).
- Observe parking restriction for street sweeping.
- Wash automobiles at car washes or on pervious surfaces (lawns) to keep wash water out of the storm drain system.
- Avoid excessive or improper use or disposal of fertilizers, pesticides, herbicides, fungicides, cleaning solutions, and automotive and paint products.
- Use biodegradable, non-toxic, and less toxic alternative products to the extent possible.
- Cover garbage containers and keep them in good repair.
- Sweep sidewalks instead of hosing down.
- Water lawn properly to reduce runoff.

Source: www.co.san-diego.ca.us/deh/stormwater/residential.html

Table 4. Recommended Setbacks to Preserve Riparian and Stream Function (from studies throughout the United States)

	Function	Citation	Recommended Setback
Physical Properties	**Sediment and Nutrient Reduction**	Corley et. al. 1999	>33 ft
		Nichols et. al. 1998	>60 ft
		Woodward and Rock 1995	>50 ft
		Desbonnet et. al. 1994	80 ft
		Peterson et. al. 1992	>33 ft
		Castelle et. al. 1992	>50 ft
		Schellinger and Clausen 1992	75 ft
		Welsch 1991	>85 ft
		Dillaha et. al. 1989	>30 ft
		Gilliam and Skaggs 1988	290 ft- 50% sediment deposition
		Budd et. al. 1987	50 ft
		Jacobs and Gilliam 1985	50 ft
		Lynch et. al. 1985	98 ft
		Erman et. al. 1983	98 ft
		Lowrance 1984	60-120 ft
		Moring 1982	98 ft
		Young et. al. 1980	80 ft
		Erman et. al. 1977	98 ft
		Karr and Scholosser 1977	75% removal 98-125 ft
		Broderson 1973	50-200 ft (one tree height)
		Wilson 1967	49 ft (silt), and 400 ft (clay)
	Removal of Fecal Coliform	Johnson and Ryba 1992*	75-300 ft
	Moderation of Stream Temperature/Microclimate	Lynch and Corbett 1990	100 ft
		Jones et. al. 1988	100-140 ft
		Lynch et. al. 1985	98 ft
		Steinblums et. al. 1984	75-125 ft for 60-80% shade
		Hewlet and Fortson 1982	50-100 ft
	Channel Complexity	Marcus 2002	4X bankfull width
		Brosofske et. al. 1997	>145 ft
		Chapel et. al. 1992	135-220 ft
		Lynch et. al. 1985	65-100 ft

Table 4. Continued

	Function	Citation	Recommended Setback
Biological Properties	**Salmonid Habitat**	Ligon et. al. 1999	>150 ft
		USFS/BLM 1994	300 ft
		Welsch 1991	>85ft
	Reptile/Amphibian Habitat	Burbink et. al. 1998	>325 ft
		Semlitsch 1998	540 ft
		Buhlmann 1998	440 ft
		Rudolph and Dickson 1990	98 ft
	Bird Habitat/Diversity	Miller et al 2003	Width of historic floodplain
		RHJV 2000	250 ft
		Whitaker and Montevechi 1999	>160 ft
		Hagar 1999	>130 ft
		Kilgo et. al. 1998	>1600 ft
		Richardson and Miller 1997	>160
		Mitchell 1996	>325 ft
		Hodges and Krementz 1996	>325 ft
		Spackman and Hughes 1995	450 ft for 90% of species diversity
	Mammal Habitat/Diversity	Hilty in press (Conservation Biology)	>1000 ft
		Dickson 1989	> 160 ft
	Plant Diversity	Spackman and Hughes 1995	30-100 ft for 90% of species
	General Riparian/Ecosystem Function	Levey et. al. 2002	>80 ft
		NH FSSWT 2000	100 ft, 300 ft, 600 ft by stream order
		Spence et. al. 1996	98-145 ft
		Johnson and Ryba 1992*	> 98 ft
		Chapel et. al. 1992	160-650 ft
		Welsch 1991	>85ft

*article does not present new data, but instead is a review of existing data

- 50 to 140 feet for water temperature moderation;
- 4 times bankfull width to 220 feet for channel complexity;
- 98 to 540 feet for reptile and amphibian habitat;
- 130 to 1,600 feet for bird habitat;
- 30 to 100 feet for plant diversity; and
- 80 to 600 feet for general riparian and ecosystem function.

The potential benefits of stream buffers can include the following (Schueler, 1997):

- separation of pollution generation from the waterway;
- provision of area for structural or vegetative water quality controls (natural or engineered vegetative buffers);
- provision of an area for runoff storage and infiltration which may help sustain stream baseflow;
- preservation of the natural vegetative character along the stream bank;
- provision of linked open spaces with potential locations for pedestrian and bike trails, possibly at reduced cost to the public;
- provision of habitat, food, and migration corridors for wildlife;
- reduction of stream warming via stream bank shading;
- protection of local critical environmental features including wetlands, springs, and seeps;
- provision of an area for future stream restoration, water quality controls, and bank stabilization.

Setbacks are particularly recommended as buffers between golf course turf management and streams. Golf courses represent unique landscape practices in that water quality monitoring data often indicate significant increases in baseflow concentrations of nitrates, ammonia, total dissolved solids, total suspended solids and turbidity adjacent to golf courses that use treated wastewater effluent for irrigation. Storm runoff samples typically indicate that tributaries associated with a golf course sites are significantly higher in nitrates, orthophosphorus, and total dissolved solids and lower in pH than samples from tributaries associated with residential and rural land uses.

Table 5 lists local stream setback ordinances currently in effect in California and elsewhere in the United States. As shown in Table 5, stream setbacks are defined in a diverse manner nationwide, ranging from a general protected area along either side of the creek to specific widths depending on the slope or size of the stream or watershed. Generally, the area closest to the creek requires the most restrictive limitations on activities disruptive to the waterway. In this area (the “critical zone”), all activities are typically restricted with a few exceptions (e.g. limited street crossings, fences that do not obstruct flood flows, parks and open spaces, and certain utilities).

The primary constraint associated with stream setbacks is the limitation of development along waterways, often considered high value areas for residential housing. However, the water quality and habitat benefits provided by stream setbacks can outweigh the benefits of development to the community.

2.1.1.3 Agricultural and Grazing Management

Though it is generally limited in scope, grazing and agriculture are historically important sources of nonpoint (i.e., diffuse) pollutants on the Otay River watershed. There is a large, well-established suite of BMPs for the control of agricultural nonpoint source pollution. The State Water Resources

Table 5. Regulatory Guidance on Stream Setbacks

Local Ordinances in Northern California	Stream Setback
Sonoma County	upland/urban = 50 ft Russian River = 200 ft flatland/valleys = 100 ft
Marin County	coastal/rural = 100 ft urban = 50 ft
Humbolt County	100 ft perennial streams 50 ft intermittent streams
Santa Cruz County	50 ft no development zone on perennial streams 30 ft no development zone on intermittent streams
Contra Costa County	Development near Natural Creeks and Streams new urban development = 50 ft buildings = 30–50 ft (depending on site specific calculations) intensification of cattle grazing = 100 ft (as part of discretionary use permit)
Santa Clara County (proposed)	150 ft on all streams draining watersheds ≥ 1mi^2 (320 acres), unclear on smaller drainages
Solano County HCP (proposed)	Lead agency is proposing a minimum 100 ft setback from top of bank or edge of existing riparian vegetation, whichever is greater on all 3rd order or higher streams
City of Palo Alto	100 ft buffer zone for any development other than single family residential
City of Santa Cruz	all watercourses = 100 ft
Selected Setback Ordinances in Effect elsewhere in the U.S.	
Clackamas County, Oregon	Principal River 100–150 ft from MHW Large Streams - 100 ft from MHW Medium Stream - 70 ft from MHW Small Stream - 50 ft from MHW
Cobb County, Georgia	50–200 ft depending on the size of the watershed
Lane County, Oregon	Large Streams w/ T&E species = 150 ft Other streams with T&E species = 125 ft Fish-bearing streams w/o T&E = 50–100 ft

Table 5. Continued

Lexana County, Kansas	Sensitive Streams: Stream order 1 = 150 ft Stream order 2 = 250 ft Stream order 3 = 300 ft Restorable Streams: Stream order 1 = 125 ft Stream order 2 = 200 ft Stream order 3 = 250 ft
Kings County, Washington	Impacted Streams: Stream order 1 = 100 ft Stream order 2 = 150 ft Stream order 3 = 200 ft 115 ft - if property is inside urban growth area
Summit County, Ohio	Watershed >300 sq.mi. =300 ft Watershed >20 sq. mi. = 100 ft Watershed <.5 sq. mi.=30–75 ft
Suwanne River, Florida	75–250 ft depending on soil type
Generic Setbacks	
EPA Ideal	100 ft minimum + slope variable 15–17%= +10 ft 18–20%= +30 ft 21–23%= +50 ft 24–25%= +60 ft
USFS, Northeastern Area Recommendations (Welsh 1991)	95 ft min (zone 1=15 ft; zone 2 min = 60; zone 3 min = 20 ft)
Storm Water Center	100 ft to 150 ft min (zone 1 = 25 ft min, zone 2 = 50 ft to 100 ft, zone 3 = 25 ft min)
Kondolf et. al. 1996	2 zones: inner zone is fixed, but based on veg. community type and energy; outer zone variable, but based on proximity to stream, hillside steepness, soil erodibility
NRCS	General purpose buffer – min. 15 ft from top of bank or normal water line To reduce excess amounts of sediment, organic matter, nutrients, pesticides – 2 zones: min 100 ft or 30% of the geomorphic flood plain whichever is less, but not less than 35 ft
Oregon Forest Practices Act - Commercial Timber Harvesting on Private Forest Land	100 ft from fish bearing streams

Control Board (SWRCB) has identified seven specific measures for the control of agricultural nonpoint source pollution:

- Erosion and sediment control
- Non-CAFO Wastewater and Runoff Control
- Nutrient Management Programs
- Pesticide Management Programs
- Grazing Management Programs
- Irrigation Management Programs
- Education and Outreach

The fundamental bases of many of these BMPs can be applied in urban and suburban settings through the landscape management of lawns, gardens, and public parks.

Grazing management programs protect sensitive areas such as stream banks, lakes, wetlands, estuaries, and riparian zones by reducing direct loadings of animal wastes and sediment. Grazing management can achieve this through several means, including:

- Carefully monitoring and managing grazing intensity, frequency, and duration.
- Installing fencing, hedgerows, or other measures to keep animals, people, and/or vehicles out of drainage courses and away from sensitive areas.
- Discouraging animals from seeking out streams by installing alternative drinking sources (e.g., water troughs) and providing shade and nutrients away from streams and sensitive areas.
- Providing stream crossings to minimize impacts on stream habitat and water quality.

Providing improvements such as stabilized access roads, trails, and walkways that will help contain vehicular, foot, and animal traffic and limit damage to sensitive areas.

2.2 STRUCTURAL (TREATMENT CONTROL) BMPs

Post-construction "treatment control" storm water management BMPs provide treatment for storm water emanating from a developed site. Implementation of a National Pollutant Discharge Elimination System (NPDES) General Permit requires using post-construction BMPs that remain in service to protect water quality throughout the life of the project. Structural BMPs are an integral element of post-construction storm water management and include storage, filtration, and infiltration practices. The most frequently used treatment control BMPs include swales, buffer strips, infiltration basins and trenches, and extended detention basins and ponds. Table 6 summarizes various types of treatment control BMPs.

Table 6 Treatment Control BMP Alternatives

Bio-Filtration Practices	Vegetated Swales Vegetated Strips
Storm Water Detention Practices	Extended Detention Basins Wet Ponds Constructed Wetlands
Storm Water Infiltration Practices	Infiltration Basins Infiltration Trenches Certain Porous Pavement Installations
Storm Water Retention Practices	Bio-Retention Retention – Irrigation
Drainage Inserts	Filter Inserts Curb Inlet Baskets
Storm Water Filtration Practices	Sand Filters (Austin Type and Delaware Type) Media Filters
Storm Water Separation Practices	Oil-Water Separators/Baffle Boxes Continuous Deflection Gross Solids Removal Devices (GSRDs)

The following paragraphs provide a brief description of a variety of treatment control BMPs.

Swales. Swales are typically shallow, gently banked channels with a relatively mild longitudinal slope, with a grass or vegetated bed. They are designed to slow velocities during small storms, allowing enhanced opportunity for infiltration along the swale bottom and for the trapping of sediment and organic biosolids in the vegetative cover. Swales typically occur in areas with a relatively limited catchment area (i.e. smaller tributaries) or can be used along a floodplain and run (as a "back channel") parallel to the main valley stream channel.

Filter Strips. Sometimes called buffer strips, filter strips perform in a manner similar to swales but are not channels. Strips are designed to receive flow with sheet flow characteristics. These are mildly sloping vegetated surfaces that are located off, and abut, an impervious surface area. They are designed to slow the velocity of the runoff from the impervious area, increasing the opportunities for infiltration and the trapping of pollutants. Note, "filter strips" are similar in purpose/effect to the "stream setback" BMP discussed above, yet need not be immediately adjacent to a stream and more typically occur adjacent to other more developed types of land uses.

Catch Basin Filter Inserts. These are containers with some filtering and/or absorbing medium installed in drainage inlets. The catch basin inserts manufactured typically have been configured to remove sediment, constituents adsorbed to sediment, and oil and grease.

Curb Inlet Baskets. Curb inlet baskets are baskets installed at curb inlets to primarily capture material such as leaves, clippings, and other floating trash.

Infiltration Basins and Percolation Trenches. These treatment controls capture runoff generated by small storms from small catchments and provide good storm water treatment by encouraging and enabling surface runoff to enter the groundwater regime. This transition to sub-surface can filter out suspended pollutants and provides other treatment processes before water returns to the surface as creek flow or some other form of runoff.

Detention Controls. Detention controls include extended detention basins (dry) which drain out completely between storm events. Detention basins remove pollutants primarily through sedimentation of solids.

Wet Basins. Wet basins can provide efficient storm water quality treatment controls. Wet basins for storm water treatment are artificially created and (for regulatory purposes) are not equivalent to naturally occurring wetland types. These artificially constructed wetlands may require obtaining permits before maintenance can be performed.

Media Filtration. These controls include sand filters with presettlement to avoid clogging. Other media mixtures of peat, sand, and compost mix and geotextiles may be used.

Oil-Water Separators. These controls are designed to remove petroleum compounds, grease, sand, and grit.

2.2.1 Structural BMPs for the Otay River Watershed

The following discussion elaborates on several types of structural BMPs recommended for application on the Otay River watershed.

2.2.1.1 Extended Detention Basins (Unlined or Lined)

Extended detention basins (EDBs) are storm water detention basins that are designed to hold storm water for an extended period of time (typically 24 to 72 hours). Extended detention basins rely upon this detention time to allow physical settling of particulates. Sediment and the constituents associated with sediment are effectively controlled by extended detention basins. In addition to particulates, extended detention basins can be designed to be effective for controlling stormflow volumes, peak discharges, and resulting downstream erosion associated with high magnitude flow events.

2.2.1.2 Biofiltration Swales and Strips

Vegetated swales are broad shallow channels with a dense stand of vegetation established in them that are designed to promote infiltration and trap pollutants. The combination of low velocities and vegetative cover provides an opportunity for pollutants to settle out or be treated by infiltration. In addition to pollutant removal, this practice can result in reduced volumes of runoff and peak discharge. Vegetated swales are most effective for removal of coarse sediment and pollutants associated with it. Fine sediment and soluble pollutants are not treated unless they are part of runoff that infiltrates through the swale. Note, the stream setback BMP described above becomes most effective when the setback area is well vegetated. In this way a “setback” begins to function as a “biofiltration swale” if it is vegetated adequately. A barren setback area adjacent to a stream, without vegetation, does not provide such functions and should not be described as a true buffer.

Filter strips consist of grass or other close-growing vegetation designed to receive overland flow. The vegetation slows the runoff and traps particulate pollutants. Filter strips can be used to trap solids such as sediment, trash, and organic matter from runoff. Filter strips can be effective for soluble pollutant removal, but only to the extent that runoff infiltrates into the soil. Figure 1 illustrates a schematic of a biofiltration strip and swale.

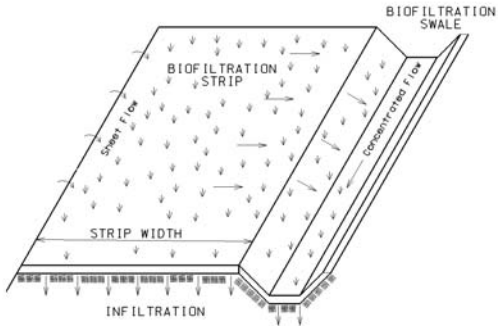


Figure 1 Schematic of Biofiltration Strip and Swale

When swales/strips are coupled, as shown in the figure above, with proper land-use source control, they can be integrated into the landscaping, drainage and flood control system, and other open spaces of the development projects. When properly designed, they become amenities rather than interferences to development projects and do not cause other environmental problems (such as groundwater pollution or hazardous sediments).

Further, studies by USEPA (1983) report that infiltration devices such as swales/strips are a practical and effective technique for reducing pollutant loads that accumulate in the upper soil layers. According to USEPA case studies, the depth of pollutant penetration is dependent on soil type; however, in no case did contaminants in the soil exceed several meters depth, and highest concentrations were found near the surface.

2.2.1.3 Inlet Filter Inserts

Drain inlet filter inserts are containers with some filtering and/or sorbing medium to be installed in existing inlets. The catch basin inserts manufactured typically have been configured to remove sediment, constituents adsorbed to sediment, and oil and grease. Figure 2 shows a typical schematic of a drain inlet insert. All drain inlet inserts used as BMPs must be installed according to manufacturer's instructions; the effectiveness of these inserts (or other types of inlet insert) require preventive inspection and maintenance and annual replacement of medium.

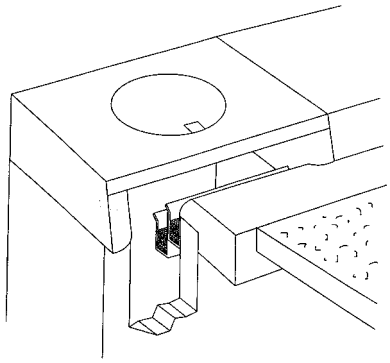


Figure 2 Schematic of Inlet Filter insert

2.2.1.4 Storm Water Separation Technologies

"Hydrodynamic separator" is a general term for flow-through structures with a settling or separation unit that removes sediments and other pollutants. No outside power source is required, because the energy of the flowing water allows the sediments to efficiently separate. Depending on the type of unit, this separation may be by means of swirl action or indirect filtration through the settling of particles and/or the separation of immiscible fluids (Figure 3).

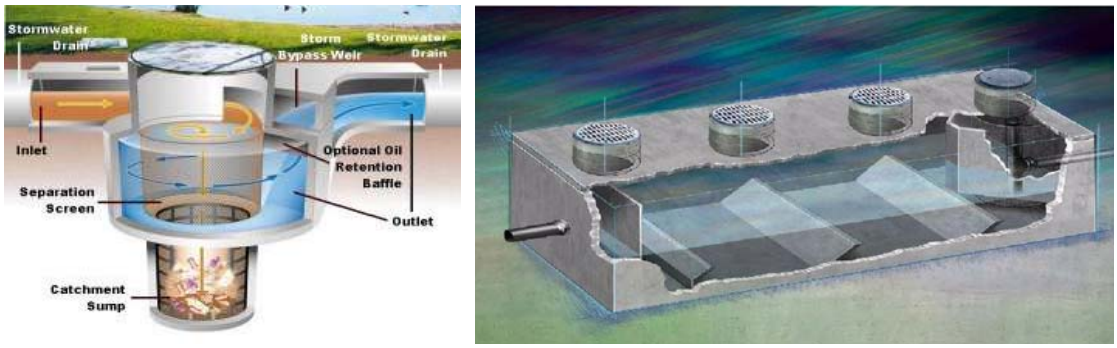


Figure 3 Storm Water Separation Units Include CDS® and Jensen Precast® Units.

This technology may be used by itself or in conjunction with other storm water BMPs as part of an overall storm water control strategy. Hydrodynamic separators come in a wide size range and some are small enough to fit in conventional manholes. This makes hydrodynamic separators ideal for areas where land availability is limited. Also, because they can be placed in almost any specific location in a system, hydrodynamic separators are ideal for use in potential storm water "hotspots" – areas such as near gas stations, where higher concentrations of pollutants are more likely to occur.

There are a wide variety of storm water separation units available. At present, most hydrodynamic separation units are proprietary technology.

2.3 STORM WATER BMP MAINTENANCE

It is important to consider the long-term success of BMPs once applied and installed. Regular inspection and maintenance of the BMPs are a necessity if BMPs are to consistently perform up to the specifications and expectations. Sediment and debris removal from inlets and outlets are the most important requirements. General maintenance requirements include the following:

Inspections. Inspections should be performed at regular intervals to ensure that the BMP is operating as designed. Annual inspections should be considered, especially prior to the November-April storm water season, with additional inspections following storm events. Inspections can be arranged to coincide with routine maintenance visits. In general, check for accumulation of debris and sediment at the inlet and outlet, check side slopes for signs of erosion, failure, condition of vegetation cover, or vehicular damage.

Maintenance. Routine preventive maintenance should be performed on a regular basis to keep the BMP aesthetic and functional. The frequency of maintenance would depend upon the device. Maintenance would include debris and sediment removal, clearing of vegetation around flow devices, and replacement of dead turf or vegetation at swales/strips.

Non-Routine Maintenance. This is a corrective type of maintenance and not performed on a regular basis (i.e., may not occur annually). These activities would include: erosion and structural repair, sediment removal and disposal, or filter media replacement.

Other Maintenance. This type of maintenance may include mowing of basin sideslopes, devices within residential areas, debris and litter removal, nuisance control (standing water, mosquitoes, weeds, and odor control).

3 BMP REMOVAL EFFICIENCY AND FEASIBILITY

The process of BMP selection and application is based upon: (a) determination of the desired pollutant removal efficiency; and (b) the feasibility of the BMP functions. The wide range of BMPs discussed above can be narrowed to a more focused or tailored list of BMPs most suitable to Otay River watershed conditions. Factors to consider include the unique attributes of the watershed, regional pollutants of concern, significant natural resources, and land use types.

3.1 BMP REMOVAL EFFICIENCY

Storm water BMPs have varying degrees of effectiveness with respect to different pollutants of concern. National studies have evaluated effectiveness of BMPs (USEPA, 2002), but did not initially include data from southern California. It is often problematic to extrapolate national data sets to the southwest region, which has specific climatic factors and water quality stressors. The most relevant removal efficiency data is from the BMP Retrofit Pilot Program conducted by the California Department of Transportation (January 2004), which included data from several sites in the San Diego region.

The County San Diego's SUSMP and City of San Diego Water Department's Guidelines provide general "menus" of storm water BMPs, which have varying degrees of effectiveness versus different pollutants of concern (Table 7).

Table 7 Treatment Control BMP Selection Matrix

○ High Removal Efficiency ◒ Medium Removal Efficiency ● Low Removal Efficiency ? Unknown Removal Efficiency	**Treatment Control BMP Categories**						
Pollutant of Concern	Biofilters	Detention Basins	Infiltration Basins(1)	Wet Ponds or Wetlands	Drainage Inserts	Filtration	Continuous Flow Deflection Systems(2)
Sediment	◒	○	○	○	◒	○	◒
Nutrients	●	◒	◒	◒	◒	◒	●
Heavy Metals	◒	◒	◒	○	◒	○	●
Organic Compounds	?	?	?	?	●	◒	●
Trash & Debris	●	○	?	?	◒	○	◒
Oxygen Demanding Substances	●	◒	◒	◒	●	◒	●
Bacteria	?	?	○	?	●	◒	●
Oils and Grease	◒	◒	?	?	●	○	●
Pesticides	?	?	?	?	●	?	●

Source: San Diego County, 2002. *(1) Including trenches and porous pavement.(2) Also known as hydrodynamic devices and baffle boxes. Original Sources: Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters (1993), National Stormwater Best Management Practices Database (2001), and Guide for BMP Selection in Urban Developed Areas (2001).*

Table 8 summarizes the potential reduction in pollutant load due to nonstructural measures.

