Santa Ana Integrated Watershed Plan
Volume 2: Environmental and Wetlands Component

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(AVAILABLE ON CD ROM)

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PREFACE

South fork of the Santa Ana River.
Photo courtesy of SAWPA.

The SAWPA Integrated Watershed Plan, Environmental and Wetlands Component is the first step toward implementing a watershed-wide wetlands program and watershed plan that integrates wetlands, trails, habitat, open space, education, and invasive species removal. This plan can be used by anyone interested in improving the ecological health of the watershed. We are all inextricably linked to the projects and opportunities identified in this Plan because they will help to create a more sustainable Santa Ana Watershed. New partnerships have arisen out of scoping meetings and other discussions during the preparation of this document. Many more partnerships are expected to grow. For example, there is a special message to the planning community inviting public and private sector planners alike to increase awareness of the benefits of planning on a watershed scale and to integrate watershed thinking into the everyday planning process. It is with great excitement and anticipation that SAWPA invites you to read the pages that follow. We hope you will be inspired by the projects, opportunities, and messages contained within this Plan.

ACKNOWLEDGEMENTS

Santa Ana River outlet in Huntington Beach.
Photo courtesy of SAWPA.

SAWPA wishes to thank its Member Agencies: Orange County Water District, Inland Empire Utilities Agency, Western Municipal Water District, Eastern Municipal Water District, and San Bernardino Valley Municipal Water District, SAWPA Commissioners, and their staff for their support and acknowledgement of the importance of this document. In addition, SAWPA expresses great appreciation to the many participants who attended the IWP Environmental and Wetlands Components Scoping Meetings and those who provided project information and input into the Plan. In particular, SAWPA thanks Ms. Martha Davis for her comments on the draft document (included in Appendix K). Ms. Davis' recommendations have been incorporated into the final document. A complete list of agencies, organizations, and individuals who contributed to this Plan are included in the Preparers and Contributors Section. Special thanks to Mr. Jerry King, Chairman of the SAWPA Commission and Orange County Water District, whose leadership and commitment to improving the ecological health of the Santa Ana Watershed have made this document a reality.