Table 8 Potential Reduction in Storm Water Load (%) from Nonstructural Measures

Land Use	Solids	Nutrients	Pesticides	Metals	Bacteria
Highway	5 – 10	< 2	80 - 100	5	0
Residential	5 - 15	< 5	20 - 30	5	0
Commercial/Industrial	5 - 50	< 2	20 - 30	5	0
Open Space	0	40 - 60	40 - 60	0	0
Agriculture	0	40 - 60	40 - 60	0	0

Source: Barrett, M.E. (1998). Report: Evaluation and Potential Effectiveness of the Clatrans Non-Structural Runoff Control Program.

3.2 BMP FEASIBILITY

The selection, design, and siting of structural BMPs within a project depend largely on the project-wide drainage plan. BMP alternatives must be evaluated for their relative effectiveness for treating potential pollutants from the project site; technical feasibility; relative costs and benefits; and applicable legal, institutional, and other constraints. Tables 9 and 10 summarize common constraints on BMP siting and design.

The characteristics of a particular watershed or land use can preclude the practical use of certain types of BMPs at the planning level. For instance, storm water infiltration practices are generally not feasible in the San Diego area, because soils in the region are typically characterized by slow infiltration rates (see SCS, 1973). Wet retention ponds and wetland basins are also generally not feasible because of the lack of perennial water sources, and high maintenance requirements to prevent potential vector and aesthetic problems. Other measures, such as media filters, are generally infeasible due to their intensive capital, operation, and maintenance costs, especially given the relatively low water quality benefit the investment provides. Such special-use BMPs may be appropriate, however, where there is significant pollutant loading (such as transportation facilities or industrial sites) and where capital, operation, and maintenance funding are more available.

Table 9 BMP Siting and Design – Community and Environmental Factors

BMP	Maintenance Effort	Community Acceptance	Relative Cost*	Habitat Value	Other
Extended Detention	Low	Low	Low	Low	
Wet Basin	Low	High	High	High	High Pond Premium
Constructed Wetland	Medium	Medium	Medium	High	Shallow depth
Infiltration Trench	High	High	Medium	Low	Avoid Large Stone
Infiltration Basin	High	Low	Medium	Low	Frequent Pooling
Media Filter	Medium	Medium	High	Low	Minimize Concrete
Bioretention	Low	Medium	Medium	Low	Landscaping
Swale	Low	High	Medium	Low	

** With respect to drainage area served. Barrett. M.E. (1999). Caltrans Report: Initial Assessment of Storm Water Treatment Methods.*

Table 10 BMP Siting and Design – Physical Constraints

BMP	Soils	Water Table Depth	Drainage Area	Site Slope	Available Hydraulic Head	Ultra-Urban Areas
Extended Detention	Soil Type A may require pond liner; Soil Type B may require testing	> 2 ft	> 10 ac*	< 15%	6 - 8 ft	Not Practical
Wet basin	Soil Type A and B may require liner	> 2 ft if hotspot or aquifer	> 25 ac*	< 8%	3 - 5 ft	Not Practical
Constructed Wetland			> 25 ac			
Infiltration Trench	Infiltration > 0.50 inch/hr	> 6 ft	< 5 ac	< 15%	1 ft	Possible
Infiltration Basin			< 10 ac		3 ft	Not Practical
Bioretention	Made Soil	> 2 ft	< 2 ac **	< 4%	5 ft	Not Practical
Biofilter	Made Soil		< 5 ac		3 - 5 ft	
Grassy Swale	Made Soil	> 2 ft	< 5 ac	< 4%	3 - 5 ft	Not Practical

*Notes: * Smaller drainage areas possible if adequate water balance and anti-clogging outlet included. ** Drainage area can be larger in some instances. Source: Schueler et al (1998).*

4 LAND USE AND STORM WATER POLLUTION

The following is a discussion of the potential impact on water quality resulting from three major land use types found in the Otay River watershed:

- Residential;
- Commercial/Industrial; and
- Agriculture.

Open space/recreational is also a major land use type in the watershed. However, the focus of this memorandum is on areas considered developed (residential, commercial, industrial) and in agricultural use because these land uses comprise the primary contributors to water quality degradation.

This section primarily relied on information provided in Schueler, et al. (1998) and CASQA, 2003a-2003d.

4.1 RESIDENTIAL – RURAL, SINGLE, FAMILY, MULTI-FAMILY/APARTMENTS

Common storm water pollutants generated from residential land use include nutrients (from fertilizers, gutter cleaning, or lawn clippings), detergents (from car washing activities), sediment (from construction), oils and greases (from car maintenance activities), paint or other chemicals (from power washing or dumping of paint or household chemicals), and trash. In addition, water can be carried to local drainages by excessive landscape irrigation, broken irrigation lines, or car washing activities occurring during dry summer months. Dry season flows tend to deliver concentrated amounts of nutrients, chemicals, oils and greases, and sediment that have accumulated on impervious surfaces, such as roads, to drainages. Consequently, small pulses of contaminants during the dry season can impact water quality and aquatic habitat more than during winter months, when higher

flows can dilute contaminant concentrations. Pollutants from residential sources increase with the number of residents and vehicles and impervious surface area.

4.2 COMMERCIAL, INDUSTRIAL, TRANSPORTATION FACILITIES

Commercial, industrial, and transportation facilities have the potential to produce the largest quantity of storm water contamination within a watershed. This is due to the high number and frequency of vehicle use, operation of machinery and large equipment, and corresponding high quantity of storm water pollutants. Facilities in this category can include: auto repair facilities, industrial car washing facilities, shopping centers with large parking lots, bus depots, gas stations, and golf courses. Storm water pollutants from these many of these facilities are similar to those from residential uses, but oil and grease and other chemicals are the major pollutants. However, golf courses tend to discharge high concentrations of nutrients and sediment, as opposed to oil and grease.

4.3 AGRICULTURAL

Agricultural activities, such as cattle and horse grazing, row crops, and orchards, heavily impact the landscape through grading, soil compaction, and physical degradation to stream banks/beds either through direct erosional disturbance or more indirect channel incision processes. Major storm water pollutants generated by agricultural activities are sediment, nutrients, and pesticides. Particularly for grazed land, high soil erosion from overgrazing can introduce large quantities of fine sediment to local drainages with the potential for conveyance downstream. Furthermore, soil compaction tends to reduce infiltration, increasing surface runoff and peak channel flows, which can destabilize the channel and further increase loadings/deposition downstream. Nitrogen, phosphorus, and pesticides are commonly applied to row crops and orchards to enhance crop production and prevent damage from insects and disease. When applied in excess, these contaminants dissolve in runoff water and are transported through the drainage network, resulting in water quality and habitat degradation.

5 RECOMMENDED STORM WATER BMPS BY LAND USE TYPE FOR OTAY

A two-tiered approach was used to identify the most appropriate or applicable BMPs for this watershed. First, the general types of BMPs listed in documents such as San Diego County's SUSMP and the City of San Diego Water Department's Guidelines provided an initial list. Second, the general list was refined based on general assumptions of the soils and hydrology of the Otay River watershed and the San Diego region, and general feasibility based on factors such as implementation costs and effectiveness with respect to constituents of concern.

The most applicable storm water BMPs for the Otay River watershed are:

- Extended Detention Basins
- Biofiltration Strips and Swales
- Storm water Separators (Commercial and Industrial Areas)
- Catch Basin Filter Inserts/Curb Inlet Baskets
- Non-Structural BMPs

Excluding infiltration practices, wet retention ponds, wetland basins, and other BMPs does not mean they cannot be applied on the Otay River watershed, given suitable circumstances or in special cases. In particular, infiltration practices would not be appropriate for many of the eastern portions of the watershed due to land use, topography, and hydrologic characteristics. Infiltration, as a BMP, is an appropriate practice in valley/floodplain or perched valley areas of the eastern watershed, where reduction of surface storm water through increases to groundwater storage is possible and favorable. However, significant opportunities for such infiltration in the eastern watershed may be constrained

and may be better focused in the lower western watershed due to topographic, soil, and geologic conditions. These measures have not been included as part of this watershed planning-level analysis given that their widespread use is unlikely given the general constraints on the watershed. However, future revisions would provide the opportunity to refine and assess the application of BMPs to specific regions of the subbasin.

Considering these factors, the following is a list of the most appropriate storm water BMPs for various land use types, given the general site constraints encountered in the Otay River watershed. Table 11, on the following page, provides a more generalized matrix of land use type and applicable (though not necessarily the most appropriate) storm water BMPs.

Residential - Single Family

- Extended Detention Basins
- Biofiltration Swales/Strips
- Drain Inlet Inserts/Curb Inlet Baskets

Residential – Rural Residential ("Ranchettes")

- Extended Detention Basins
- Biofiltration Swales/Strips

Residential - Multi-Family/Apartments

- Extended Detention Basins
- Biofiltration Swales/Strips
- Drain Inlet Inserts/Curb Inlet Baskets

Commercial

- Extended Detention Basins
- Drain Inlet Filter Inserts
- Curb Inlet Baskets
- Biofiltration Swales/Strips
- Oil/Water Separators

Industrial

- Extended Detention Basins
- Drain Inlet Inserts/Curb Inlet Baskets
- Biofiltration Swales/Strips
- Oil/Water Separators

Institutional (Schools/Parks)

- Extended Detention Basins
- Drain Inlet Inserts/Curb Inlet Baskets
- Biofiltration Swales
- Oil/Water Separators

Transportation Facilities

- Extended Detention Basins
- Biofiltration Swales/Strips
- Oil/Water Separators
- Special-Use BMPs (e.g., Sand Filters)

Agriculture

- Biofiltration Swales and Strips
- Pesticide and Fertilizer Management (Source Control)
- Policy Measures (Source Control)

Open Space Areas

- Grazing Management (Source Control)
- Policy Measures (Source Control)

Table 11 Appropriate BMPs by Land Use

Land Use	Unlined Extended Detention Basin	Bio-Swales	Bio-Strips	Filter Inserts	Storm Water Separation	Oil-Water Separation	Education (Non-Structural)	Policy (Non-Structural)	Austin Sand Filter	Concrete-Lined EDB	Wet Basins	Infiltration Practices
Agriculture	0	1	1	0	0	0	1	1	0	0	0	1
Commercial	1	1	1	1	1	1	1	1	0	1	1	1
Industrial	1	1	1	1	1	1	1	1	1	1	1	1
Residential (Low Density)	1	1	1	1	1	0	1	1	0	1	1	1
Residential (High Density)	1	1	1	1	1	0	1	1	0	1	1	1
Institutional - Public Facilities	1	1	1	1	1	0	1	1	0	1	1	1
Institutional - Public Utilities	1	1	1	1	0	0	1	1	0	1	1	1
Recreation/Open Space	0	1	1	0	0	0	1	1	0	0	1	1
Institutional - School	1	1	1	1	1	0	1	1	0	1	1	1
Transportation	1	1	1	1	1	1	1	1	1	1	1	1

Key: *1 = Appropriate; 0 = Not Appropriate*

6 BMP ANALYSIS AND DECISION SUPPORT TOOL (PLOAD)

As part of this assessment, a modified PLOAD model, developed by the Otay River Watershed Management Plan Project Team (Aqua Terra Consultants 2005), was utilized to evaluate the effectiveness of BMPs in the Otay River watershed. This model calculates annual nonpoint (diffuse) pollutant loads using the USEPA Simple Method, an empirical approach developed for estimating pollutant export from urban development. The USEPA Simple Method employs runoff coefficients and event mean concentrations (EMCs) to calculate the annual loads (USEPA 2001b), and is endorsed by the USEPA as a viable screening tool for NPDES storm water projects. More specifically, the model utilized PLOAD, a GIS-based tool within the USEPA BASINS model (USEPA 2001a), to apply the USEPA Simple Method to estimate annual loads for specified pollutants within each subbasin in the Otay River watershed.

The model first estimated existing annual diffuse source pollutant loading based on current land uses in the Otay River watershed. The pollutant loading assessment subdivided the Otay River watershed into 28 subbasin scale Planning Areas ranging in size from 815 to 6,725 acres. These Planning Areas match the 9 subbasin areas discussed in the Planning Principles Report (Jones & Stokes 2005), but divide each subbasin into smaller units (these units are further described in Section 7, below). The analysis did not include point (discrete) sources, which are generally not present on the Otay River watershed.

The model was then used to evaluate and compare pollutant loads from current and future land uses and the pollutant removal effectiveness of various BMPs applied to future land uses. Only structural BMPs were evaluated in the PLOAD tool due to their quantifiable impact on water quality, as opposed to the variable impact of non-structural BMPs, such as education and unenforced policies.

The analysis evaluated a total of 5 BMP types and the removal efficiency of 13 constituents, as shown in Table 12 on the following page. However, as mentioned previously, Austin sand filters, concrete-lined detention basins, infiltration practices, and wet basins are generally not practical for application in the Otay River watershed. To assess the effectiveness of BMPs throughout the watershed, input tables were created that incorporated the appropriate suite of BMPs applicable for the land use type (Table 11) and the area of planned land use by type (Table 13). The BMPs were applied to each Planning Area according to common practice of BMP installation, appropriateness for the Otay River watershed, and the quantity of land use by type. As such, all of the BMPs were not always applied to each Planning Area, and the BMPs were applied to the total area of land use, existing plus planned use. The model then calculated the constituent removal efficiency based on the area of future land uses and appropriate application of BMPs. In this way the model was used to evaluate how a tailored list of specific BMPs could be effective in reducing storm water pollution at the scale of subbasin Planning Areas.

The model output consisted of the total constituent loads for each Planning Area at full build-out with and without application of BMPs. The percentage of constituent reduction for each Planning Area is shown in Table 14. Of the 13 constituents analyzed by the model, this discussion considers a subset of these constituents (total suspended solids; total dissolved solids; total nitrogen; total phosphorus; copper; zinc; lead; and oil and grease). Total forms of nitrogen and phosphorus are the primary indicators of the status of nutrients in the water. Figures 4a through 4i show removal effectiveness of these pollutant categories based on the BMPs applied to future land uses, as produced by the PLOAD model. According to the results, the largest reduction in pollutant loading rate was seen in oil and grease and metals (copper, zinc, and lead) where the removal rate averaged between 20 and 30%. Particularly in Planning Areas where many roads exist or are planned, implementation of BMPs was predicted to have the greatest impact on removal of heavy metals and oil and grease.

Table 12 Removal Efficiency for Applicable BMPs

Constituent	BMP Removal Efficiency (%)										
	EDB (Unlined)	Bio-Swales	Bio-Strips	Storm Water Separation[3]	Filter Inserts[3]	Infiltration Practices[1]	Education[2]	Policy[2]	Austin Sand Filter	Concrete-Lined EDB	Wet Basins
Biochemical Oxygen Demand (BOD_5) [4]	25	30	30	20	30	100	20	30	70	20	35
Total Suspended Solids (TSS)	72	49	69	0	40	100	6	13	90	40	94
Total Dissolved Solids (TDS) [4]	35	30	30	10	20	100	10	10	25	25	60
Nitrate Nitrite Nitrogen (NO_2,NO_3) [4]	25	30	30	10	15	100	10	15	20	20	35
Ammonia Nitrogen (NH_3) [4]	15	35	35	10	20	100	10	20	35	10	20
Total Kjeldahl Nitrogen (TKN) [4,5]	17	31	35	10	19	100	10	30	53	16	27
Total Nitrogen (N) [4,5]	14	30	40	15	13	100	10	30	32	14	51
Ortho-Phosphate (PO_4) [4,5]	15	35	35	10	9	100	10	20	24	10	20
Total Phosphorus (P) [4,5]	39	50	50	15	17	100	10	20	39	16	60
Total Copper (Cu)	58	63	85	8	53	100	6	13	7	27	89
Total Zinc (Zn)	72	68	88	17	52	100	6	13	40	30	98
Total Lead (Pb)	73	77	72	11	51	100	6	13	61	54	91
Oil and Grease	18	51	59	34	52	100	0	0	31	11	38

Notes: *Data from Caltrans BMP Retrofit Pilot Program (2004), except: (1) Infiltration practices (which, by definition, remove all from surface water runoff by eliminating surface water runoff) and (2) non-structural measures (education and policy). (3) Stormwater separation and filter insert removal efficiency will vary by type, installation, and manufacturer. (4) Values derived from various sources, including EPA (1999), Winer (2000), and a brief literature review by Donigian (2005, personal communication). (5) Empirical results sometimes indicated negative removal efficiency for analyte. In these cases, removal efficiency has been set to be consistent with other similar species.*

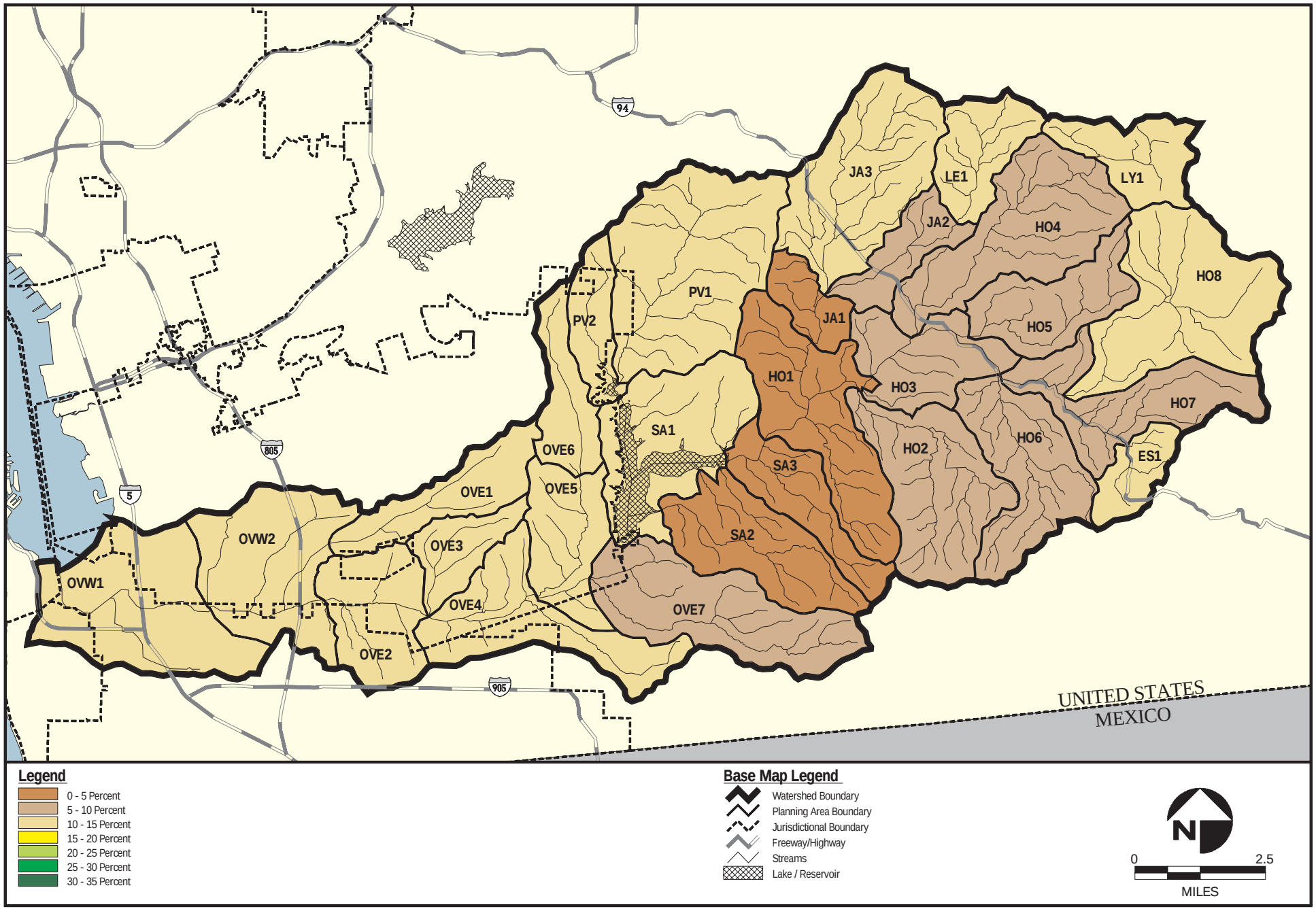
Table 13: Planned Land Use at Buildout (acres) by PLOAD Planning Area

Planning Area	Agriculture	Commercial	High Density Residential	Industrial	Low Density Residential	Public Facilities	Public Utilities	Recreation/ Open Space	Schools	Transportation	Grand Total
ES1					324.1	2.6	0.1	871.0		35.0	1232.8
HO1				22.3				4470.6		41.9	4534.9
HO2					238.6			4031.8		1.1	4271.6
HO3					238.9			2323.6		54.6	2617.1
HO4					388.7			4423.6		50.4	4862.7
HO5					246.6			2392.8		40.6	2679.9
HO6					316.2			3351.5		1.8	3669.6
HO7		0.6	1.9		71.8	2.2		3346.5		68.0	3491.1
HO8					1025.5	2.7		4478.3		96.5	5602.9
JA1			0.2		10.1			1133.1		7.5	1150.9
JA2	22.6				99.0		0.3	1433.0		14.4	1569.3
JA3	23.6	10.9	354.0		2357.5	14.1	8.8	2072.5	62.6	170.5	5074.6
LE1	5.6				668.5			1378.1		22.4	2074.6
LY1		2.7			481.3	5.9		1534.1		51.8	2075.8
OVE1		121.1	939.3	163.4		56.6	14.9	626.7	93.9	393.4	2409.4
OVE2		47.1	318.2	1049.3		37.8		1150.6		273.1	2876.1
OVE3			688.5	118.8		21.3	5.6	568.5		68.5	1471.2
OVE4		182.6	278.5	648.8		109.8	2.3	2309.7		237.8	3769.5
OVE5			481.6			546.4		1402.5		101.3	2531.8
OVE6		19.1	669.9	23.4		30.8	6.5	740.3	36.7	294.4	1821.1
OVE7				26.8		156.2	40.6	4567.0		4.0	4794.6
OVW1	7.5	321.7	1661.4	438.1		51.1	98.3	1767.7	204.6	889.1	5439.5
OVW2	19.2	197.8	2239.6	172.0		102.2	58.1	634.4	188.3	938.6	4550.1
PV1			808.3		773.0		23.0	4949.3		77.9	6631.4
PV2			512.8		44.1	1.9	6.6	896.0		36.3	1497.6
SA1		194.8	63.4		476.1	38.2		3581.8		108.4	4462.7
SA2								3490.0			3490.0
SA3				0.5				2200.0		67.1	2267.7
Grand Total	78.5	1098.4	9017.3	2663.3	7760.0	1179.9	265.1	66125.1	586.1	4146.4	92920.1

Table 14 PLOAD Results: Percent of Constituent Removal after BMP Application to Planned Land Uses by Planning Area.

Planning Area	Biological Oxygen Demand (BOD)	Total Suspended Solids (TSS)	Total Dissolved Solids (TDS)	Nitrate-Nitrite Nitrogen	Ammonia Nitrogen	Total Kjeldhal Nitrogen	Total Nitrogen	Orthophosphate Phosphorus	Total Phosphorus	Total Copper	Total Zinc	Total Lead	Oil and Grease
ES1	(11.86)	(6.31)	(7.28)	(4.96)	(9.02)	(8.81)	(7.61)	(8.99)	(13.45)	(31.12)	(25.82)	(27.20)	(25.62)
HO1	(4.73)	(1.94)	(2.14)	(0.97)	(3.04)	(2.69)	(1.78)	(2.80)	(4.49)	(8.12)	(14.06)	(13.24)	(20.52)
HO2	(5.66)	(1.34)	(1.88)	(1.17)	(2.85)	(2.95)	(2.11)	(3.49)	(4.38)	(19.18)	(6.74)	(11.00)	(11.45)
HO3	(8.76)	(3.15)	(4.42)	(2.57)	(5.98)	(5.84)	(4.52)	(6.55)	(9.56)	(24.66)	(19.76)	(21.65)	(23.91)
HO4	(7.75)	(2.34)	(3.43)	(1.99)	(4.84)	(4.81)	(3.58)	(5.56)	(7.81)	(23.21)	(15.64)	(18.73)	(21.62)
HO5	(8.48)	(2.81)	(4.04)	(2.35)	(5.57)	(5.48)	(4.18)	(6.22)	(8.92)	(24.50)	(18.10)	(20.64)	(23.02)
HO6	(7.28)	(1.78)	(2.66)	(1.63)	(3.95)	(4.06)	(2.95)	(4.71)	(6.08)	(23.23)	(9.58)	(14.82)	(14.69)
HO7	(5.96)	(2.16)	(3.05)	(1.59)	(4.31)	(4.02)	(2.93)	(4.80)	(7.19)	(16.21)	(16.81)	(17.98)	(23.14)
HO8	(10.64)	(4.30)	(5.74)	(3.63)	(7.54)	(7.42)	(6.03)	(7.93)	(11.54)	(29.21)	(22.08)	(24.65)	(24.30)
JA1	(2.93)	(1.14)	(1.41)	(100.00)	(2.01)	(1.92)	(1.38)	(2.53)	(3.67)	(9.16)	(8.93)	(10.51)	(17.39)
JA2	(7.26)	(4.34)	(3.74)	(100.00)	(5.82)	(4.76)	(3.97)	(5.29)	(8.36)	(22.21)	(15.88)	(20.13)	(21.09)
JA3	(13.26)	(12.55)	(9.47)	(100.00)	(10.42)	(10.13)	(9.73)	(9.36)	(14.63)	(29.24)	(28.84)	(28.36)	(26.30)
LE1	(12.15)	(6.69)	(7.53)	(5.32)	(9.45)	(9.20)	(8.01)	(9.53)	(14.23)	(32.53)	(25.67)	(28.76)	(24.68)
LY1	(11.59)	(5.67)	(6.82)	(4.52)	(8.57)	(8.37)	(7.08)	(8.55)	(12.72)	(30.45)	(24.71)	(26.35)	(25.41)
OVE1	(13.30)	(13.98)	(8.66)	(7.11)	(8.94)	(8.60)	(7.99)	(6.72)	(10.98)	(20.38)	(25.76)	(23.60)	(26.69)
OVE2	(13.71)	(14.50)	(8.44)	(6.41)	(8.64)	(8.25)	(6.89)	(5.56)	(9.25)	(21.67)	(24.55)	(23.21)	(26.97)
OVE3	(13.03)	(12.24)	(8.00)	(6.23)	(8.39)	(8.00)	(7.29)	(5.82)	(9.62)	(19.09)	(23.81)	(21.28)	(25.98)
OVE4	(13.48)	(12.79)	(8.04)	(5.63)	(8.45)	(8.01)	(6.55)	(5.39)	(9.06)	(21.06)	(24.33)	(22.88)	(26.85)
OVE5	(12.91)	(10.36)	(7.66)	(5.50)	(8.39)	(7.90)	(6.61)	(5.21)	(8.94)	(19.77)	(23.71)	(21.85)	(26.70)
OVE6	(13.00)	(12.45)	(8.50)	(6.86)	(9.00)	(8.62)	(8.22)	(7.14)	(11.64)	(20.13)	(26.29)	(23.75)	(26.52)
OVE7	(8.91)	(4.13)	(3.79)	(1.56)	(6.63)	(5.26)	(3.14)	(2.79)	(5.26)	(12.40)	(19.81)	(16.73)	(25.11)
OVW1	(13.39)	(14.26)	(8.70)	(7.04)	(9.00)	(8.65)	(7.91)	(6.74)	(10.98)	(20.77)	(26.07)	(24.01)	(26.83)
OVW2	(13.28)	(14.77)	(8.87)	(7.54)	(9.14)	(8.79)	(8.39)	(7.02)	(11.50)	(20.40)	(26.50)	(23.98)	(26.71)
PV1	(12.11)	(6.00)	(6.32)	(4.19)	(7.55)	(7.27)	(6.26)	(6.30)	(9.77)	(21.23)	(21.25)	(20.90)	(24.33)
PV2	(12.63)	(8.47)	(7.19)	(5.29)	(7.94)	(7.58)	(6.98)	(5.90)	(9.65)	(18.90)	(22.10)	(20.03)	(25.04)
SA1	(12.51)	(5.79)	(6.46)	(3.80)	(8.02)	(7.41)	(5.83)	(100.00)	(9.46)	(24.42)	(22.83)	(22.75)	(26.20)
SA2	(0.30)	(0.59)	(0.30)	(0.30)	(0.35)	(0.33)	(0.35)	(100.00)	(0.50)	(0.75)	(0.79)	(0.75)	(0.55)
SA3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(100.00)	0.00	0.00	0.00	0.00	0.00

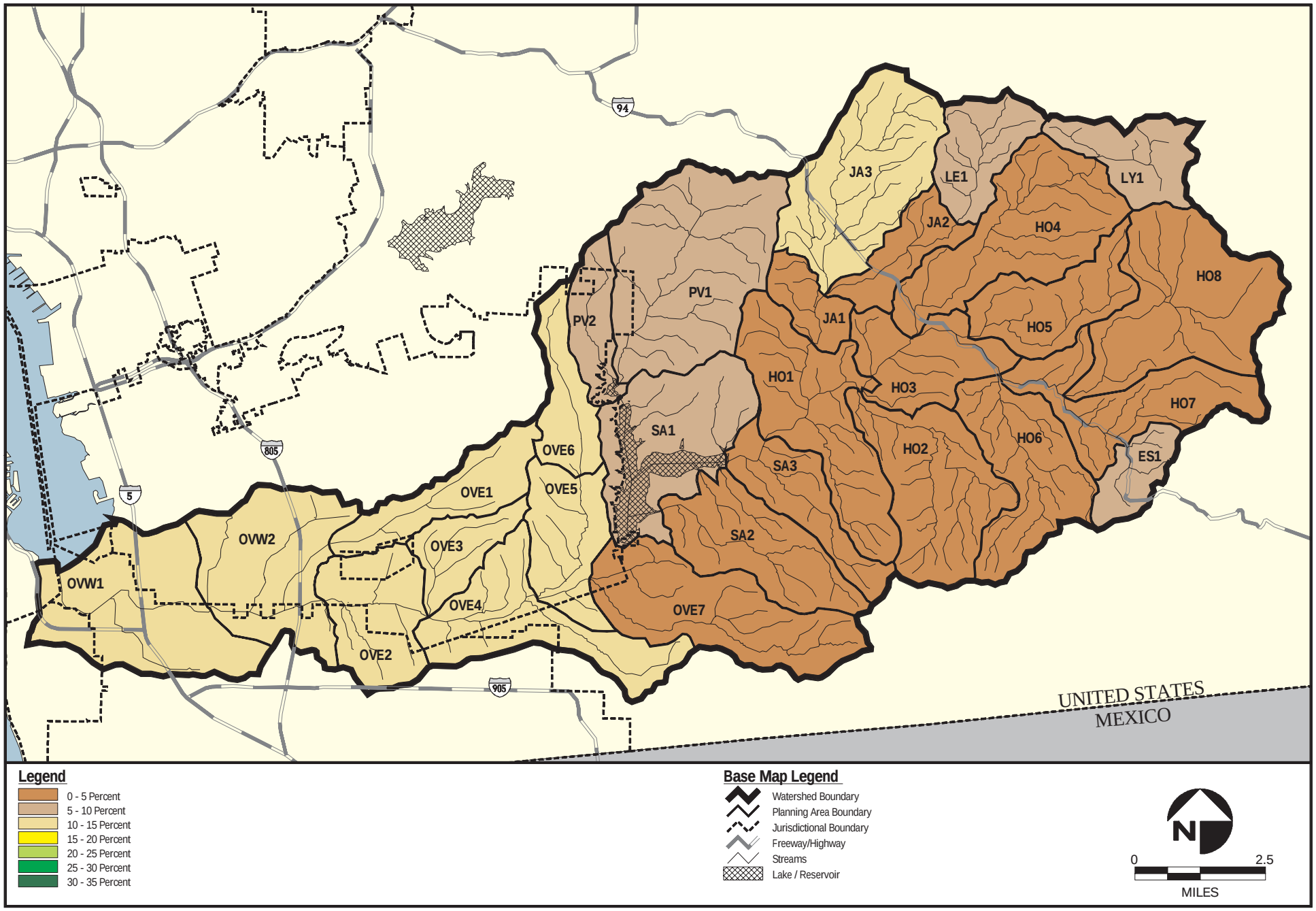
Numbers in parenthesis and red indicate the percent of constituent reduction in lbs/acre/yr.



TAIC

PLOAD for Buildout Scenario 1 with BMPs Applied:
Percent Reduction in Loading Rates for Biological Oxygen Demand - 5 Day (lbs/acre/year)

Figure 4a



TAIC

PLOAD for Buildout Scenario 1 with BMPs Applied:
Percent Reduction in Loading Rates for Total Suspended Solids (lbs/acre/year)

Figure 4b

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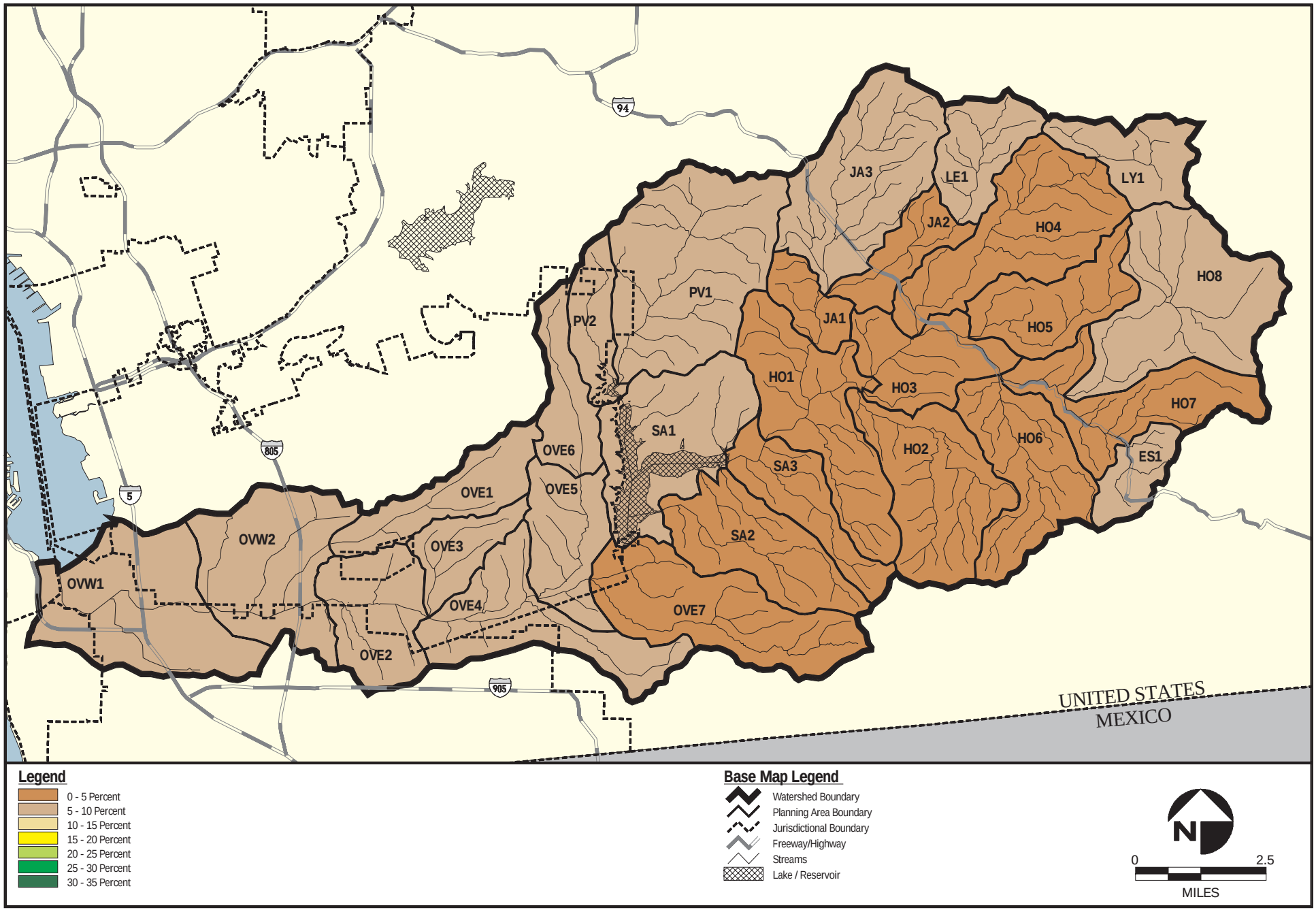
07/12/05



Legend

- 0 - 5 Percent
- 5 - 10 Percent
- 10 - 15 Percent
- 15 - 20 Percent
- 20 - 25 Percent
- 25 - 30 Percent
- 30 - 35 Percent

Base Map Legend

- Watershed Boundary
- Planning Area Boundary
- Jurisdictional Boundary
- Freeway/Highway
- Streams
- Lake / Reservoir

N

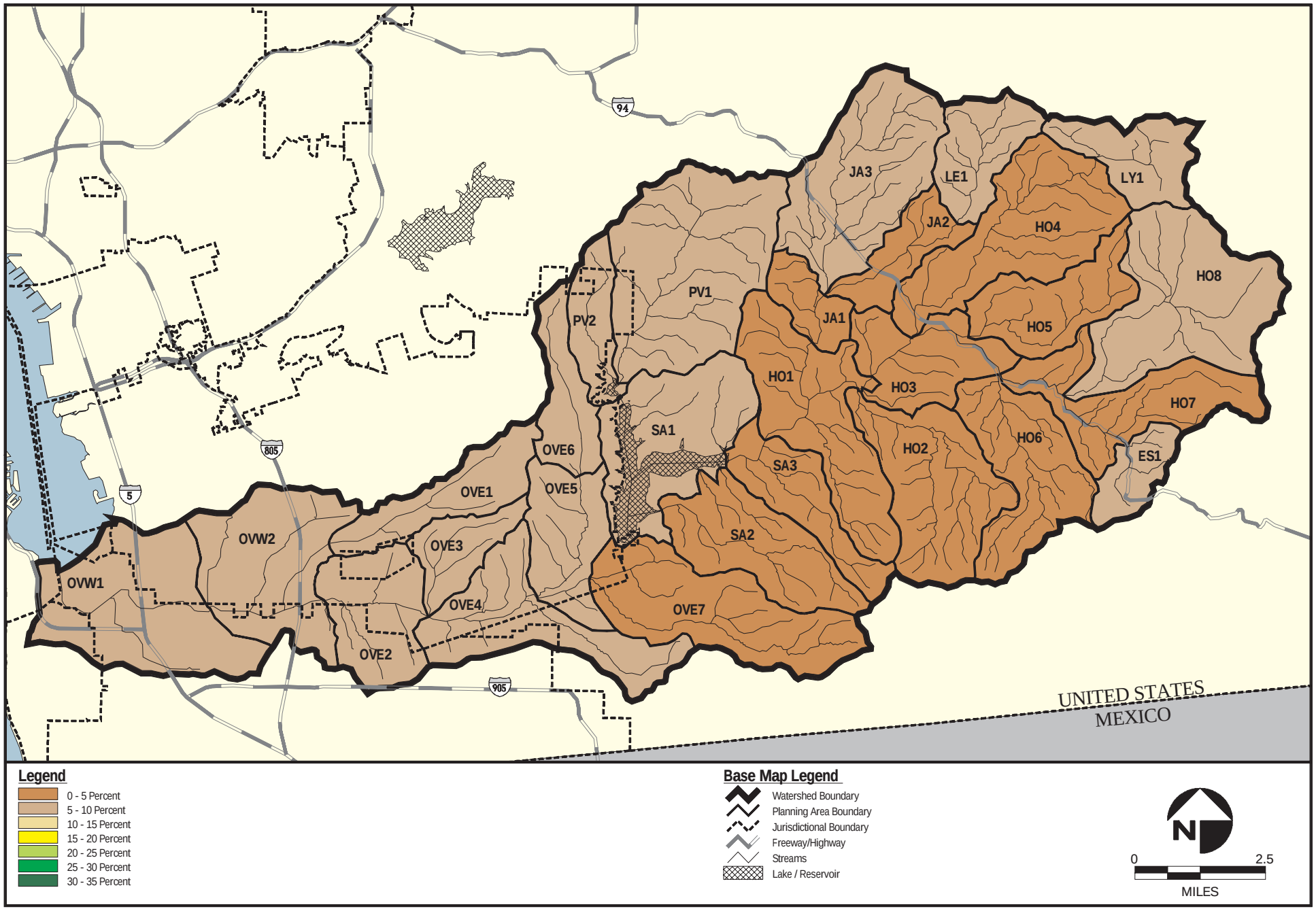
0 2.5

MILES

TAIC

PLOAD for Buildout Scenario 1 with BMPs Applied:
Percent Reduction in Loading Rates for Total Dissolved Solids (lbs/acre/year)

Figure 4c



TAIC

PLOAD for Buildout Scenario 1 with BMPs Applied:
Percent Reduction in Loading Rates for Total Nitrogen (lbs/acre/year)

Figure 4d

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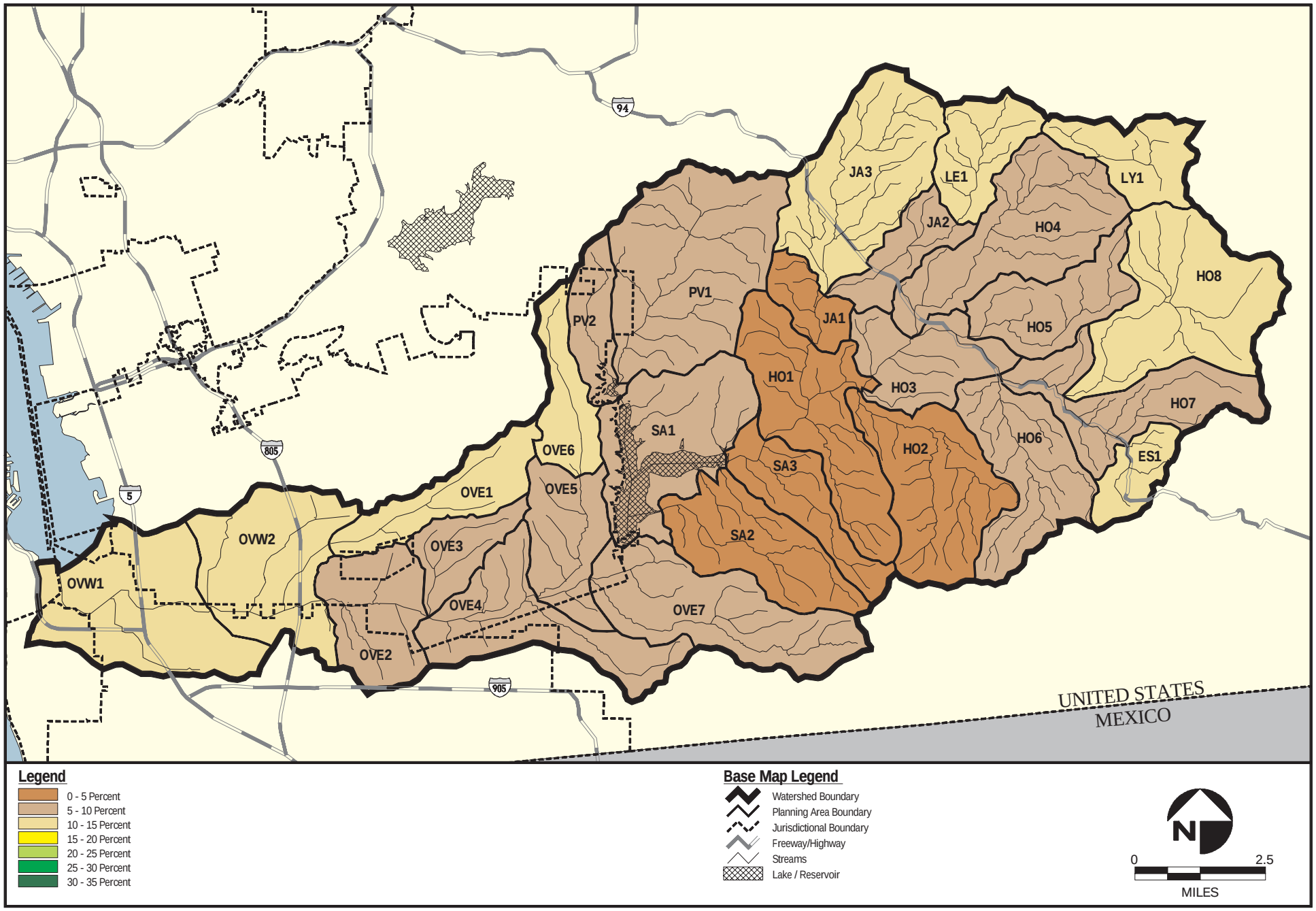
07/12/05



TAIC

PLOAD for Buildout Scenario 1 with BMPs Applied:
Percent Reduction in Loading Rates for Total Phosphate (lbs/acre/year)

Figure 4e

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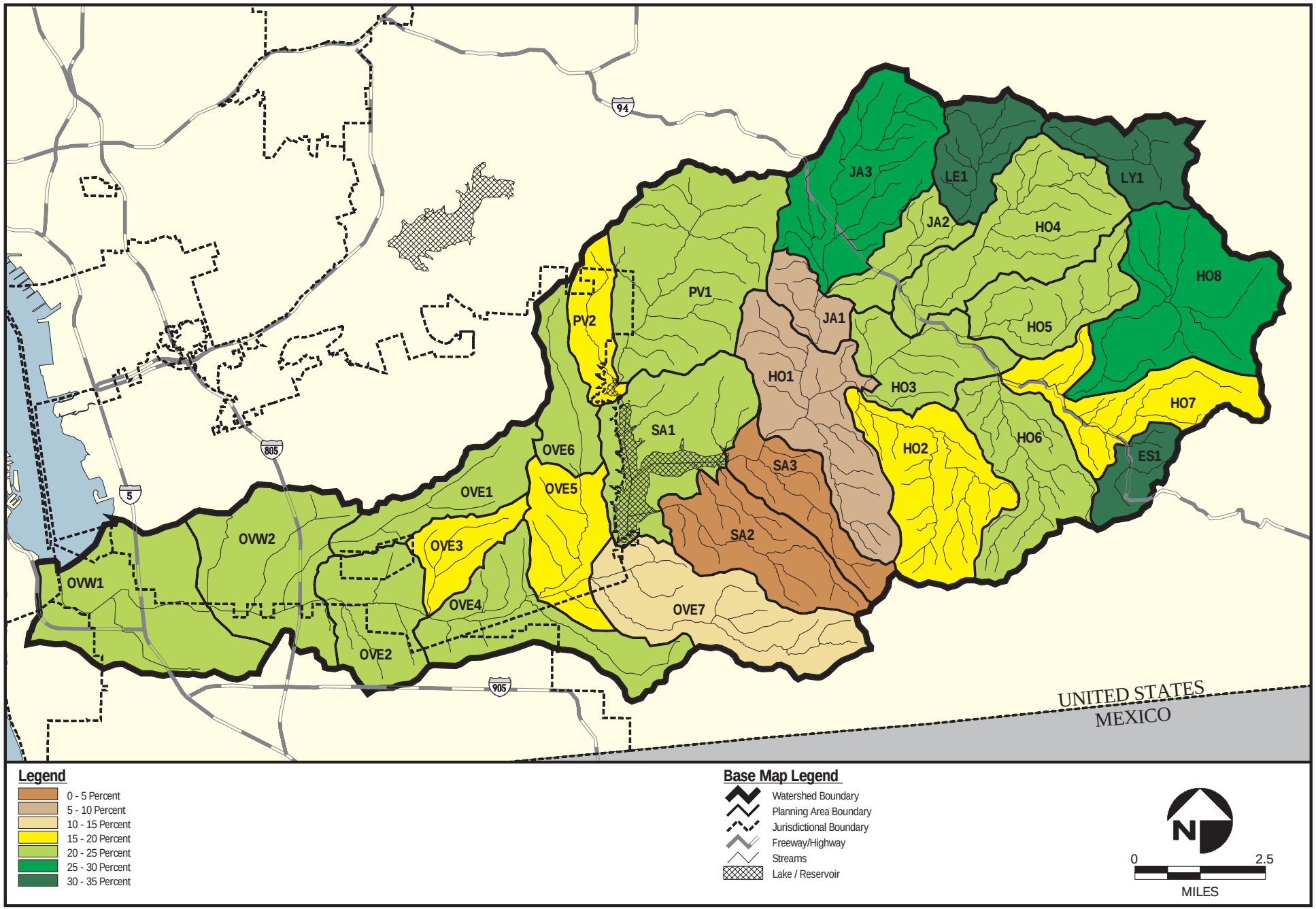
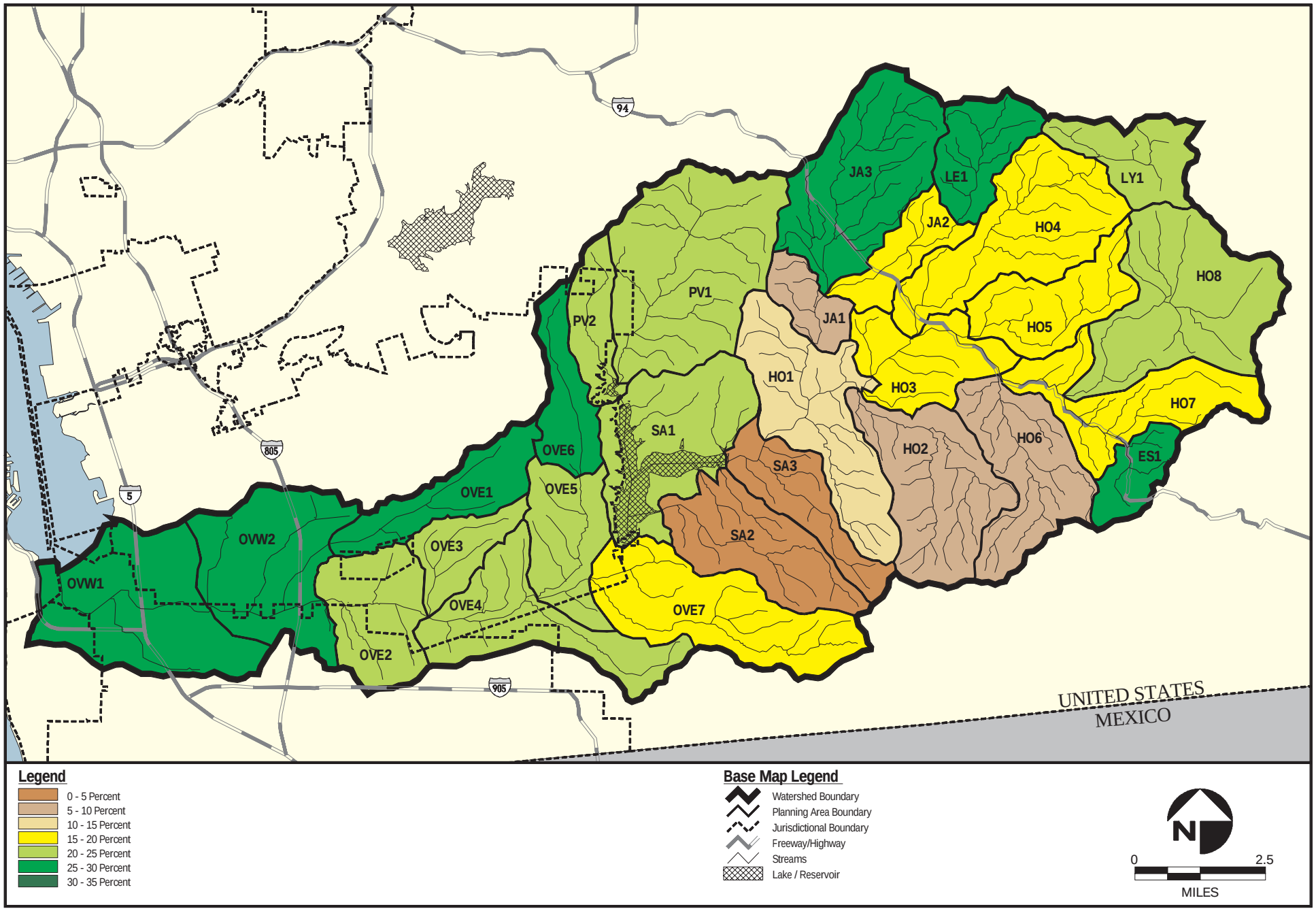
07/12/05



TAIC

PLOAD for Buildout Scenario 1 with BMPs Applied:
Percent Reduction in Loading Rates for Total Copper (lbs/acre/year)

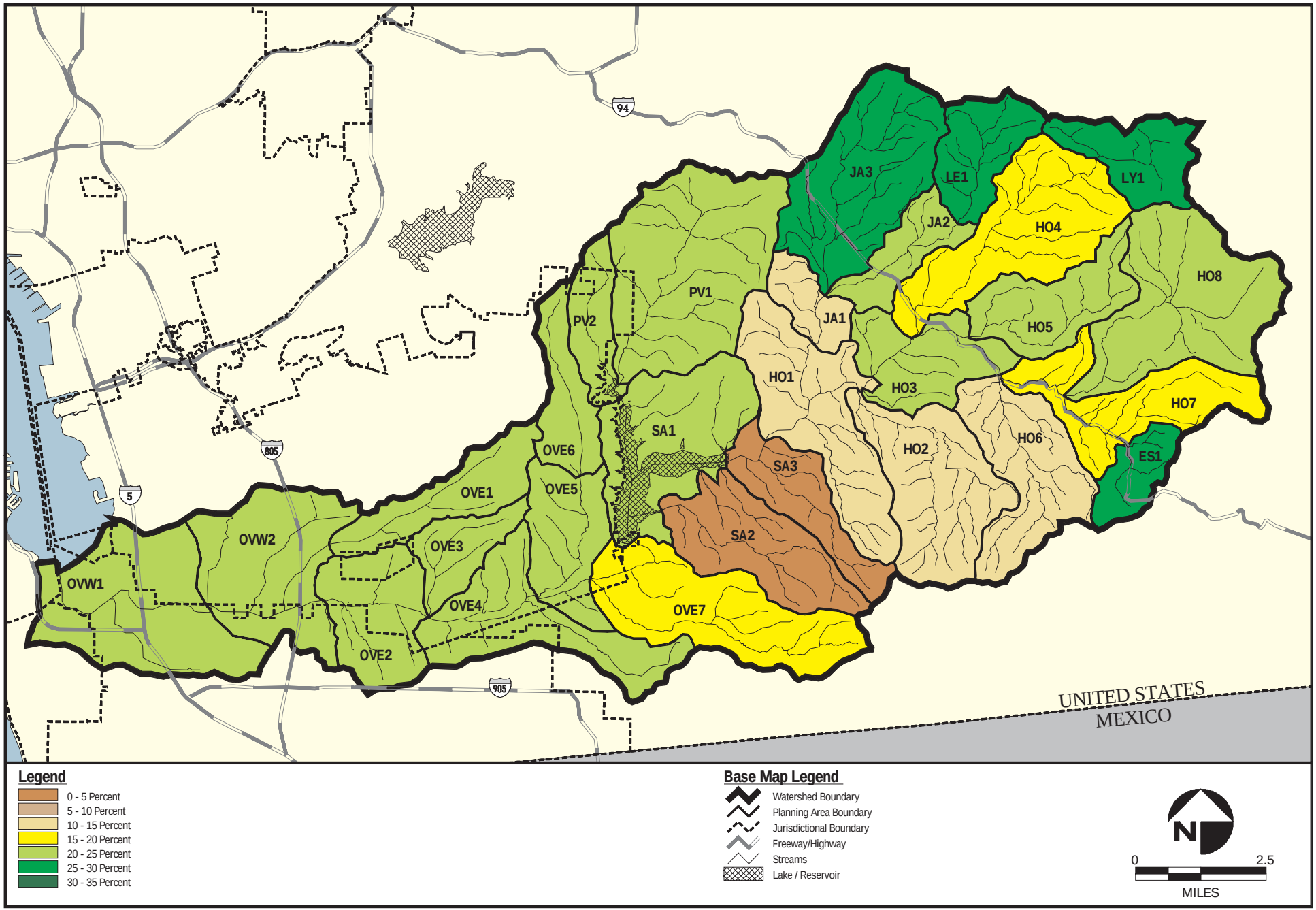
Figure 4f



TAIC

PLOAD for Buildout Scenario 1 with BMPs Applied:
Percent Reduction in Loading Rates for Total Zinc (lbs/acre/year)

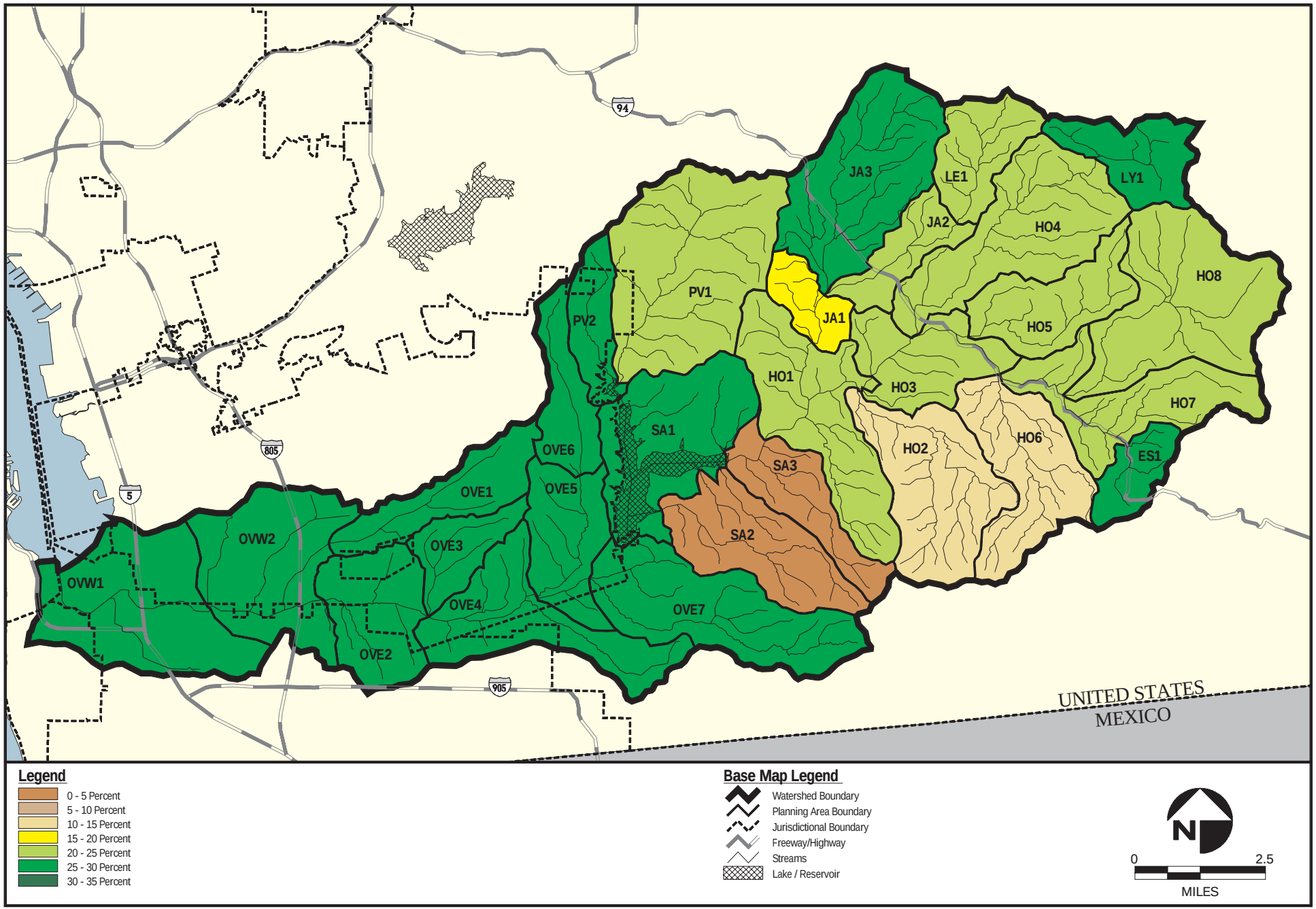
Figure 4g



TAIC

PLOAD for Buildout Scenario 1 with BMPs Applied:
Percent Reduction in Loading Rates for Total Lead (lbs/acre/year)

Figure 4h



TAIC

PLOAD for Buildout Scenario 1 with BMPs Applied:
Percent Reduction in Loading Rates for Oil/Grease (lbs/acre/year)

Figure 4i

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07/12/05

The level of detail offered in the PLOAD model does not allow for attribution of elevated pollutant loading to any specific land use or project. The results of the model generally corroborate the qualitative analysis of potential water quality stressors resulting from planned land use in the Otay River watershed (RBF Consulting, 2005).

7 STORM WATER BMP APPROACHES BY OTAY SUBBASINS

In this section, BMP approaches are evaluated for each of the nine Otay River watershed subbasins. The Otay River watershed is divided into the following nine subbasins, while the specific nested PLOAD Planning Areas are listed in parenthesis:

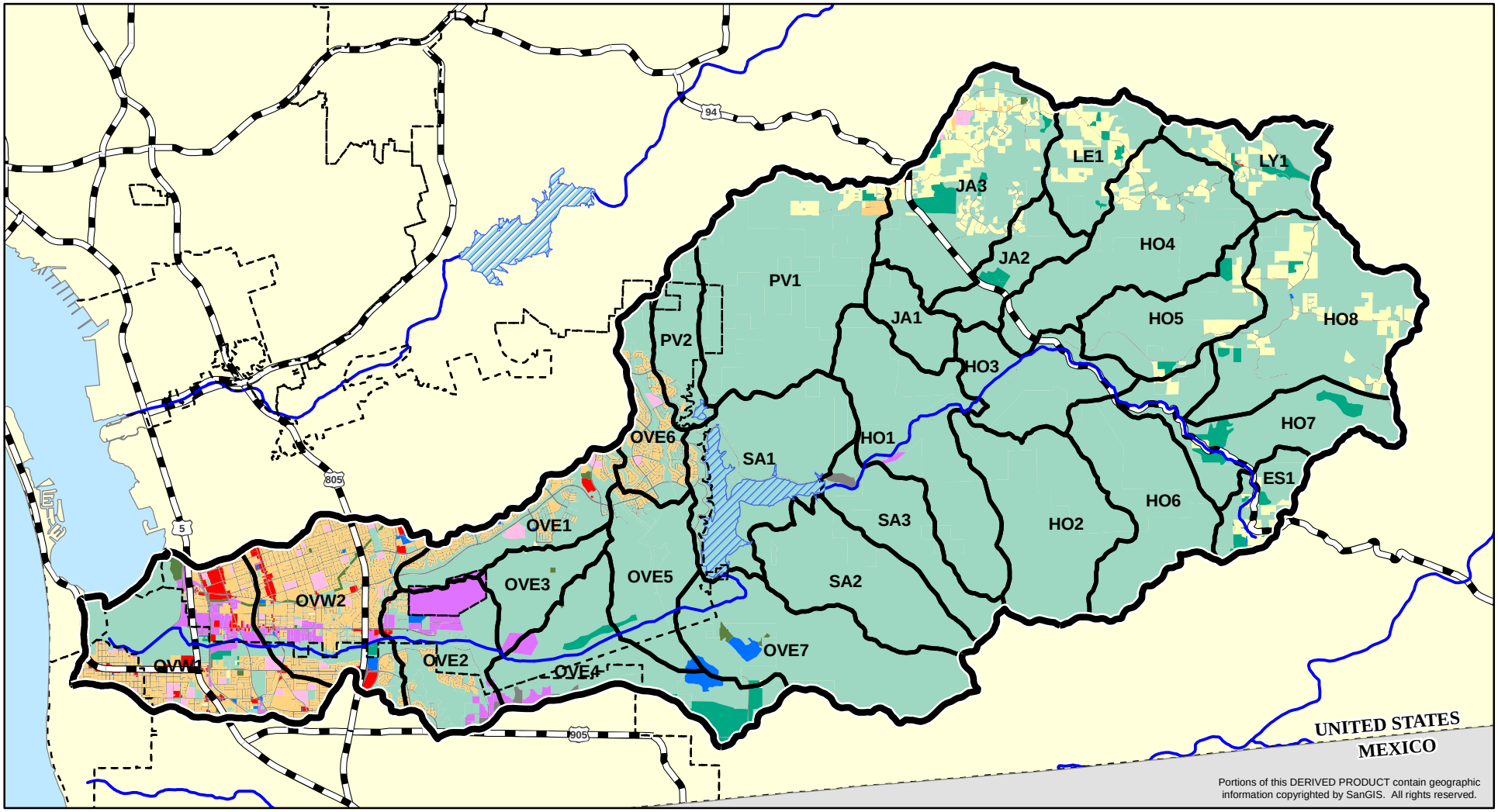
1. Proctor Valley Subbasin (PV1 and PV2).
2. Jamul Creek Subbasin (JA1 – JA3).
3. Lee Subbasin (LE1).
4. Hollenbeck Subbasin (HO1 – HO8).
5. Lyon Subbasin (LY1).
6. Engineer Springs Subbasin (ES1).
7. Savage Subbasin (SA1 – SA3).
8. Otay Valley East Subbasin (OVE1 – OVE7).
9. Otay Valley West Subbasin (OVW1 and OVW2).

In consideration of the BMPs and associated effectiveness discussed above, BMPs are recommended for each subbasin based on subbasin characteristics, discussed in the Otay River Watershed Special Area Management Plan Draft Planning Principles Report (Jones & Stokes, 2005), and the appropriateness of the BMP type, discussed in Sections 3, 4, and 5 above. The location of existing and planned land use types for the PLOAD planning areas are shown in Figures 5a and 5b, respectively. It is important to note that while PLOAD results were used to evaluate how pollutant reductions could occur with the application of BMPs, the quantifiable reduction in pollutant from PLOAD is a general indicator. Specific BMPs would be designed, located, and sized for the most appropriate and effective usage. Under such conditions, the pollutant-reducing ability of BMPs might exceed the sensitivity of the PLOAD tool. Such a design-specific efficacy is not available at this scale of subbasin analysis. That being said, the PLOAD tool provided a useful methodology to quantitatively evaluate BMP applications. The PLOAD results in conjunction with a baseline understanding of subbasin conditions was used in the assessment below.

7.1 PROCTOR VALLEY SUBBASIN

Planned development for the Proctor Valley subbasin includes multiple family, single family, and spaced rural residential housing. Development is planned in upper and central areas of the subbasin and within the lower southern San Miguel Mountain drainage. However, the majority of land use in the subbasin is open space, protected by existing or planned preserves.

Properly designed and implemented non-structural BMPs incorporated into development projects could provide the most protection for natural resources. Structural BMPs listed for residential land use (extended detention basins, biofiltration swales and strips, filter inserts, and storm water infiltration) could assist in further resource protection during/after build-out. Biofiltration strips would be particularly effective where



Legend

- Agriculture
- Commercial
- Light Industrial
- Low Density Residential
- Medium/High Density Residential
- Public Facility
- Public Utility
- Recreation/Open Space
- Schools
- Transportation

Basemap Legend

- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes
- PLOAD Planning Areas

N
W E
S

Miles
0 1.25 2.5

Map Notes
Date Created: July 7, 2005
File Ref: t:\projects\otay_final\plots\figures\PLOAD Land Uses.mxd

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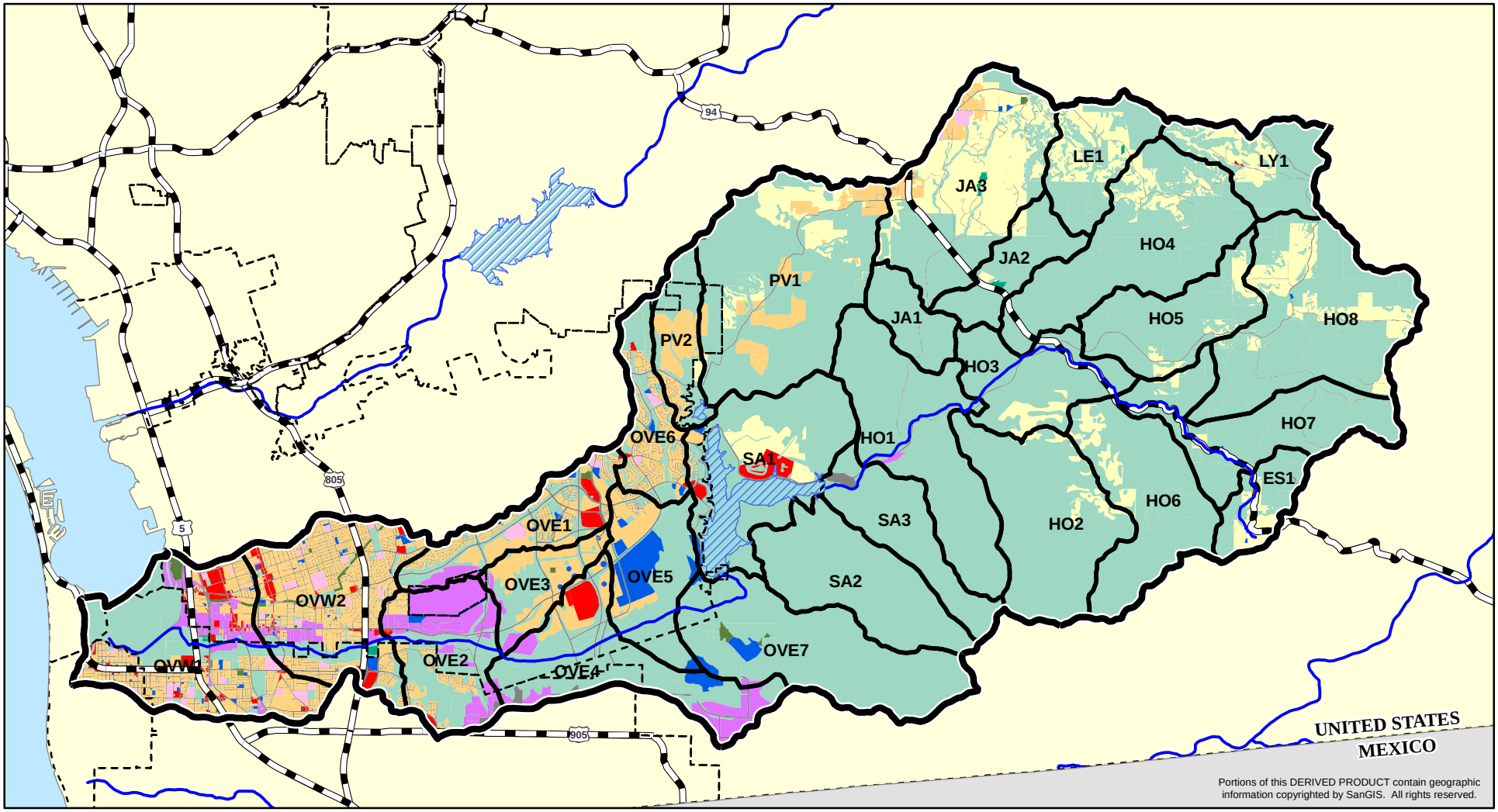
PLOAD Land Use Categories - Existing Land Use

Figure 5a



Legend

- Agriculture
- Commercial
- Light Industrial
- Low Density Residential
- Medium/High Density Residential
- Public Facility
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- Recreation/Open Space
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Basemap Legend

- Otay River Watershed Boundary
- City Boundary
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N
W E
S

Miles
0 1.25 2.5

Map Notes
Date Created: July 7, 2005
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PLOAD Land Use Categories - Planned Land Use

Figure 5b

development would occur in close proximity to streams. Filtration BMPs (swales and storm drain inserts) and detention basins have high pollutant removal efficiency when installed in areas with high impervious surface coverage (CASQA 2003a); thus, planned single and multiple family development in the mid and lower areas of the subbasin would most benefit from filtration BMPs and detention basins. In addition, storm flows tend to increase farther downstream; thus, use of detention basins is common to prevent flooding from areas with high impervious surfaces, such as residential, which produce large surface runoff flows.

Based on the planned land uses for the Proctor Valley subbasin, the PLOAD model estimated that application of BMPs would reduce the loading rate of suspended solids, nitrogen, phosphorus, and oil and grease by an average of 7%, 7%, 10%, and 25%, respectively, if implemented. Though a significant increase in residential housing is planned in this subbasin, the major land use type would remain as open space. Thus, in addition to BMPs, natural filtration process would reduce loading of these constituents. Also, implementation of non-structural policy BMPs would potentially increase load reductions in the upper subbasin, particularly in areas surrounding ranchettes.

7.2 JAMUL CREEK SUBBASIN

The majority of the upper half of this subbasin is planned for rural residential development, while the lower half will remain in open space. Though rural residential development does not substantially contribute hydrocarbon or nutrient pollutants to storm water runoff compared to runoff from dense residential developments, unpaved access roads in rural areas can substantially increase the quantity of sediment contained in storm water runoff; particularly within areas of severely erodible soils, as found in much of the Jamul Creek subbasin.

Development, implementation, and enforcement of policies for unpaved roadway designs and education and outreach would be highly effective non-structural BMPs to employ. Reducing road widths, ensuring proper runoff drainage, and limiting creek crossings can drastically reduce erosion, and thus fine sediment in storm water runoff. Secondarily, installation of biofiltration BMPs and extended detention basins would further reduce transport of fine sediment in storm water runoff, particularly in the upper subbasin. Additionally, stream setbacks would provide sediment and nutrient filtration to further protect habitat within open space lands in the lower subwatershed.

Planned residential development would comprise nearly 50% of the Jamul Creek subbasin, primarily occurring in Planning Area JA3. PLOAD estimated that implementation of BMPs in the subbasin would reduce annual loading rate of total suspended solids in Planning Area JA3 by 13 %. Similarly, the loading rate of total nitrogen and phosphorus would reduce by approximately 10% and 15%, respectively, the largest reduction rates compared to the rest of the watershed. Implementation of BMPs on Planning Areas JA1 and JA2 also resulted in reduction in pollutant loading rates. However, natural processes are perhaps more influential in open space lands than implementation of structural BMPs. Consequently, the reductions predicted by PLOAD for JA1 and JA2 were small in comparison to Planning Area JA3.

7.3 LEE VALLEY SUBBASIN

Similar to Jamul Creek subbasin, planned development for Lee Valley subbasin is identified as rural residential land use, which would occupy over 50% of the subbasin area. Due to the steepness of the topography (surrounding the Lee Valley) in this subbasin, and considering that this subbasin is really a headwater tributary to Jamul Creek subbasin, sediment is a key storm water pollutant for application of BMPs.

Application of non-structural BMPs, discussed for Jamul Creek above, can reduce erosion and sediment transport at the source. Proper roadway and drainage design may be the most effective BMPs in this steep

subbasin. Due to the steep topography of the subbasin, biofiltration BMPs would have to be substantially large to optimally capture and filter sediment during the high peak storm flows experienced in this subbasin. Likewise, extended detention basins would have to be sized to capture large quantities of flow in a short duration of time. This is reflected in the PLOAD results where implementation of structural BMPs would reduce the loading rate of TSS by 7%. Though the reduction of TSS would be small, BMPs would potentially reduce loading of nitrogen and phosphorus by 8 and 14%, respectively, large reductions similar to those predicted for Jamul Creek. Considering the topography and drainage network of this subbasin, a particularly important opportunity for sediment storage occurs at the southern end of Lee Valley, upstream of the bedrock narrows that lead to the downstream canyon into the Jamul subbasin. As discussed previously, structural BMPs can effectively remove nutrients in storm water runoff originating from residential land use. In addition to structural BMPs, employing non-structural BMPs during development design and through the life of the project would be effective for resource protection, particularly for areas downstream, and for existing land uses.

7.4 HOLLENBECK SUBBASIN

Over 90 percent of the Hollenbeck subbasin is undeveloped open space, half of which currently occur in preserve areas. Rural residential development is planned for the ridgeline between Sycamore and Cedar Canyons and within Bratton Valley. The majority of Sycamore and Cedar Canyons are within existing or planned preserve areas. These areas have the highest potential to experience adverse affects from development due to habitat fragmentation. Planned development in Bratton Valley would take place largely within perched valleys. Soils in Bratton Valley can be highly erosive. Though development within perched valleys is less erosive than development on surrounding slopes, installation of access roads leading from the canyon/valley to the perched valley entrance areas would provide a potentially significant avenue for water quality degradation down slope.

Non-structural BMPs, including policies designed to reduce road widths, minimize and cluster development, and restrict development on steep slopes, would be effective measures to protect and enhance existing resources in the subbasin, particularly in preserve areas. In addition, establishment of stream buffers would protect and enhance existing riparian habitat, springs and seeps, wetlands, and vernal pools from further degradation, particularly from sedimentation. To limit impacts from development on the hydrologic regime of the upper subbasin, use of bio-swales and bio-strips may be appropriate, particularly to capture runoff from roads and other areas with increased impervious surfaces.

Though a large number of new houses would be constructed within the Hollenbeck subbasin, the majority of the land use would be open space. Land use would be most threatening to water quality in Planning Area HO8, where land use would be similar to the Lee subbasin. PLOAD results for Planning Area HO8 predict small TSS loading reduction and larger reduction of nitrogen and phosphorus loading. As with Lee subbasin, the potential for pollutant reduction by structural BMPs in Bratton Valley is constrained by the high topographic setting of this perched valley. Pollutant loading from development on the ridge between Sycamore and Cedar canyons are predicted to be minimally reduced by implementation of structural BMPs, potentially because the surrounding open space and natural filtration mechanisms mask the removal effectiveness of BMPs. The Hollenbeck subbasin and areas downstream would benefit from non-structural BMPs, particularly those that would protect springs and seeps in headwater areas, such as setbacks. Implementation of structural BMPs would perhaps be most effective at removing nutrients and vehicle contaminants, particularly where development is concentrated and dense.

7.5 LYON SUBBASIN

The majority of the Lyon subbasin is undeveloped open space. Similar to Lee Valley, Lyon Valley Subbasin is a perched valley in the upper watershed and affords opportunities to store pollutants/sediments prior to their transport downstream through a steeper/narrower canyon. Rural residential development is planned for the western portions of the subbasin, mostly within the Lyon Valley. However, residences would be constructed atop ridgelines on the outer edges of the subbasin. Roads constructed to access ridgetop residences have the potential to greatly increase transport of sediment and other contaminants to downstream areas. The subbasin drains south to Hollenbeck Canyon. Consequently, degradation of water quality within the subbasin may in turn degrade water quality of Hollenbeck Creek.

Stream setback buffers surrounding aquatic resources would enhance habitat and filtration mechanisms to protect and improve water quality. In addition, detention basins strategically positioned to capture surface runoff would effectively trap sediment, nutrients, and other contaminants contained in runoff from roads and other impervious surfaces. However, as discussed for Lee subbasin, detention basins in this perched, very steep valley would have to be carefully designed and buffers would have to be very wide to properly function as stated above.

Results from the PLOAD model indicate that application of structural BMPs to the Lyon subbasin would moderately reduce the loading rate of nitrogen and phosphorus (approximately 7% and 13%, respectively), while they would reduce total suspended solids loading by approximately 5%. To ensure protection of water quality in Hollenbeck Creek and downstream areas, employing non-structural BMPs, such as education and setbacks, in addition to structural BMPs would be beneficial.

7.6 ENGINEER SPRINGS SUBBASIN

Similar to Lyon and Lee subbasins, the Engineer Springs subbasin is a perched valley surrounded by steep slopes. The subbasin drains to Dulzura Creek within the Hollenbeck subbasin. The majority of preserve areas are in the northeastern half of the subbasin, while most of the aquatic resources are found in the northwest and western portions of the subbasin. Agriculture and rural residential developments are currently established in the southern portion of the subbasin. Planned development would expand rural residences in the area surrounding Highway 94, encroaching on the primary aquatic resources in the subbasin. Due to the presence of well-drained soils and the location of this subbasin within the headwater area of the Hollenbeck subbasin and Otay River watershed, potential increase of impervious surfaces and resulting altered hydrologic regime may degrade water quality conditions within and downstream of the subbasin. Increased impervious surfaces in headwater valleys such as Engineer Springs cause more rapid runoff response to storm events and accentuate a short-term peak of storm flows moving downstream. These storm flows can be highly erosive and damaging to areas downstream.

Setback buffers would protect and enhance riparian habitat and water quality and would contribute to the natural aesthetics of the surrounding area. Extended detention basins and vegetated swales would help reduce the erosive potential of storm water runoff, thus reducing sedimentation farther downstream. This would be particularly effective at the northwestern portion of the subbasin, prior to entering the steeper Dulzura Canyon downstream. However, as with Lee and Lyon subbasins, detention basins and swales are not as effective in perched valleys where storm flows are short-lived, due to the steep topography. As such, the PLOAD results indicate that employing structural BMPs in the Engineer Springs subbasin would have a small impact on reducing the loading rate of TSS. Non-structural BMPs, such as setbacks and education, would potentially reduce TSS loading by encouraging source reduction and natural filtration processes. Because a major highway traverses the subbasin and a large percentage of the subbasin would be occupied by residential uses,

structural BMPs would be effective at reducing the loading rate of nitrogen, phosphorus, and oil and grease, as shown in the PLOAD results.

7.7 SAVAGE SUBBASIN

The Savage subbasin is located in the central Otay River watershed. This region is the transition point between the upper watershed to the east and the lower watershed to the west. The most prominent feature in this subbasin is the Otay Reservoir (i.e., considering the Upper and Lower Otay Reservoirs as one unit for this document). This reservoir is managed for potable water supply and flood control protection for the lower watershed. Surrounding the reservoir is a small area of medium-to-high density residential housing and a sports training facility. The majority of current land use in the subbasin is open space. Planned land use for this subbasin includes commercial, single and multiple family housing, some public facilities, and new roads. However, a large majority of the subbasin would remain in open space.

Setbacks and vegetated buffers surrounding the Otay Reservoir and tributaries could serve as an important method to reduce pollutant transport and benefit the water quality of the reservoir. In addition, setbacks and vegetated buffers could provide wildlife habitat and contribute to the natural aesthetics of the subbasin. Incorporation of vegetated swales and strips into the layout design of future housing developments would help reduce surface runoff and improve the quality of waters flowing to the reservoir. The new development would threaten to transport sediment, nutrients, and oil and grease into the reservoir through increased surface runoff from impervious surfaces. As shown in the PLOAD results from Planning Area SA1, where the majority of new development would occur, structural BMPs would moderately reduce the loading rate of nitrogen and phosphorus and minimally reduce the loading rate of TSS. Because the large majority of the Savage subbasin would continue to be occupied by open space, structural BMPs may be ineffective, in general. It is likely that close management and enforcement of non-structural BMPs would better protect the quality of resources in the Savage subbasin and the Otay Reservoir, compared to implementing structural BMPs.

7.8 OTAY VALLEY EAST SUBBASIN

This subbasin is located in the lower region of the watershed, where the land begins to flatten and the river channel widens to form a large floodplain. Because the Otay Reservoir captures and controls the majority of flows from the upper watershed, downstream flood flows are limited and do not typically engage the floodplain. Other changes to the hydrologic regime have also occurred, which allowed for increased urbanization. As a result, existing and planned land use in the subbasin includes medium-to-high density housing, industrial, commercial, and public facilities. The majority of the subbasin would be built-out, while open space uses would occupy a much smaller portion of the southern and eastern areas of the subbasin compared to existing conditions.

To protect and enhance the current level of riparian ecosystem functioning and water quality from high density residential and industrial land uses in this subbasin, creek setback BMPs would provide the potential for floodplain connectivity and flood storage during storm events. These natural floodplain areas would provide storage capacity for the additional runoff caused by increased impervious surfaces. In addition, vegetated swales and strips would allow for natural filtration of contaminants, such as sediment and oil and grease, from urban storm water runoff. Within build-out areas, storm water separation units and use of filter inserts would filter contaminants from areas where installation of bio-swales and strips is not possible.

Results from the PLOAD model indicate that implementation of structural BMPs in this subbasin would reduce the loading rate of TSS by approximately 11%, a sizeable amount compared to other subbasins in the watershed (Table 14). In addition, moderate reduction of nitrogen (7%) and phosphorus (9%) loading would

result. Because the majority of land use in this subbasin would be high density residential, industrial, and open space within a relatively flat region which experiences high flows from urban runoff, structural BMPs are perhaps the most effective method to reduce TSS loading. High loading of TSS would cause the most negative impact on flood control structures and riparian habitats in this subbasin. Non-structural BMPs, such as education, are increasingly important in fully built-out areas for protection of water quality from direct pollutant inputs, including leaking vehicles and trash.

7.9 OTAY VALLEY WEST

The majority of the Otay Valley West subbasin is currently urbanized, primarily high density residential housing and industrial land uses. However, the subbasin also contains the lower reach of the Otay River and its river mouth and estuary area. Hydrologic functioning of the lower region of the watershed has been greatly altered from natural conditions. As such, storm water events that carry water quality contaminants from urbanized areas have an increased effect on the Otay River preserve areas, Otay estuary, and San Diego Bay.

Opportunities to implement BMPs in an urbanized area primarily include modification and upgrading of the existing storm drainage network and enhancement of preserved open space areas. Installation of storm water separators and filter inserts, along with close management and maintenance of the storm drain network, can remove a large portion of urban contaminants from storm runoff. This is predicted by the PLOAD results for this subbasin. The largest percentage of TSS loading reduction in the watershed, approximately 15%, was estimated for this subbasin. The PLOAD model also estimated a sizeable reduction of nitrogen and phosphorus loading, 8 and 11%, respectively. Enforcement of non-structural BMPs and protection of areas along the river corridor and estuary could further improve the water quality of runoff waters.

8 CONCLUSIONS

As stated herein, implementation of BMPs, both structural and non-structural, are effective at reducing pollutants carried within storm water runoff from various land uses. In the Otay River watershed, the applicability and efficiency of BMPs varies according to the position in the watershed and the land use type. Non-structural BMPs, along with some structural BMPs, are perhaps most effective in protecting water quality within upper tributary areas. Lower in the watershed, where urban land uses dominate, use of structural BMPs, such as filter inserts, are perhaps the most effective for water quality protection BMPs. Data from PLOAD modeling of BMP effectiveness contributed to these general conclusions. Employment of BMPs can be important tools to protect and enhance existing natural resources from pollutants generated by existing and future developed areas.

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Appendix 5.
Funding Matrix

Appendix 5 - Otay River Watershed Management Plan
Summary of Potential Project Funding Sources*

Program Name	Agency	Type	Requirements: Eligibility	Requirements: Types of Projects	Requirements: Match required	Funds available	Processing Time	Strategy C.9.1.1 - Eradicate Non-Native Flora and Fauna	Strategy C.9.1.2 - Maintain, Enhance, and Restore Habitat Linkages	Strategy C.9.1.3 - Restore the Lower Otay River Floodplain	Strategy C.9.1.4 - Implement Setbacks or Buffers Around Aquatic Resources	Strategy C.9.1.5 - Remove Existing and Limit Future Trash and Debris	Strategy C.9.1.6 - Protect Drinking Water Quality in the Reservoirs	Strategy C.9.1.7 - Limit Directly Connected Impervious Surface Area	Strategy C.9.1.8 - Implement a Watershed-Wide Education Program	Strategy C.9.1.9 - Form a Watershed Council to Implement the ORWMP	Strategy C.9.2.1 - Retrofit Existing Developments to Protect Aquatic Resources	Strategy C.9.2.2 - Restore Urban Creeks	Strategy C.9.2.3 - Implement Agricultural Land BMPs to Protect Aquatic Resources	Strategy C.9.2.4 - Improve Existing and Create New Recreational Facilities	Strategy C.9.2.5 - Preserve, Enhance, Restore, Manage Tecate Cypress Forest and Oak Woodlands	Strategy C.9.3.1 - Preserve, Enhance, Restore Additional Parcels Within the Floodplain	Strategy C.9.3.2 - Preserve, Enhance, Restore Cultural Resources	Month of Deadline	Address
Habitat Conservation Fund	Calif. Dept. of Parks and Recreation	State	local govt	wetland/ upland/ riparian	100% non-state	grants	4-6 mo	X	X	X					X			X		X	X	X		Oct.	P.O. Box 942896 Sacramento, CA 94296-0001
Land and Water Conservation Fund Program	Calif. Dept. of Parks and Recreation	State	local govt	outdoor rec	100%	grants	4-6 mo					X								X			X	June	P.O. Box 942896 Sacramento, CA 94296-0001
Recreational Trails Program (Non-Motorized)	Calif. Dept. of Parks and Recreation	Federal	local govt, state, nonprofit.	outdoor rec	20%	grants	4-6 mo					X			X					X				Oct.	P.O. Box 942896 Sacramento, CA 94296-0001
Environmental Enhancement and Mitigation Program	California Resources Agency	State	public agency or nonprofit	any	preferred	grants to $250,000	No funds are available for Fiscal Year 2005/2006. Applications that are received will be reviewed for ranked in priority order for funding as it comes available.																	Nov.	1416 Ninth St., Suite 1311 Sacramento, CA 95814
Murray-Hayden Urban Parks and Youth Services Program	California State Parks	State	local govt, state, nonprofit.	outdoor rec	none	$46,000						X			X		X	X		X		X		Dec.	1416 Ninth St., Room 918 Sacramento, CA 95814
The Per Capita Grant Program	California State Parks	State	local govt, nonprofit	interpretive facilities	none	$326,000														X				July	1416 Ninth St., Room 918 Sacramento, CA 95814
Watershed Enhancement Program	Coastal Conservancy	State	local agencies, nonprofits	coastal watersheds	yes	up to $100,00		X	X	X		X	X					X		X		X		None	1330 Broadway, Suite 1100 Oakland, CA 94612
Wetlands Recovery Project - Work Plan	Coastal Conservancy	State	public, private groups	wetlands	match preferred	grants	2-6 mo		X	X			X					X				X		Feb.	1330 Broadway, Suite 1100 Oakland, CA 94612
Wetlands Recovery Project - Small Grants Program	Coastal Conservancy	Earth Island Institute	non-profit, local,	preservation or restoration of wetlands	none	grants		X	X			X			X			X				X			1330 Broadway, Suite 1100 Oakland, CA 94612
Bring Back the Natives	National Fish and Wildlife Foundation	Private	state, local, nonprofits	aquatic species benefits	yes	project grants		X			X	X			X			X							806 SW Broadway, Suite 750, Portland, OR 97205
Migratory Bird Conservancy	National Fish and Wildlife Foundation / Migratory Bird Conservancy	Private / Federal	community-based	wetlands	yes	grants		X	X	X												X			1875 Century Blvd., Suite 200, Atlanta, GA 30345
Native Plant Conservation Initiative	National Fish and Wildlife Foundation	Private	state, local, nonprofits	native plants	yes	project grants		X							X			X			X	X		Mar	1120 Connecticut Avenue, NW, Suite 900, Washington, DC 20036
NFWF Challenge Grants	National Fish and Wildlife Foundation	Private	state, local, nonprofits	fish and wildlife restoration	yes	avg. $25K-$75K	6 mo																	June and Oct.	1120 Connecticut Avenue, NW, Suite 900, Washington, DC 20036
Pulling Together Initiative	National Fish and Wildlife Foundation	Private	state, local, nonprofits	invasive species removal	yes	project grants	6 mo	X																Dec.	1120 Connecticut Avenue, NW, Suite 900, Washington, DC 20036
Rivers, Trails and Conservation Assistance Program - not a funding program but helpful for planning and implementation	National Parks Service	Federal	local community - based	trails and greenways	NA	NA	NA	X		X					X			X		X	X	X		July	14th and Independence Ave. S.W., Room 6019-5, Washington, DC 20013
Watershed Protection and Flood Prevention Program	Natural Resources Conservation Service	Federal	local govt	watershed management	aprox 75%	avg. $400,000		X		X	X			X			X	X	X			X			14th and Independence Ave. S.W., Room 6019-5, Washington, DC 20013
Community Based Restoration Program - Individual Program Grant	NOAA-Office of Habitat Conservation	Federal	public, private, nonprofits	habitat protection	yes	grants	4-mo																	Feb	1315 East-West Highway, Silver Spring, MD 20910
Community Based Habitat Restoration National and Regional Partnership Grant	NOAA-Office of Habitat Conservation and regional partners	Federal	state, local, private, non-profit	habitat restoration and education	unknown	grants				X															1025 Vermont Avenue, NW, Suite 720, Washington, DC 20005
Environmental Grants Program	Patagonia	Private	community-based			$3,000-$8,000						X			X			X				X		April and Aug.	P.O. Box 150, Ventura, CA 93002

Appendix 5 - Otay River Watershed Management Plan
Summary of Potential Project Funding Sources*

Program Name	Agency	Type	Requirements			Funds available	Processing Time	Strategy C.9.1.1 - Eradicate Non-Native Flora and Fauna	Strategy C.9.1.2 - Maintain, Enhance, and Restore Habitat Linkages	Strategy C.9.1.3 - Restore the Lower Otay River Floodplain	Strategy C.9.1.4 - Implement Setbacks or Buffers Around Aquatic Resources	Strategy C.9.1.5 - Remove Existing and Limit Future Trash and Debris	Strategy C.9.1.6 - Protect Drinking Water Quality in the Reservoirs	Strategy C.9.1.7 - Limit Directly Connected Impervious Surface Area	Strategy C.9.1.8 - Implement a Watershed-Wide Education Program	Strategy C.9.1.9 - Form a Watershed Council to Implement the ORWMP	Strategy C.9.2.1 - Retrofit Existing Developments to Protect Aquatic Resources	Strategy C.9.2.2 - Restore Urban Creeks	Strategy C.9.2.3 - Implement Agricultural Land BMPs to Protect Aquatic Resources	Strategy C.9.2.4 - Improve Existing and Create New Recreational Facilities	Strategy C.9.2.5 - Preserve, Enhance, Restore, Manage Tecate Cypress Forest and Oak Woodlands	Strategy C.9.3.1 - Preserve, Enhance, Restore Additional Parcels Within the Floodplain	Strategy C.9.3.2 - Preserve, Enhance, Restore Cultural Resources	Month of Deadline	Address
			Eligibility	Types of Projects	Match required																				
Integrated Regional Water Management Grant - Proposition 50	State Water Resources Control Board	State	public, nonprofits	planning and implementation of restoration projects	25% planning, 10% implementation	up to $500,000 planning and $50 million for implementation		X	X	X	X	X	X	X	X		X	X	X			X		July	1001 I Street, 16th Floor, Sacramento, CA 95814
Integrated Watershed Management Program - Proposition 40	State Water Resources Control Board	State	local, nonprofits	watershed management	for most	$2.6 billion/ bond		X		X	X		X	X	X	X	X	X	X			X		Feb.	1001 I Street, 16th Floor, Sacramento, CA 95814
Nonpoint Source Implementation Grant Program (sec. 319)	State Water Resources Control Board	State	public, private, nonprofits	nonpoint source pollution	yes	project grants				X			X				X	X	X			X		June	1001 I Street, 16th Floor, Sacramento, CA 95814
American Land Conservation Award	The Conservation Fund	Private	local govt, state, federal, nonprofit	conservation		$50,000	3 mo																	Jan - Jul	1800 North Kent Street. Suite 1120 Arlington, VA 922209
Kodak American Greenways Award Program	The Conservation Fund/Kodak Company/National Geographic Society	Federal/ Private	local govt, state, federal, nonprofit	outdoor rec, education, mapping	none	$2,500 per award									X					X				None	1800 North Kent Street. Suite 1120 Arlington, VA 922209
Coastal and Estuarine Land Conservation Program	NOAA-The Office of Ocean and Coastal Resource Management	Federal	state, local, nonprofits	protection, restoration, development	unknown	grants				X							X	X	X			X			N/ORM3 11th Floor SSMC4, 1305 East-West Highway, Silver Spring MD, 20910
Clean Water State Revolving Fund (CW-SRF)	U.S. Environmental Protection Agency http://restoration.nos.noaa.gov/	Federal	public, private groups	nonpoint source pollution		loans, must be repaid		X		X		X	X	X	X			X	X			X		None	75 Hawthorne St., San Francisco, CA 94105
Wetlands Program Development Grants - State and Tribal	U.S. Environmental Protection Agency - Regional Offices	Federal	state, tribal, local	restoration planning/not	25%	$50,000				X								X				X		April	75 Hawthorne St., San Francisco, CA 94105
Wetlands Pogram Development Grants - Non-profits	U.S. Environmental Protection Agency - Headquarters	Federal	public agency, nonprofits	wetland restoration planning/not implementation	25%	$50,000				X								X				X		April	75 Hawthorne St., San Francisco, CA 94105
Five Star Restoration Grant Program	Agency / National Fish and Wildlife Foundation	Federal	community-based	wetlands	yes	avg. $10,000		X							X			X						Mar	N.W., Suite 900, Washington, DC 20036
Watershed Assistance Grants	River Network/U.S. Environmental Protection Agency	Federal	any watershed group	watershed	none	project grants to $30,000	6 mo	X	X	X					X							X		July	1200 Pennsylvania Ave. NW., 4501T, Washington, DC 20460
Beaches Environmnetal Assessment and Coastal Health (BEACH)Act Grants	U.S. Environmental Protection Agency	Federal	community-based	watershed management	100%	avg. $250,000																X			1200 Pennsylvania Ave. NW., 4305, Washington, DC 20460
California Cultural and Historical Endowment Board	California State Library	State	local and nonprofit	cultural resources protection	none																		X	Oct.	900 N Street, Room 500, Sacramento, CA 95814
Sport Fish Restoration	U.S. Fish and Wildlife Service	Federal	State	restore sport fish populations	40%	avg. $4.8 millon	avg. 8 days			X								X						none	1849 C St., NW., Washington, DC 20240
Wildlife Restoration	U.S. Fish and Wildlife Service	Federal	State	habitat improvement	50%	avg. $2.75 million	avg. 8 days	X	X	X	X	X		X				X				X		none	1849 C St., NW., Washington, DC 20240
Coastal Program	U.S. Fish and Wildlife Service	Federal	public/ private lands	coastal watersheds	federal match	technical assistance		X		X	X	X		X				X				X			Carlsbad Office 2730 Loker Ave. West Carlsbad, CA 92008
National Coastal Wetlands Conservation Act	U.S. Fish and Wildlife Service	Federal	WCB and Coastal Conservancy	coastal wetlands	at least 25%	$1 million	6 mo	X		X	X	X		X				X				X		June	Carlsbad Office 2730 Loker Ave. West Carlsbad, CA 92008
North American Wetlands Conservation Act	U.S. Fish and Wildlife Service	Federal	public agency, nonprofits	wetland	100%	small and large grants	4 mo	X		X	X	X		X				X				X		Dec.	4401 North Fairfax Dr., Room 110; Arlington, VA 22203

**** The information provided on this chart provides a summary of the sources and funds that are available at the time of preparation of this plan. The purpose of this matrix is to provide an example of what is currently available. The exact amount of funds that would be available in the future would be dependent on a number of factors, such as the amount allocated to each of the federal sources by Congress or the condition of California's economy for State funding sources. In addition, the contact information could be different at that time. Cells were left blank if information was unknown or not available.***

Appendix 6.
Otay River Watershed Baseline Indicator Reports

WATER QUALITY INDICATORS FOR THE OTAY RIVER WATERSHED

INTRODUCTION

The objective of this report is to identify water quality indicators that will be useful for evaluating the effectiveness of stormwater management measures implemented in the watershed. This identification is based primarily on the existing and potential uses assigned to the river as well as identified impairments in the ultimate receiving water, San Diego Bay. In addition, potential effects of urbanization will also be identified through comparison with other watersheds in the area that have undergone substantial urbanization.

The watershed at this time is primarily undeveloped, with the hydrology substantially influenced by the presence of the Lower and Upper Otay Reservoirs. These reservoirs essentially eliminate the baseflow that may have originally been present in the river, because they release water to the downstream channel only under rare occasions. Urbanization is expected to increase both wet and dry weather flows due to increased runoff from higher levels of impervious cover, through over-irrigation of lawns and other managed landscape areas, car washing, and other activities common in residential communities. These changes may lead to substantial changes in both the water quality and quantity in the river.

EXISTING WATER QUALITY DATA

Ambient and wet weather water quality data from the River are extremely limited. At one time, there was an Otay monitoring station located on the southeast side of Beyer Boulevard, just past the south end of the Otay River Bridge. The drainage area consisted of approximately 23,680 acres and contained light industrial and residential land uses. There were no data collected at the Otay station due to vandalism of the monitoring equipment and the subsequent decision not to replace it (San Diego Bay WURMP, 2003).

The Wet Weather Monitoring Program established a new Otay River monitoring station; however, this site never experienced flow. It was determined that the hydrographic conditions within the Otay River drainage area would not produce adequate flow for sample collection. It should be noted that this site was recommended for removal from the remainder of the Wet Weather Monitoring Program (San Diego Bay WURMP, 2003).

The California Department of Water Resources has developed estimated Event Mean Concentrations (EMCs) for selected constituents for the Otay River in their Urban Runoff Management Plan. Table 1 presents these concentrations, which are estimated based on the water quality observed in similar watersheds in the area (MEC Analytical, 2004). However, given the lack of data for the Otay River itself, the values are useful only as a general guide to estimate average expected water quality, and should not be assumed representative of a discrete storm event.

The City of Chula Vista and the City of San Diego have conducted dry weather sampling of outfalls to the Otay River. These data characterize the quality of dry weather discharges to the River, but do not give any indication of the river quality itself.

It is unlikely given the lack of historical data and the hydrology of the river that a conventional water quality monitoring program would provide data useful for establishing a baseline indicator. The paucity of historical wet weather monitoring data means that there is little information on current or past conditions in the river with which to gauge the effectiveness of any BMP program. In addition, the lack

Table 1 Estimated Event Mean Concentrations for Otay River

Constituent	Event Mean Concentration
Biochemical Oxygen Demand	13 mg/L
Chemical Oxygen Demand	39 mg/L
Total Kjeldahl Nitrogen	1.15 mg/L
Dissolved Phosphorus	0.16 mg/L
Total Suspended Solids	87 mg/L
Total Lead	22.1 µg/L
Total Copper	21 µg/L
Total Zinc	115 µg/L
Total Cadmium	0.6 µg/L

Source: MEC Analytical, 2004.

of substantial flow in the river means that the logistics of collecting accurate, representative samples would be very difficult.

In addition, wet weather water quality in natural systems, particularly in southern California, can be highly variable. Development of statistically defensible estimates of average constituent concentrations would likely require several years of monitoring. Should incremental changes occur to water quality because of urbanization, differences observed in a monitoring program would likely not be statistically significant.

The San Diego Stream Team (http://sdstreamteam.org/), which is a citizen monitoring effort, has conducted bioassessments in the Otay River watershed. Table 2 presents a summary of these data, which provide a measurable assessment of the long-term health of a stream by examination of the aquatic invertebrates that live in the water. Many insect taxa have aquatic larvae that inhabit a stream from several months to several years. Larval groups have differential tolerances to stream conditions including pollution. There are different feeding methods requiring certain conditions for obtaining food, anchoring in the substrate of the stream, etc. Unfortunately, data in the Otay Watershed are available only for Jamul and Dulzura Creeks, which are located above the reservoirs and from locations unlikely to be affected by urbanization or other human activities. However, this data will be useful as a benchmark (representing near 'natural' conditions) for comparison with downstream urbanized areas as such data becomes available.

Bioassessments are considered an excellent way to measure the health of receiving waters. Rather than measuring concentrations of individual constituents and then assuming impairment exists, direct measurement of the biological health provides the ultimate answer as to whether conditions in the Otay River support a healthy biological community. In addition, bioassessments integrate the effects of all potential changes in the river due to changes in runoff volumes, runoff rates, and changes in the chemical and physical characteristics, including the synergistic effects of multiple pollutants. Consequently, a program of regular bioassessments in the river could provide one of the better baseline indicators of the effectiveness of the BMP program.

Table 2 Bioassessment Data from the Otay River Watershed (Spring 2001)

Metrics	Dulzura Creek	Jamul Creek
Richness Measures		
Taxa Richness	6 *	5.3
Ephemeroptera Taxa	2	1
Plecoptera Taxa	0	0
Trichoptera Taxa	2	1
EPT Taxa	4	2
Composition Measures		
EPT Index	98	46.4
Sensitive EPT Index	1	0
% Hydropsychidae	92.9	24.8
% Baetidae	0	21.6
Tolerance/Intolerance		
Tolerance Value	4	5.2
% Intolerant Organisms	0	0
% Tolerant Organisms	0	3.1
% Dominant Taxa	92.9	43.9
Feeding Groups		
% Collectors (c)	5.1	55.1
% Filterers (f)	92.9	42.9
% Scrapers (g)	1	0.3
% Predators	1	1.7
% Shredders (s)	0	0

* Value based on average of three composite samples per site

EXISTING AND POTENTIAL BENEFICIAL USES

Several existing and potential beneficial uses have been identified in the 1994 Water Quality Control Plan for the San Diego Basin (Basin Plan). Table 3 lists these beneficial uses, which provide a potential basis for selection of water quality assessment parameters. At the current time, the Otay River is not on the State Section 303(d) list. However, the RWQCB included several Otay River watershed streams on their 2002 "Monitoring List," which indicates that there may be a lack of data necessary to determine if the uses are fully supported. These uses have narrative or numeric water quality objectives necessary to maintain those uses, which are described below.

Table 3 Existing and Potential Beneficial Uses for the Otay River

Beneficial Use	Description
AGR	Uses of water for farming, horticulture, or ranching.
IND	Uses of water for industrial activities that do not depend primarily on water quality
REC1	Recreational uses of water involving body contact with the water.
REC2	Non-contact recreational uses of water.
WARM	Support of warm water ecosystems.
WILD	Support of terrestrial ecosystems.
RARE	Support of habitats necessary for the survival and maintenance of rare, threatened or endangered species.

Agricultural (AGR)

The agricultural (AGR) beneficial use includes water for farming, horticulture, or ranching. Historically, the primary restriction concerning the use of water for irrigation or livestock is salinity. Generally, total dissolved solids (TDS) concentrations of 100-140 mg/L in irrigation water have no effect on plants. Concentrations between 140 mg/L and 350 mg/L can result in slight to moderate injury to plants depending upon the species. Dissolved solids concentrations can be higher than these values for water supply. Consequently, periodic measurements of TDS may help determine whether this existing beneficial use is fully supported.

Urbanization tends to reduce dissolved solids concentrations in receiving waters, especially during wet weather. This is because the increased volume of stormwater runoff, which is low in dissolved solids, tends to dilute salt concentrations in the system when they are derived from other sources. Consequently, monitoring of TDS concentration would be a relatively low priority.

Industrial (IND)

The industrial (IND) beneficial use is for industrial activities that do not depend primarily on water quality. At the current time, IND is considered a potential rather than existing beneficial use. The eventual use of water in the Otay River for this purpose must be considered highly unlikely, because of the very small volumes in the river system. To the extent that this use might ultimately be realized, one of the key requirements is related to the salinity of the river. Consequently, measurement of TDS for determining whether baseline conditions are maintained for AGR uses will also serve to document whether IND use is also supported. Nevertheless, periodic monitoring of TDS concentrations would still be a low priority in any assessment program.

Recreational (REC1/REC2)

Recreational beneficial uses (REC1 and REC2) involve uses of the water for contact and non-contact recreation. The REC1 use is considered potential, while REC2 is an existing use. Given the small volume of water in the river, it is extremely unlikely that the REC1 use will ever be realized. The primary criteria for determining whether these uses are supported are concentrations of indicator bacteria (i.e., fecal coliform, enteroccocus, e. coli), which also serve as proxy for viruses.

In addition to the recreational uses within the watershed, the Otay River discharges to San Diego Bay, which is currently listed as impaired based on the concentrations of bacteria observed. Because of the small volume of water in the river, it is unlikely that the Otay provides a substantial contribution to the problems in the bay; however, this could change in response to urbanization. The potential increase in contribution to the bay is discussed in additional detail in the section describing changes in other watersheds in the area because of urbanization.

Ambient water quality monitoring for bacteria concentrations is recommended because of the existing beneficial use and to determine the degree to which the Otay River contributes to the recognized problems in San Diego Bay.

Warm Water Ecosystems (WARM)

Warm water ecosystems (WARM) are an existing beneficial use that involves the support of warm water ecosystems. In the Otay River, this ecosystem likely consists largely of benthic macro

invertebrates and other small species. Supporting conditions for this use are often determined through bioassessments, which were discussed and recommended earlier. Consequently, evaluation of the degree to which the WARM use is fully supported could also rely on this measure of river health.

Wild and Rare Species (WILD/RARE)

These two uses, which encompass support of terrestrial ecosystems (WILD) and support of habitats necessary for the survival and maintenance of rare, threatened, and endangered species (RARE), are commonly assigned to waterbodies in relatively undeveloped areas. These designations normally do not specify particular species or habitats that should be preserved; consequently, it is difficult to determine the precise measure to use in evaluating precisely what water quality parameters are necessary to support the uses. Therefore, at this time no specific baseline indicators are selected to evaluate changes in conditions that might affect these uses.

LESSONS FROM OTHER WATERSHEDS

In determining the types and degree of changes that might occur in the Otay River because of urbanization, it is instructive to examine the effect this process has had on other rivers and creeks in southern California. The Aliso Creek watershed, located in southern Orange County, is particularly instructive in this regard.

The problem of channel instability is regarded as one of the most fundamental problems in the Aliso Creek watershed, and contributes to other identified problems. This problem is caused by natural channel change, development inside the watershed, increased flood flow peaks and/or volumes, and increased dry weather discharge and reduced sediment supply. Lowering of the channel invert, which historically would be interspersed with periods of channel aggradation (or infilling), has turned into an increasingly destructive trend as the cyclical erosion and fill cycle has been replaced by continued degradation (general scour). Figure 1 is a picture of the bank of Aliso Creek showing how channel erosion has lowered the streambed compared to the adjacent floodplain, leaving a vertical bank that is especially susceptible to block type failure.

Channel degradation can contribute to:

- Infrastructure damage (e.g., water pipes, sewer pipes, roads, bridges, bank protection);
- Land loss;
- Decreasing floodplain soil moisture levels;
- Gradual disappearance of historical floodplain and riparian zone vegetation and related wildlife species;
- Conversion of vegetation to xeric species;
- Destruction of “pool-and-riffle” sequences (i.e., disappearance of the sequences of “falls” and “pools” that once characterized the stream channel);
- Disappearance or reduction of aquatic and riparian-related species, and other problems; and
- Increased aggradation downstream in response to increased sediment load from upstream reaches.

Erosion of the channel banks is also causing land loss to adjacent properties. This is largely due to channel instability. Although this has been related to urbanization of the watershed, increased impermeability, and increases in flood flow peaks and volumes, there is no definitive cause-and-effect

Figure 1 Channel Erosion on the Main Stem of the Aliso Creek Watershed.

relationship. It is sufficient to recognize that erosion of channel bed and banks is increasing and that land loss is accelerating.

Floodplain habitat, as discussed here, refers to vegetation complexes that would be found within the floodplain, or overflow area from most flood events. The gradual conversion of floodplain habitat from trees and bushes of certain more water-dependent types, dominated by the complex known as "California Oak Woodland," to those of a more xeric (drought tolerant) nature is related by many observers who have spent much time in the watershed. Several long-term residents have noted that the trees once found in the floodplain are now largely gone, replaced by scrub and dry grasses. It is believed that many trees were cut in the "Mission" period, as the oaks, sycamores, and other species were a valuable resource in the production of ships, structures, charcoal, and other uses. Still, many trees survived into this century, as evidenced by in-person accounts with older residents. It is not definitively known what caused the recent disappearance of trees in the floodplain, particularly in the lower watershed, but it has been noted that areas dominated by channel degradation have few resident trees, and those not suffering from appreciable degradation have a much greater associated tree population. Given that the degradation of the channel has been accompanied by a decline in floodplain soil moisture levels, it may be the case that the source of water for these large trees has disappeared and taken the trees with them. Taproots for these trees, although lengthy, may have been of insufficient length to reach the far deeper groundwater table under current conditions.

Much of the riparian habitat in the Aliso Creek watershed has also suffered the same kind of destruction as that on the floodplains. Regrowth is evident in some reaches, but tends to disappear with each flood event. This could be lessened if the structure of the stream channel were more stable. Riparian habitat, which supports fish, reptiles, insects, and mammals that traditionally occupied the watershed, is more evident in the Wood Canyon sub-watershed, and within some of the upper reaches of Aliso Creek. Because this habitat is dependent on both water availability and structural stability, protection of the riparian habitat is dependent on the success of channel stabilization measures.

If channel instability becomes a problem in the Otay River watershed, many of the beneficial uses assigned to the river, such as WARM, WILD, and RARE, may be negatively affected. Consequently, it is recommended that measures of channel stability be used as a baseline indicator. Rosgen (2001) has

provided a good channel classification scheme that is an example of the methodology that could easily be applied in the Otay Watershed. The method classifies the current state of the channel using such variables as bed material, channel width and depth ratio, floodplain width and cross section shape. The geomorphic assessment will begin to provide these data and should be used as the first step in identifying "canary" (i.e., sensitive) reaches of the stream that should be tracked to determine whether the river morphology is changing in response to urbanization. Monitoring channel stability does not require establishment of monitoring stations. Instead, area infrastructure (i.e., bridge piers, storm drain outfalls, wastewater lines) can provide convenient benchmarks for determining the amount and rate of channel erosion through time. In addition to rate of erosion, it could be valuable to establish a permanent gauging station on the river to measure potential changes in runoff volumes and rates, which are the primary causes of accelerated erosion. A gage location in the lower part of watershed would provide a reasonable assessment of the hydrologic response of the watershed over time.

In addition to changes in the channel morphology, water quality has also been affected in Aliso Creek, with one of the prime considerations being concentrations of indicator bacteria regularly exceeding objectives during both wet and dry weather conditions. This has resulted in the lower portion of the creek being designated impaired and being included on the state 303(d) list. Because even creeks in undeveloped watersheds frequently exceed objectives during storm events, a larger concern may be the exceedances of the objectives during ambient conditions. This problem has been exacerbated by the increase in the volume of dry weather flow caused by activities such as excess irrigation or car washing in residential areas. This larger runoff volume has increased problems at the adjacent beach in the Aliso Creek watershed because a larger load of bacteria is being delivered to the surf zone. Figure 2 illustrates an example of the dry weather diversions that are being constructed on many of the creeks in Orange County to divert contaminated flows to area wastewater treatment plants for treatment. Unfortunately, such structures are costly to install and operate. Consequently, it is again recommended that bacteria concentrations be used as baseline indicator.

Figure 2 Installation of Dry Weather Flow Diversion in Orange County.

A final area of potential concern in the Otay River is the discharge of trash and debris in stormwater runoff, which is prohibited by the Clean Water Act. Litter is extremely common in certain urban areas and can be easily washed or blown into the storm drain system, where it can be transported to area water

bodies. This has resulted in a trash TMDL being developed for two watersheds in the Los Angeles area, Ballona Creek and the Los Angeles River. These TMDLs are currently the subject of litigation. Consequently, a monitoring program to track the changes in trash in the Otay River may be warranted.

SUMMARY OF RECOMMENDATIONS

The objective of this section is to summarize and prioritize the potential baseline indicators identified in the preceding sections. These indicators are categorized as either primary or secondary in importance.

Primary Baseline Indicators

Bioassessment Program – Regular bioassessments provide an integrated approach to assessing changes in the river ecosystem and water quality and provide a direct measurement of the degree to which the river supports the WARM beneficial use designation. Previously collected data upstream of the reservoir will provide good benchmark information.

Permanent Stream Gauging Station – Changes in river and stream morphology are generally related to changes in the volume and rate of runoff and sediment supply. Implementation of BMPs may reduce these changes, but it would be difficult to quantify without better data on current and future river discharges. Consequently, a permanent station to monitor river discharge rates is warranted in the lower part of the watershed.

Channel Stability Monitoring – Changes in the rate of erosion can have dire and costly consequences for urban infrastructure installed in or adjacent to stream channels and impair RARE and WILD beneficial uses. The Rosgen classification system assessment should be completed for selected reaches on a bi-annual basis to track changes to the stream cross-section and profile.

Ambient Bacteria Monitoring – Increases in bacteria concentrations in dry weather flows may affect designated REC1 and REC2 beneficial uses and further contribute to the impairments already identified in San Diego Bay.

Secondary Baseline Indicators

Percent Impervious Cover – Percent impervious cover has received more study recently relative to thresholds for impact to aquatic life. Tracking of percent impervious cover within the watershed can provide additional information in making weight of evidence type evaluations of watershed impact.

Conventional Water Quality Monitoring – This type of monitoring is very problematic on a system with so little flow and may be of limited value because of the lack of historical data with which to compare newly acquired data.

Total Dissolved Solids Monitoring (TDS) – Monitoring of TDS can provide a measure of the degree to which the river supports the AGR, MUN and IND beneficial uses; however, urbanization is unlikely to increase dissolved solids.

Trash Monitoring – Trash and litter are common components of stormwater runoff and TMDLs have been developed to address this issue in the Los Angeles area. Monitoring of representative storm drain outfalls (rather than the river itself) may provide useful information on the degree to which trash is contained in stormwater discharges.

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BIOLOGICAL INDICATORS FOR THE OTAY RIVER WATERSHED

INTRODUCTION

Riparian areas may be the most important natural habitat in the western United States. Although comprising less than 1 percent of land area, riparian habitats support the most diverse and abundant wildlife communities. Yet they are disappearing at an alarming rate. In California, an estimated 95 percent of riparian habitat has disappeared during the last hundred years (Grupel and Elliott, 2001). In most cases the loss of riparian habitat was preceded by a degradation in habitat quality that could have been measured by a change in species abundance and habitat composition. These changes in the ecological community have the potential to function as indicators of changes in the riparian and wetland ecosystem as a whole. If appropriately selected, these bioindicators can be uses as an effective means to monitor the effectiveness of watershed management activities. The objective of this discussion is to identify bioindicators that will be useful for evaluating the effectiveness of wetland and riparian habitat conservation and management measures implemented in the Otay River watershed.

Simply stated, a bioindicator is an ecological unit (such as an individual species or a group of species like a vegetation community or taxonomic assemblage) that can be monitored over time and that has a correlation of its condition with the condition of other ecosystem elements. Bioindicators that are chosen to monitor the wetland and riparian habitat in the Otay River watershed should have the following characteristics:

- Bioindicators should be taxonomically well known and easy to identify and distinguish from other species.
- The ecology and/or general life history of the bioindicators should be well understood.
- Bioindicators should be readily surveyed and manipulated such that a field monitor can find, observe, and mark the bioindicators easily.
- Bioindicators should be specially adapted to the conditions of the target riparian or wetland system type. The more specialized the bioindicator, the more sensitive it is to changes such as pollution and habitat modification.
- Patterns observed in the bioindicators should be correlated in other related and unrelated species or components of the ecosystem.

RIPARIAN AND WETLAND HABITAT IN THE WATERSHED

In the Otay River Watershed Management Plan (ORWMP) study area, the riparian habitats include riparian forest, riparian woodland, riparian scrub, and natural floodchannel/streambed vegetation. These general vegetation types are associated with rivers, streams, drainages, and other watercourses. Riparian vegetation communities in the watershed area generally are dominated by willows (*Salix* spp.), cottonwoods (*Populus* spp.), mulefat (*Baccharis salicifolia*), and western sycamores (*Platanus racemosa*). Willows and cottonwoods are often dominant along the active stream channel when permanent water is present, whereas sycamores tend to be a minor component of riparian habitats associated with permanent water, but increase in abundance on higher flood terraces or along intermittent and ephemeral drainages. In several reaches of the lower Otay River as well as other localized areas throughout the watershed, the non-native, invasive giant reed (*Arundo donax*) and tamarisk (*Tamarix* spp.) are the dominant species in the riparian zone.

Riparian plant species recruitment and survival are strongly associated with riverine hydrology and fluvial processes (Scott et al., 1996 and 1997; Shafroth et al., 1998; Stromberg, 1993 and 1998). Woody riparian plant species establish in positions along streams where there are suitable conditions for seed germination and sufficient water for seedling survival, and where they can tolerate physical

disturbance from floods (Stromberg and Patten, 1992; Hupp and Osterkamp, 1996; Scott et al., 1996; Mahoney and Rood, 1998). Thus, the structure of riparian vegetation communities is often a mosaic (at varying spatial scales) of species and age classes produced by spatial and temporal variations in stream discharge patterns (Auble and Scott, 1998; Stromberg et al., 1997; Shafroth et al., 1998).

Many willow species are recognized as "pioneer species" that are among the first to colonize newly exposed substrates along streams. In the Mediterranean climate zones of coastal California, riparian tree species tend to follow a dominance gradient with willows occurring on lower, wetter sites, cottonwoods on slightly higher first terraces, and sycamores on higher, dryer stream terraces (Walters et al., 1980). In Southern California, sycamores and coast live oaks dominate intermittent and ephemeral streams, whereas willows and cottonwoods dominate the banks of perennial streams (Faber et al., 1989).

Aquatic habitat quality is largely determined by substrate composition and water quality. Macroinvertebrate diversity is generally highest in streams with coarse substrates (coarse sands, gravels, and cobbles), moderate nutrient and high dissolved oxygen concentrations, and adequate tree canopy cover to moderate water temperatures. Many species associated with aquatic habitats require undisturbed adjacent upland areas to complete portions of their life cycle. Vegetation in adjacent upland areas also provides carbon and nutrients to aquatic habitats in the form of leaf litter, woody debris, and terrestrial insects and serves to moderate sediment input.

Other non-riparian wetland habitats in the watershed include the southern coastal salt marsh, alkali marsh, freshwater marsh, open water, estuarine, and saltpan/mudflats vegetation communities. The species composition in these communities is variable and dependent on elevations relative to tidal fluctuations and soil and pore water salinities. Characteristic species in areas of higher salinity may include cordgrass (*Spartina foliosa*), pickleweed (*Salicornia* spp.), alkali-heath (*Frankenia salina*), shoregrass (*Monanthochloe littoralis*), and saltgrass (*Distichilis spicata* var. *spicata*). In areas with reduced salinities, cattails (*Typha* spp.), bulrushes (*Scirpus* spp.), and rushes (*Juncus* spp.) typically dominate.

THREATS TO RIPARIAN AND WETLAND HABITAT INTEGRITY

Storm water runoff from developed areas can carry significant loads of urban pollutants (Paul and Meyer, 2001). Runoff from impermeable surfaces such as buildings, streets, and landscaped areas transports a number of water quality constituents, such as silt, metals, fertilizers, herbicides, and pesticides, to downstream water bodies. These constituents have been shown to cause toxicity to aquatic organisms and cause eutrophication of receiving waters. Eutrophication generally depresses dissolved oxygen concentrations, particularly in pools and slow-moving waters. Sewage effluent can contain contaminants. The effect of high levels of estrogens in sewage effluent on biological communities is unclear.

Less studied, but potentially as significant, is the influence of altered stream hydrology on riparian biological communities. Alteration of hydrology and sediment supply affect riparian habitats by altering the amount and timing of flows. Many species have evolved under specific hydrologic regimes and can be sensitive to changes in the magnitude, frequency, and duration of flows. There is increasing evidence that modifications of riverine hydrologic characteristics by urban development and irrigated agriculture can greatly affect the composition of the riparian and aquatic communities. In many instances, altered hydrologic characteristics favor non-native species at the expense of native species. For example, recent research by the USGS (Fisher, unpubl. data) shows that historically intermittent

drainages that now have permanent base flow from irrigated landscaping or agriculture no longer support arroyo toads. This pattern has been attributed to the successful establishment of non-native aquatic species (e.g., bullfrogs, bass, and sunfish) that prey on or compete with larval toads. Permanent summer flow can also encourage the establishment of non-native plant species, such as giant reed.

A number of factors can reduce breeding success of riparian bird species. Excessive noise and lights can adversely affect mating behaviors of songbirds. Nest parasitism by brown-headed cowbirds (*Molothrus ater*) has the potential to significantly reduce reproductive success, and cowbirds can be particularly abundant in agricultural areas with livestock. Non-native predators, such as house cats, can also prey on riparian birds.

Development and human uses facilitate the invasion of non-native plant species into adjacent natural habitats. Residential developments in close proximity to natural open space areas generally result in increased disturbances from foot, bicycle, and motorized vehicular traffic as well as an increase in trash. Illegal migrant worker encampments also contribute to trash and disturbance in riparian areas. Establishment of unauthorized trails is a large management issue in most open space areas in San Diego County, resulting in the loss of vegetation and compaction and erosion of underlying soils. These trails are also routes for the invasion of non-native species. In some instances, these disturbances can produce severe, virtually permanent habitat degradation. Buildup of trash or litter in and adjacent to the preserve can attract house rats and promote the abundance of mesopredators, such as raccoons and skunks. An unnaturally high abundance of mesopredators can affect nesting success of native birds.

SUGGESTED BIOINDICATORS FOR THE OTAY RIVER WATERSHED

The following list identifies the general ecological groups identified as having potential bioindicators. Individual species and monitoring approaches are outlined below.

- Vegetation Communities
- Freshwater macroinvertebrates
- Amphibian species
- Riparian and wetland birds
- Exotic species.

Monitoring of bioindicators in the Otay River watershed as a component of the Otay River WMP and SAMP implementation should, to the maximum extent practical, be coordinated with the species and habitat monitoring of the MSCP (subregional and individual subarea plans). A number of the species covered by the MSCP are dependent on wetland and riparian habitats, several of which are suitable bioindicators (Table 1). Several of these species have been selected as potential bioindicators for the Otay River watershed, and are described below in detail.

Table 1 Wetland and Riparian Species Covered by the San Diego MSCP that may Make Good Wetland/Riparian Bioindicators

Species	Habitat Type(s)
Riparian Species	
Southwest willow flycatcher	Riparian Woodland
Least bell's vireo	Riparian Woodland, Riparian Forest
Cooper's hawk	Oak Woodland (breeding), Riparian Woodland
Arroyo southwestern toad	Breeds near water
California red-legged frog*	Aquatic/riparian
Southwestern pond turtle	Aquatic/riparian

Species	Habitat Type(s)
Freshwater Marsh Species	
Tricolored blackbird	Freshwater Marsh
White-faced ibis	Freshwater Marsh, estuaries
Saltmarsh Species	
Salt marsh bird's beak	Saltmarsh
Salt Marsh Skipper	Saltmarsh
Reddish Egret	Saltmarsh
Light-footed clapper rail	Saltmarsh
Long-billed curlew	Saltmarsh
Belding's savannah sparrow	Saltmarsh
Large-billed savannah sparrow	Saltmarsh, Grassland, Freshwater Marsh
Northern harrier	Saltmarsh, Grassland, Agricultural fields
River Mouth/Bay Species	
Western snowy plover	Ocean/bay shoreline, river mouths

*Extirpated, but would be a good indicator if the species were reintroduced into the watershed.

MONITORING OF VEGETATION COMMUNITIES

Riparian and wetland vegetation communities should be used as a bioindicator to provide information for a variety of different purposes, including identifying and prioritizing management actions, tracking the response of communities to management actions, assessing systematic vegetation community patterns that may be an expression of human-induced stresses, and evaluating vegetation patterns that may help explain observed distributions and abundance of wildlife species.

Identifying the structural diversity is important in managing riparian biodiversity and integrity for the following reasons:

- Young communities support a different fauna than mature communities.
- Healthy riparian ecosystems have mature, intermediate, and young components.
- If a mature plant community is not being replaced by younger individuals, the vegetation type and associated species may eventually be lost over time.

Vegetation community monitoring data should be used to evaluate the following:

- The distribution of vegetation communities, seral phases, levels of disturbance, and change over time. Disturbance factors include relative abundance of exotic species, vehicular traffic, trampling, erosion, urban runoff, trash, habitat loss as a result of development activities, etc.
- Changes in vegetation communities related to changes in sensitive species distributions.
- Changes in vegetation communities that may require management actions.

A baseline of riparian and wetland vegetation should be established against which future monitoring efforts will be compared. The existing vegetation mapping should be updated in coordination with MSCP mapping updates.

Baseline surveys should be conducted to accurately delineate riparian and wetland vegetation communities, and to describe relevant attributes of vegetation stands (e.g., level of disturbance, relative abundance of exotics, successional stage, etc.). Information from these surveys will be mapped into a GIS database with appropriate attributes.

Vegetation community classification and mapping will be conducted on all riparian and wetland habitats in the watershed, using both remote sensing information and field verification. The community classification system and specific attributes to be used must be consistent with those used in the MSCP. At this time, the modified Holland classification is being used; however, the wildlife agencies may recommend a different classification system in the future. In addition to mapping vegetation community polygons, the relevant attributes for each polygon should be described, such as the dominant species for each area, the health or condition of the patch, and the general level of disturbance (e.g., percent composition of invasive species, percent of bare ground caused by trails or off-road vehicles, evidence of grazing or tilling, etc.). The minimum mapping unit for riparian and wetland vegetation communities should be 0.5 acre.

At 5-year intervals, the vegetation community maps should be updated and analyzed to identify changes in the boundaries or attributes of vegetation community polygons (e.g., changes in the spatial distribution of vegetation communities or attributes such as level of disturbance). It may be desirable to refine maps more frequently if vegetation community changes occur more frequently (e.g., by fire, flood disturbance, adjacent development, or frequent recreational activities).

Using riparian vegetation as a bioindicator has the following objectives:

- Document changes in the distribution or characteristics of habitats (e.g., level of exotic species, type change as a result of urban runoff) that may trigger management actions.
- Document changes in habitats that may correlate with factors such as adjacent land uses, fire, floods, etc.

MONITORING OF FRESHWATER MACROINVERTEBRATES

Freshwater macroinvertebrates are small invertebrate fauna, large enough to be seen with the naked eye, and that inhabit the bottoms of streams, lakes, and wetlands. They include snails, worms, and the multitude of insects and their larvae (such as midges, stoneflies, caddisflies, and some beetles). Using the macroinvertebrate assemblages that characterize these freshwater environments as bioindicators provides several advantages to monitoring riparian and wetland condition:

- They are sensitive to the cumulative impacts of a wide range of disturbances.
- They are differentially sensitive to various pollutants; the pollution responses of many common species are known; and they can detect and respond to intermittent pollution.
- They react quickly and are capable of a graded response to a broad spectrum of stresses.
- They are ubiquitous, abundant, and relatively easy to collect.
- They generally move only small distances, and therefore, their distribution may reflect the various impacts on river health over time at the sampling site.
- They live long enough to provide a record of environmental quality.
- Qualitative sampling and analysis are relatively simple.

Because many species of aquatic macroinvertebrates require undisturbed adjacent upland areas to complete portions of their life cycle, they can also be good indicators of upland conditions.

A thorough discussion of the utility of aquatic macroinvertebrates as bioindicators in this watershed is included in the accompanying Baseline Water Quality Indicators for the Otay River Watershed, and therefore, is not discussed in detail here.

MONITORING OF AMPHIBIAN SPECIES

Amphibians are well known for their sensitivity to habitat degradation caused by pollutants and changes in hydrologic conditions. They must spend at least part of their life cycle in the water, and because they tend to have highly permeable skin, they are highly vulnerable to toxins, which are readily absorbed. Eggs are particularly susceptible to pollutants, and exposure often results in abnormal development. In addition to poor water quality, amphibians are sensitive to environmental alterations that result in changes in sedimentation rate and water flow. Amphibian species often have very particular micro-habitat requirements for each life stage in order to fully develop, and any changes in these conditions can have devastating effects that are manifested very quickly. However, long-term monitoring of amphibian species is essential. Populations may fluctuate dramatically due to natural conditions, such as drought, and therefore, a drop in numbers could be due to hibernation or dormancy rather than to an actual decline in numbers. The introduction of non-native predatory species, such as bullfrogs, game fish, and bait fish has become a significant problem for amphibians. Therefore, any monitoring of one or more amphibians as a bioindicator should also include parallel monitoring of non-native species. Amphibian species in San Diego County include four species of salamanders, three species of toads, and two species of treefrog.

Arroyo Toad

The arroyo toad has the potential to be a good bioindicator for aquatic, riparian, and adjacent upland habitat integrity. The arroyo toad breeding habitat is affected by water quality, stream hydrogeomorphology, and sediment substrate conditions. The non-breeding adjacent upland habitat must be available for toads to persist in a given area. The arroyo toad has been well-studied in recent years, and therefore, has the characteristics of a good bioindicator as outlined in the introduction to this section. Furthermore, it is an MSCP-covered species that must be monitored and managed as a part of the MSCP implementation.

The primary populations of arroyo toad in the watershed are on Dulzura Creek; however, potentially suitable habitat occurs in many areas of the watershed (County of San Diego, 2004). Therefore, monitoring for this bioindicator should occur in all suitable habitat using the following protocol:

First, survey for potential arroyo toad habitat. If potential habitat occurs in the area, conduct night-time surveys for toads, tadpoles, and/or egg masses. In areas of potential breeding habitat, conduct surveys once every 3 years. Conduct at least three site visits between late March and late May. The survey should be conducted by a permitted biologist familiar with the male arroyo toad's breeding call and identification of toad eggs, tadpoles, and adults. Conduct surveys between 1 hour after dusk and midnight on nights lacking a full moon and nights when air temperatures are $>55^{o}$F. Avoid surveying during rain, high winds, or flood flows. Surveyors must be silent during surveys so as not to disturb calling toads. Use strong flashlights to visually identify adult toads; otherwise, lighting should be kept to a minimum. Surveyors must not enter the water near mating pairs and should not handle any toads.

Survey along the bank of the watercourse 10 ft back from the water's edge. If possible, survey up one bank and back along the other, concentrating on open habitats adjacent to suitable breeding habitats. Stop, listen for calls, then proceed to the next listening point until all suitable habitat has been covered. Shine a bright light ahead to detect eye-shine, and also survey for toads at close range. When crossing the stream, cross at the downstream end of potential breeding areas or on stable substrate to avoid trampling eggs or larvae and to avoid clouding the water with silt, which can smother eggs and young.

Each sighting of a toad, egg mass, or group of tadpoles should be entered as a separate line on a standard field form, and a GPS reading should be recorded for the location. Condition and degree of disturbance to the habitat should be recorded, and management actions to control or reduce habitat disturbance should be monitored for effectiveness.

MONITORING OF RIPARIAN AND WETLAND BIRDS

The relative abundance of bird species in riparian and wetland habitats is a useful bioindicator. Riparian and wetland habitats with a diverse array of bird species including a number of habitat specialists (e.g., least Bell's vireos, southwestern willow flycatchers, yellow-breasted chats) is generally considered of higher ecological integrity than habitats with lower diversity and only generalist species but few or no specialists. The objectives of riparian monitoring are to: (1) increase our knowledge of habitat use by breeding riparian birds, in general; (2) identify variables that influence the dynamics of populations of least Bell's vireos, southwestern willow flycatchers, yellow-breasted chats, and other obligate riparian bird species that are particularly sensitive to habitat degradation, nest parasitism, nest predation, and other adverse edge effects; and (3) assess the effectiveness of watershed management actions. General riparian bird monitoring data should be used to determine the distribution and abundance of riparian and wetland bird species populations in the watershed.

Southwestern Willow Flycatcher, Least Bell's Vireo, Cooper's Hawk, Yellow-Breasted Chat

Focal species monitoring for the southwestern willow flycatcher, least Bell's vireo, and Cooper's hawk, which are MSCP-covered species, and the yellow-breasted chat as bioindicators for riparian habitats should address the following issues:

- Number of pairs of these bird species estimated to be present in the watershed, and what factors influence their occupancy over time.
- Factors that are positively or negatively affecting these species (e.g., are recreational users negatively impacting nesting success).
- Management actions that are effective in maintaining or enhancing the population.

Monitoring for these bioindicators should use the following protocol:

- Surveyors should establish systematic survey routes through patches of suitable habitat, such that the suitable habitat is completely covered. Survey routes should be varied relative to time of day between visits. The surveyors will visit these patches three times during April through June, with at least a 7-day interval between site visits. Taped vocalizations will be used, as needed. The number of pairs of each covered species will be recorded, and notes will be taken on the condition of the habitat (e.g., level of vehicular disturbance, trampling of habitat, relative abundance of exotic species, trash, erosion, drainage conditions, etc.).
- The observer should be skilled in identification, including knowledge of the songs and calls of birds. Surveys should begin within 1 hour after sunrise and end by noon. Surveys should not be conducted under extreme conditions, i.e., during heavy rain or when the temperature is $>95°F$ or $<40°F$ or with winds >10 mph. Condition and degree of disturbance to the habitat will be recorded, and management actions to control or reduce habitat disturbance will be monitored for effectiveness.

Western Snowy Plover

The western snowy plover, a federally listed species covered by the MSCP, is a potential bioindicator for relatively undisturbed shoreline habitat at the mouth of the Otay River and nearby vicinities in San Diego Bay. Monitoring of the snowy plover as a bioindicator should address the following issues:

- Identify and monitor areas this species uses and how it changes over time.
- The status and trends in the number of breeding pairs.
- The number of breeding pairs relative to habitat availability and distribution and to the activity of mammalian and avian predators.

Monitoring for this bioindicator should use the following protocol:

- Survey all potential western snowy plover breeding habitat annually in April. Map locations supporting this species, and record the number of breeding pairs. Record condition and degree of disturbance to the habitat, and monitor management actions for effectiveness in controlling or reducing habitat disturbance.

Belding's Savannah Sparrow

The Belding's Savannah sparrow is State listed as endangered and is covered by the MSCP. It is a potential bioindicator for high quality intact saltmarsh habitat. Monitoring of this species as a bioindicator should address the following issues:

- Identify and monitor areas this species uses and how it changes over time.
- The number of breeding pairs relative to habitat availability and distribution and to the activity of mammalian and avian predators.
- Response to efforts at reducing predation or disturbance.

Monitoring for this bioindicator should use the following protocol:

- Annually count the total number of breeding Belding's Savannah sparrow pairs in March. The surveys will consist of circuitously walking through salt marsh habitat and mapping locations of territorial birds, using existing CDFG and USGWS protocols. Note and record the condition and the degree of disturbance to the habitat, and monitor management actions for effectiveness in reducing habitat disturbance. An alternative protocol, which may be used by CDFG, requires conducting annual censuses only in areas of potential human disturbance or where a restoration project is proposed. Under this protocol, a lagoon-wide census of all potentially occupied habitat, as described above, should be conducted every 3 years.

Light-Footed Clapper Rail

The light-footed clapper rail is federally and State listed as endangered and is covered by the MSCP. It is a also potential bioindicator for high quality intact saltmarsh habitat. Monitoring of this species as a bioindicator should address the following issues:

- Identify and monitor areas this species uses and how it changes over time.
- The number of breeding pairs relative to habitat availability and distribution and to the activity of mammalian and avian predators.
- Response to efforts at reducing predation or disturbance.

Monitoring for this bioindicator should use the following protocol:

- Annually conduct spring call counts in appropriate habitat. Conduct call counts between March and early May, in early morning (until two hours after sunrise) or late afternoon (two hours before sunset). In locations where rails are relatively common, all spontaneous rail calls should be mapped. In marshes with few rails, or in long narrow channels or narrow strips of habitat, use taped "clappering" calls sparingly. No surveys should be conducted under rainy or windy conditions. "Duets" and "clappering" should be treated as a rail territory (Zembal, pers. comm.). Note and record the condition and the degree of disturbance to the habitat, and monitor management actions for effectiveness in reducing habitat disturbance. Collect data to test the effects

of factors hypothesized to influence the distribution or habitat use by the birds. High tide counts may also be appropriate to survey for rails. Observers should be stationed around the perimeter of a flooded marsh to observe all clapper rails (Zembal, pers. comm.).

MONITORING OF EXOTIC SPECIES

Invasive, exotic species may be the greatest threats to sensitive species and the ecological integrity of the watershed. Careful monitoring and management will be necessary to identify invasions or expansions of these exotic pests and hopefully to control them or minimize their impacts on native resources. Therefore, exotic species presence and abundance can be a bioindicator of an area that has been disturbed from a more natural state. In some cases, exotic species can be completely removed from a system, and in most cases, the exotic species abundance can be reduced to a level that has minimal impact to the natural system. Identifying an exotic species early before it gains a foothold and causes serious damage also provides the best opportunity to remove it from the system with the least cost.

Invasive plant species pose one of the greatest threats to the characteristics of ecosystems. These species can dominate and cause permanent damage to vegetation communities by altering natural processes and reducing biodiversity. Invasive weeds can destroy wildlife habitat; displace many threatened, endangered, or sensitive species; and result in reduced plant and animal diversity where they form monocultures.

Direct competition between native and exotic plant species is well documented (Alberts et al., 1993). Furthermore, the successful invasion of exotic species may alter habitats and lead to displacement or extinction of native species over time. For example, exotic invasions have been shown to alter hydrological and biochemical cycles and disrupt natural fire regimes (MacDonald et al., 1988; Usher, 1988; Vitousek, 1990; D'Antonio and Vitousek, 1992; Alberts et al., 1993).

Invasive or potentially invasive weed species occurring in or near the watershed that may pose threats to native species include but is not limited to tamarisk (Tamarix spp.), Pampas grass (Cortaderia selloana), eucalyptus (Eucalyptus spp.), giant reed (Arundo donax), mustard (Brassica spp.), African fountaingrass (Pennisetum setaceum), tocalote (Centaurea melitensis), purple falsebrome (Brachypodium distachyon), artichoke thistle (Cynara cardunculus), castor bean (Ricinus communis), fennel (Foeniculum vulgare), and ice plant (Mesembryanthemum chilensis).

Exotic animal species also can have a significant effect on biological resources, which has been well documented (e.g., Gates and Gysel, 1978; Brittingham and Temple, 1983; Wilcove, 1985; Andren and Angelstam, 1988; Langen et al., 1991; Donovan et al., 1997); most of this literature pertains to effects on wildlife species. For example, both domestic dogs and cats are known to adversely impact native wildlife, with effects ranging from harassment to disturbance of breeding activities to predation (Kelly and Rotenberry, 1993).

Disturbed habitats are often considered vulnerable to Argentine ant invasions. There is evidence that this exotic species rapidly invades disturbed areas within stands of native habitat (Erickson, 1971; Ward,1987; DeKock and Giliomee, 1989; Knight and Rust, 1990; Suarez et al., 1998). Suarez et al. (1998) found Argentine ants are most abundant along the edge of urban/wildlands interface, with densities of ants in the natural areas decreasing with distance from the edge. They found that ant activity was highest within about 325 feet of the nearest urban edge, whereas areas sampled beyond 650 feet contained few or no Argentine ants. However, Argentine ants have also been found at distances of

approximately 1,300 feet and 3,280 feet from the edge, respectively, in other urban reserves in southern California (Suarez et al., 1998).

Argentine ants appear to be confined to low elevation areas with permanent soil moisture (Erickson, 1971; Ward, 1987; Knight and Rust, 1990). Tremper (1976) reported that Argentine ants desiccate more easily and are less tolerant of high temperatures than native ants. Suarez et al. (1998) indicated that the presence of the Argentine ants in urban reserves might be dependent on water runoff from developed areas. Holway (1998) found that the rate of Argentine ant invasion is primarily dependent on abiotic conditions (e.g., soil moisture), rather than on disturbance. He suggested that disturbed areas are often a point of introduction, but encourage invasions only if they increase the availability of a limiting resource such as water. Blachly and Forschler (1996) found Argentine ants thriving in areas disturbed by human activity, but indicated that their presence is also related to added ground cover, permanent water supplies, and a simplified native ant fauna. Monitoring of the presence and density of Argentine ants in natural areas is a potential bioindicator of the edged effects from nearby urbanization. However, because Argentine ants are primarily limited by areas with sufficient soil moisture, once they invade from urban fringes into riparian and wetland habitats, it is possible that they may persist in these moist environments independent of any continued edge effect.

Invasive faunal species (e.g., Argentine ants, parasites) have the potential to negatively impact pollinator populations. Loss or limitation of pollinators may adversely affect the long-term survivability of rare plant species by reducing seed output (e.g., reproductive failure) if there is no selfing (Jennersten, 1988; Bawa, 1990). The Argentine ant is known to displace native ant species (Erickson, 1971; Ward, 1987; Holway, 1995; Human and Gordon, 1996; Suarez et al., 1998). Ants may also function as primary or secondary dispersers of seeds (Roberts and Heithaus, 1986; Louda, 1989). They have been reported to contribute to the spatial heterogeneity of seed distribution (Reichman, 1984, 1979), and they decrease seed abundance of some numerically dominant ruderal species in relation to less dominant native annual species (Inouye et al., 1980). Displacement of native ant species by the Argentine ant could negatively affect persistence of rare native plant species by reducing seed number and distribution.

Other non-native animals that may be a threat to sensitive species include red fox, opossum, cats, dogs, black rats, cowbirds, bullfrogs, African clawed frogs, non-native turtles, and nonnative fish. The presence and relative abundance of these species in natural areas throughout the watershed should be observed and recorded during monitoring of other bioindicators.

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SOCIOECONOMIC AND LAND USE INDICATORS FOR THE OTAY RIVER WATERSHED

INTRODUCTION

Research performed by a variety of local and regional government agencies, as well as by non-profit watershed protection organizations, has determined that certain socioeconomic variables for a region, along with characteristics of the area's existing and planned land uses, can be used as indicators which can help evaluate and project the health of the area's watershed. Both socioeconomic and land use characteristics can be used to estimate the amount of impervious cover in an area. The Center for Watershed Protection (CWP), in its 1999 Rapid Watershed Planning Handbook, posits that the level of stream quality is a function of the proportion of impervious cover in the region. The majority of research contributing to these findings, however, has been performed in the Pacific Northwest and the Mid-Atlantic states of the U.S., climates with greater overall rainfall as well as more regular rainfall. Supporting data has also been collected for the Northeast, Upper Midwest, and Southeast (Zielinski, 2002).

Unfortunately, due to the arid, Mediterranean conditions of the San Diego region, many traditional water quality monitoring and modeling techniques used in the area fail to achieve the same results as those used in wetter climates. As such, the Impervious Cover Model, recommended in the CWP Rapid Watershed Planning Handbook, would be largely inappropriate for use in the Otay River watershed. Despite this, however, impervious cover in the Otay River watershed plays a large role in the health of the watershed and its water quality. The socioeconomic and land use characteristics that would be used in the Impervious Cover Model would still be valuable indicators of watershed health and could also provide insightful projections into health of the watershed in the future.

EXISTING SOCIOECONOMIC AND LAND USE DATA

The socioeconomic and land use data that would be useful as watershed health indicators are largely public information, but is updated infrequently, ranging from four to ten or more years. Socioeconomic data for use as a watershed health indicator can be accessed directly from the United States Census Bureau, or can be obtained through the San Diego Association of Governments (SANDAG). Land use information can also be obtained through SANDAG, but general plans and zoning ordinances for the jurisdictions within the Otay River watershed provide a higher resolution of detail for analysis.

Socioeconomic characteristics of interest for watershed health include: population, population growth, population density, and housing density. Population data can be obtained directly from the U.S. Census and is updated every ten years. The last U.S. Census provides data for the year 2000. Population density and housing density can be calculated from U.S. Census data with the population, number of housing units, and acreage of each census tract. As described in Section B.3.2 of the Otay River Watershed Assessment Technical Report, approximately 310,000 people live within the Otay River watershed (San Diego County, 2004). SANDAG develops long-range (out to 30 years in the future) population and housing data approximately every four years. The 2030 Regional Growth Forecast was accepted for review and use in planning studies by the SANDAG Board of Directors on November 21, 2003 (SANDAG, 2004a). According to these projections, the population growth of jurisdictions within the Otay River watershed by the year 2030 will vary widely, ranging from 6 percent (in Coronado) to 60 percent (in Chula Vista), averaging approximately 32 percent for the region. Housing stock is also projected to increase, ranging from a growth of 4 percent in Coronado, up to 56 percent in unincorporated San Diego County (SANDAG, 2004b). Utilizing population density, housing density, and growth of these measures, areas can be identified where urban runoff is expected to increase.

Land use characteristics which can contribute to an understanding of a watershed's health include the land cover type (airports, shopping centers, undeveloped, etc.) and the land use classification (single family residential, light industrial, commercial, etc.). These characteristics are provided in the planning documents for the region, such as the general plans and zoning codes for the jurisdictions within the watershed. As described in Section B.3.1 of the Otay River Watershed Assessment Technical Report, the Cities of Chula Vista, Imperial Beach, National City, and San Diego, the County of San Diego, and the San Diego Unified Port District all have land use plans providing guidance for the development of lands within their jurisdictions (San Diego, 2004). These planning documents are frequently updated with amendments and zoning changes, but receive full updates only infrequently (perhaps once every ten to twenty years). Land use cover types and classifications can not only provide valuable information on where urban runoff is expected to increase, it can also provide basic information on what types of contamination may be included in runoff flows.

SOCIOECONOMIC INDICATORS

Although quantitative modeling techniques developed on the east coast recommend combining population-based impervious cover calculations with land use or direct measure impervious cover estimates (CWP, 1999), due to the climate of the San Diego region, population data would be better used for qualitative evaluation of jurisdictional areas' water quality contributions to the Otay River watershed.

Population density and housing density can be used to identify areas contributing substantial amounts of urban runoff due to correlations between these characteristics and impervious cover (CWP, 1999). While this would be appropriate for residential areas, commercial or industrial areas with low population and housing stock, but high impervious cover, would be underrepresented for their contribution to urban runoff. In areas with substantial amounts of commercial or industrial land uses, population and housing density should be used in conjunction with other indicators to evaluate an area's contribution to regional water quality (CWP, 1999).

SANDAG produces population forecasts out to 2030 for geographic units ranging from the region and metropolitan statistical areas down to the census tract level. Population and housing density data can be collected for the census tracts in each sub-watershed area contributing to the Otay River watershed and evaluated for their relative contribution to the watershed's health. Growth of population, population density, and housing density projected to 2030 can be used to flag areas that will see particularly large expansion for further examination of how this growth would affect the watershed.

LAND USE INDICATORS

Land use characteristics used as indicators for watershed health take into better account all of the different land uses in an area, instead of being biased towards residential areas, as is the case with socioeconomic indicators. Land use characteristics can also identify sources of non-urban runoff in the form of agricultural and recreational areas. With differentiations able to be made between land use types, generalizations can also be made about the potential contaminants that may come from these land uses. The trade-off for this, however, is the greater level of effort required to use land use characteristics for water quality indicators. Maps and aerial photography must be obtained, digitized, and analyzed in a GIS system where areas of different land use types can be identified and calculated. As with the socioeconomic indicators described above, these techniques are based on quantitative techniques for determining impervious cover (CWP, 1999). While the CWP's Impervious Cover Model may not be suitable for evaluating watershed health in the San Diego region's climate, the methods of

identifying land uses, calculating the areas of these uses, and comparing them to planned uses can still be of use in the Otay River watershed.

Land cover information can be used to provide a baseline from which future planned uses may be compared. Land cover can be inferred from existing land use information, such as shown in Figure 1, Existing Land Use (at the end of this report). The land cover types of existing uses are broken into a variety of categories describing their general use. Although the volume and constituents of runoff from these land cover types cannot determined from their identification, generalizations such as these can be made from the cover types that can assist in the watershed evaluation (SWRCB, 2004):

- Multiple-family residential areas – high proportion of impervious surfaces contributing to runoff; contaminants likely to consist of litter, motor oil, or other car fluids;
- Single-family residential areas – with lawns, have moderate proportion of impervious surfaces contributing to runoff; contaminants likely to consist of litter, motor oil or other car fluids, and pesticides and herbicides from yards;
- Recreational areas – low proportion of impervious surfaces contributing to runoff; contaminants differ widely depending on type of facility but likely to contain fecal coliform from pets, herbicides, pesticides, and fertilizers from landscaped areas;
- Agricultural areas – low proportion of impervious surfaces contributing to runoff; contaminants likely to contain herbicides, pesticides, and fertilizers;
- Roads and freeways, shopping centers, commercial, and light industrial areas – high proportion of impervious surfaces contributing to runoff; contaminants likely to consist of litter, motor oil, or other car fluids.

Assumptions regarding the runoff and contaminants likely to originate from other cover types can also be made at this level of analysis. Because these generalizations are assumptions, they should be used to assist in the identification of areas that deserve closer scrutiny in an analysis of watershed health, but will not provide any categorical conclusions.

The area of the different land cover types in each sub-watershed can be calculated and used as a baseline to compare future planned land uses against. Using the general plans and zoning for the jurisdictions in the Otay River watershed, an estimation can be made of the area of future land uses. As zoned land uses represent the potential for the community at full build-out, evaluators should consider discounting the acreage of zoned land at a rate appropriate for the planning horizon of the zoning codes or for the period examined in the evaluation. For calculations of near-term or mid-term effects of growth on water quality and watershed health, acreages for build-out could be calculated at a discounted rate of 70 to 80 percent of the total zoned acreage (CWP, 1999). An analysis examining the effects of growth on a longer term would need to ensure that the planning documents used had also planned for that extended period of time. The land use classifications used in the general plans and zoning codes may not specifically match the categories of land cover types identified for the existing land uses. To compare the existing land use areas to the planned areas, existing uses may need to be re-categorized to match the land use classifications used in the zoning codes. Figure 2, Planned Land Uses, shows the Otay River watershed's planned future uses in categories equivalent to those shown in Figure 1.

The comparison of the area of planned land uses to the area of existing uses can provide a quantitative estimate of the change, and even the rate of change, of land uses in the watershed. Although these results cannot provide a quantitative value for how the land use change will affect the watershed, they

can illustrate, relative to other areas within a sub-watershed or between sub-watersheds, which areas will see the greatest changes in their contributions to the water quality in the Otay River watershed.

SUMMARY OF RECOMMENDATIONS

Neither socioeconomic data nor land use characteristics provide precise, quantitative indicators for existing water quality and watershed health or for future conditions. Both socioeconomic and land use indicators can, however, provide important information on where quantitative studies should be focused. While appropriate socioeconomic indicators are more limited than land use indicators, the analyses behind them require less effort to perform and can be more easily updated on a regular basis as census data and growth forecasts are updated. Land use indicators require substantially more time and effort than the socioeconomic indicators, but provide a more comprehensive and more detailed view of how land use and development changes affect the watershed. Because of the amount of effort required for the analysis of land use indicators and the constantly changing landscape of the San Diego area, regular updates of the land use analysis require substantial ongoing work. With this in mind, however, calculation of socioeconomic and land use indicators should occur on a regular basis with the update of population and growth forecasts and planning documents. Suggested baseline indicators of land use and socioeconomic change in the watershed are presented below.

BASELINE INDICATORS

Population and Housing Density – Assessment of population and housing density provides a relative measurement of which sub-watershed areas are experiencing the most land use change and associated impacts from land development. Identification of such areas allows for prioritization of more detailed analysis focused on these areas. Areas with high proportions of commercial and industrial areas and low population and housing densities can be inadvertently overlooked, however, and so should be evaluated using other methods. Population and housing density should be calculated at the sub-watershed level using census tract-level data following the release of new population and housing numbers by the U.S. Census Bureau or SANDAG.

Population Growth – Regular examination of population growth estimates within the sub-watersheds identifies future areas of concern and allows for increased assessment of existing water quality conditions, greater awareness of changes to water quality and contributions to watershed conditions in these areas, and an improved ability to plan for maintaining and enhancing threatened resources. Population growth for each sub-watershed should be monitored with the release of new growth forecasts by SANDAG and adoption of General Plan updates.

Land Cover Types – Identification of even basic categorizations such as “forest”, “wetland”, “agriculture”, and “intensive/urban” land cover types and tracking the change in their area over time can be valuable for assessing whether watershed conditions have improved, declined, or remained the same. With greater detail, land cover types can also provide an indication of the constituents of contaminants introduced into the watershed. Because of rapid growth in the San Diego area, land covers in the watershed and sub-watersheds should be quantified and tracked on a bi-annual basis.

Projections of Future Land Use Changes – The comparison of projected future land use to existing land uses allows for a more detailed analysis to determine which areas within sub-watersheds will change and how those changes may affect the watershed. Since the greatest proportion of the watershed occurs within the County of San Diego and the City of Chula Vista’s jurisdictions, these analyses

should be performed following major updates to these jurisdiction's general plans and zoning ordinances.

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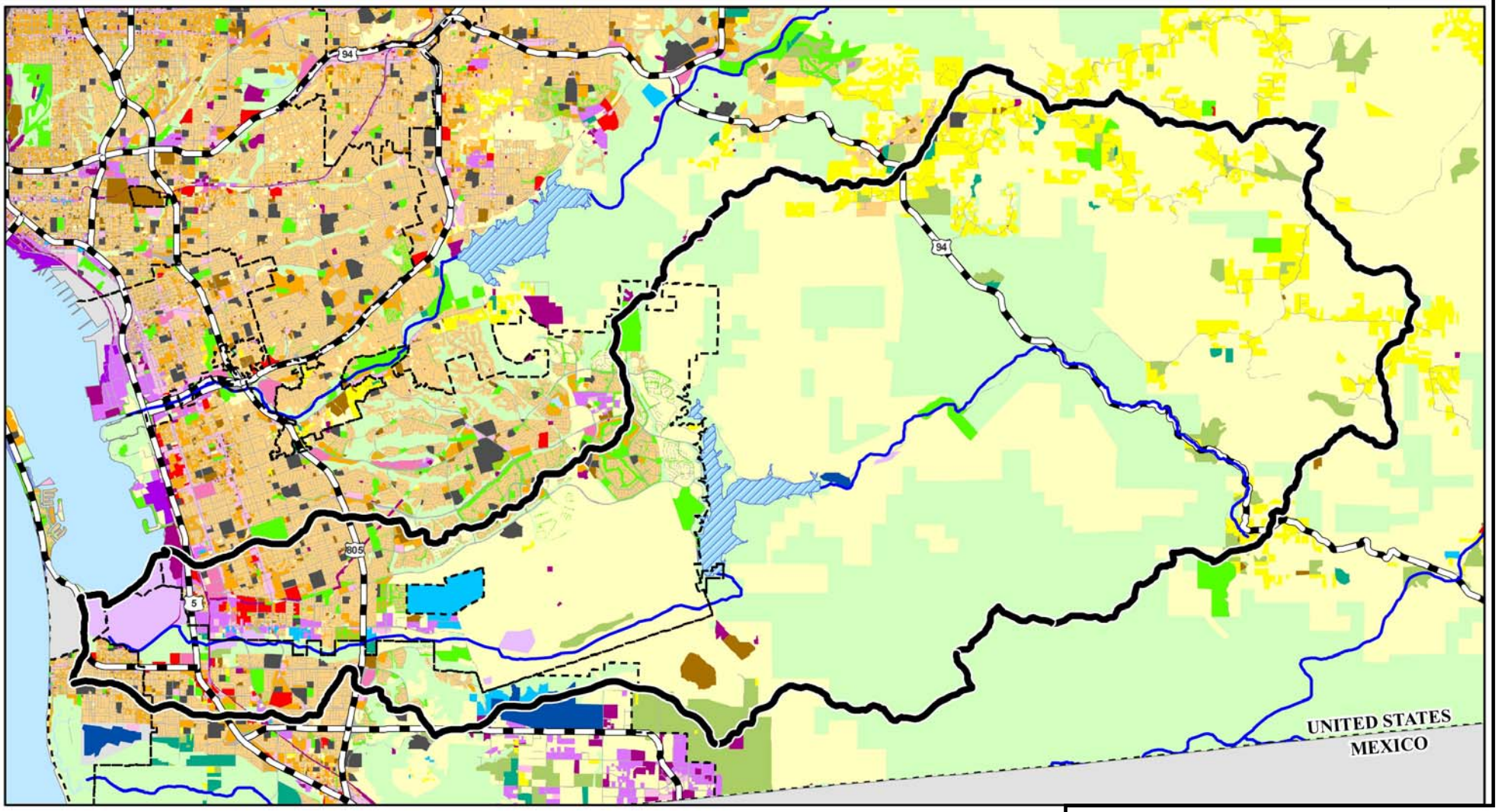


Legend

- Airports
- Commercial Recreation
- Commercial and Office
- Education
- Extensive Agriculture
- Extractive Industry
- Freeway-Roads
- Heavy Industry
- Institutions
- Intensive Agriculture
- Junkyard/Dump/Landfill
- Light Industry
- Military
- Mobile Homes
- Multiple Family
- Open Space Preserves
- Parks
- Shopping Centers
- Single Family
- Spaced Rural
- Transportation/Communication
- Undeveloped
- Water

Source: SANDAG 2003

Basemap Legend

- Otay River Watershed Boundary
- City Boundary
- Rivers
- Lakes

N

0 2.5 5

Scale in Miles

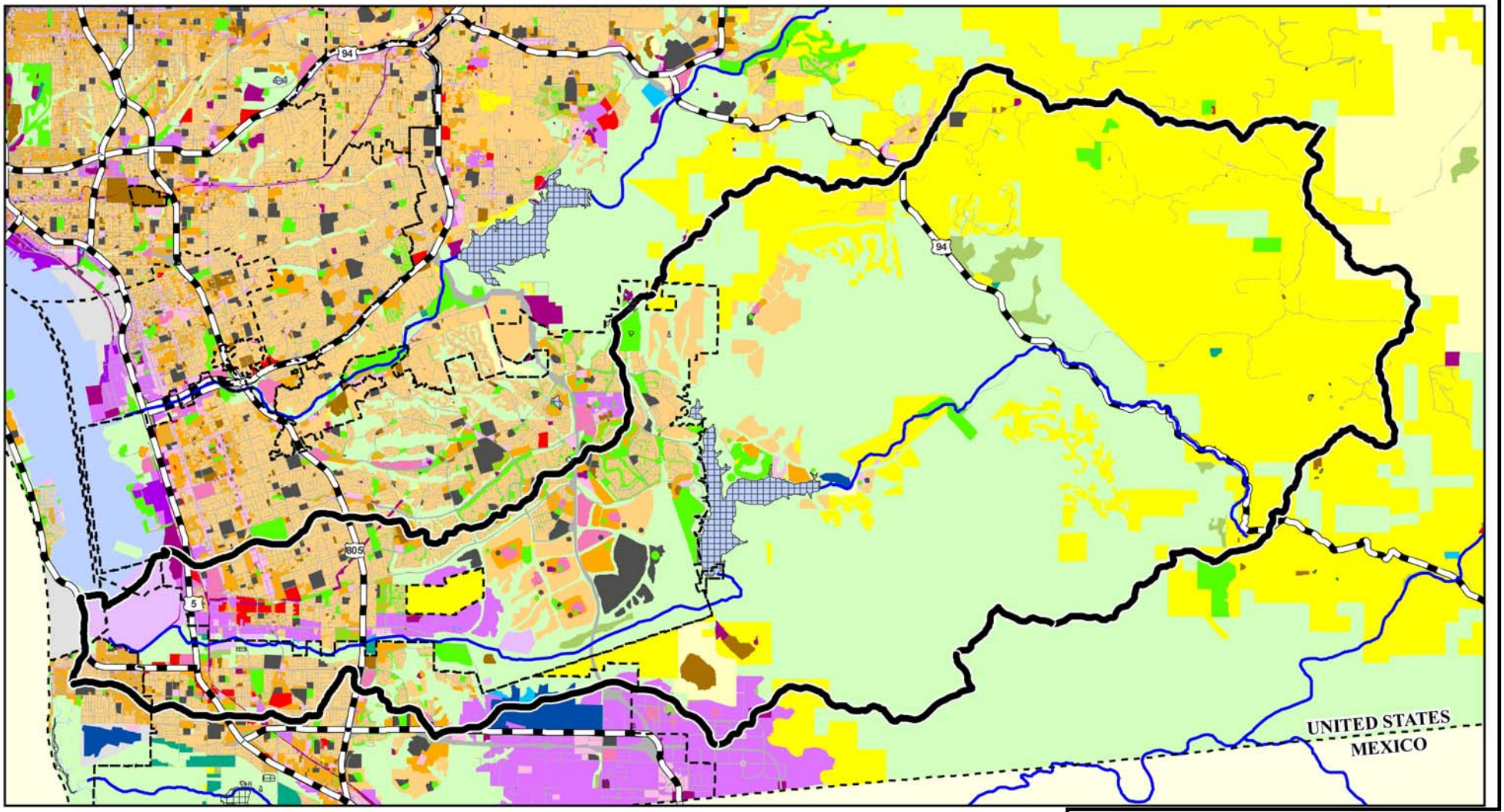
Source: TAIC, 2004

Socioeconomic and Land Use Indicators Report

Figure 1

Existing Land Use

Aspen Environmental Group



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N

Source: TAIC, 2004

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Figure 2

Planned Land Use

Aspen Environmental Group