ACRONYMS

Caltrans

California Department of Transportation

CDFG

California Department of Fish and Game

EMARCD

Elsinore-Murrieta-Anza Resource Conservation District

EMWD

Eastern Municipal Water District

EPA

Environmental Protection Agency

EVMWD

Elsinore Valley Municipal Water District

EVRCD

East Valley Resource Conservation District

HCP

Habitat Conservation Plan

IEWRCD

Inland Empire West Resource Conservation District

IEUA

Inland Empire Utilities Agency

IWRP

Integrated Water Resources Plan

IWP

Integrated Watershed Plan

LESJWA

Lake Elsinore/San Jacinto Watersheds Authority

MWD

Metropolitan Water District

MSHCP

Multi-species Habitat Conservation Plan

NCCP

Natural Community Conservation Plan

NFS

National Forest Service

NPDES

National Pollutant Discharge Elimination System

NPS

National Park Service

OCPFRD

Orange County Public Facilities and Resources Department

OCSD

Orange County Sanitation District

OCWD

Orange County Water District

POTW

Publicly-owned Treatment Works

RWQCB

Regional Water Quality Control Board

RCD

Resource Conservation District

RCRCD

Riverside-Corona Resource Conservation District

SAR

Santa Ana River

SARI

Santa Ana Regional Interceptor

SARWG

Santa Ana River Watershed Group

SAW

Santa Ana Watershed

SAWA

Santa Ana Watershed Association of Resource Conservation Districts

SAWPA

Santa Ana Watershed Project Authority

SBVMWD

San Bernardino Valley Municipal Water District

SBVWCD

San Bernardino Valley Water Conservation District

SCIWP

Southern California Integrated Watershed Program

SJBRCD

San Jacinto Basin Resource Conservation District

SWRCB

State Water Resources Control Board

TDS

Total Dissolved Solids

TIN

Total Inorganic Nitrogen

TMDL

Total Maximum Daily Loads

TVRI

Temescal Valley Regional Interceptor

USACE

United States Army Corps of Engineers

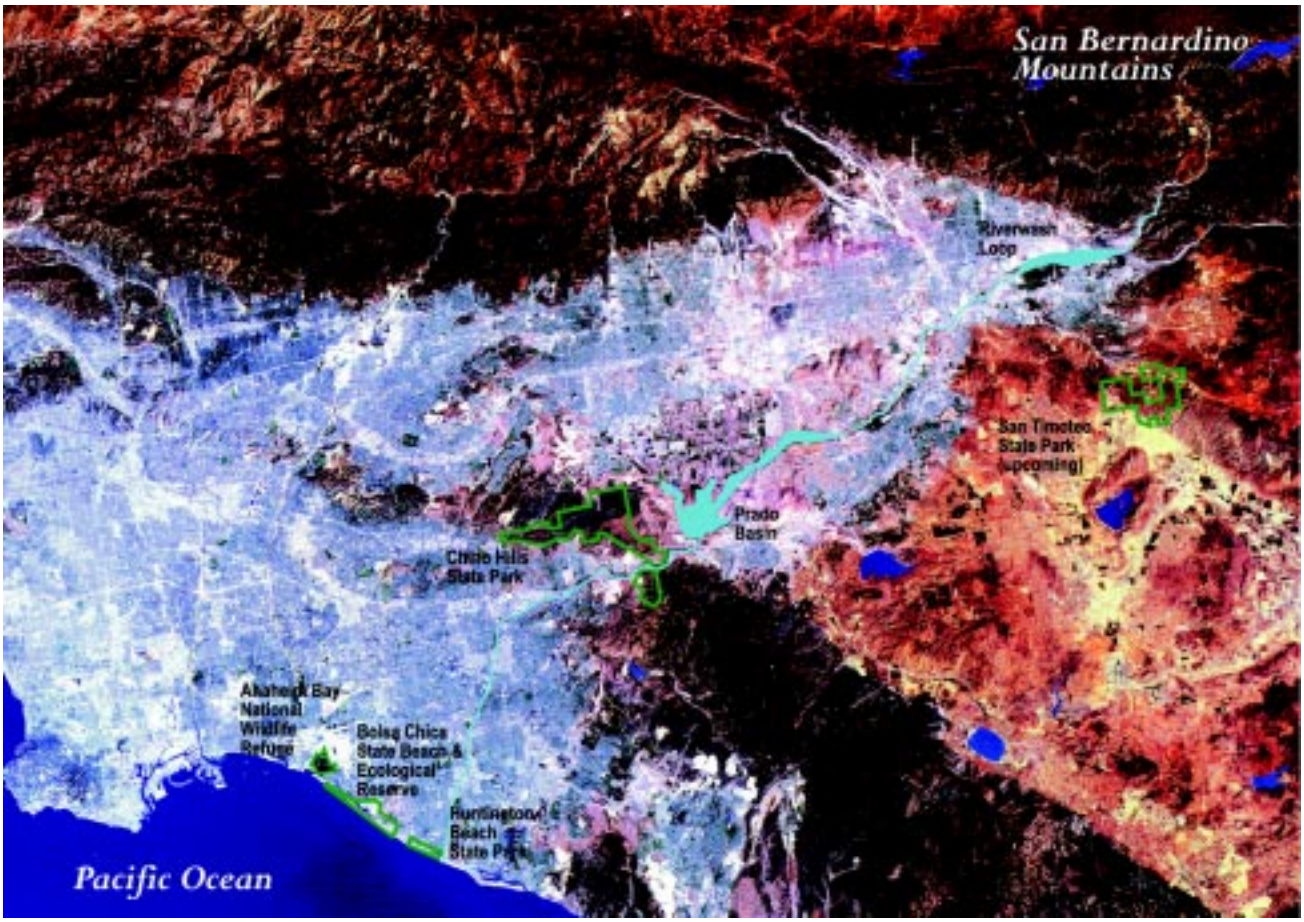
USFWS

United States Fish and Wildlife Service

WMWD

Western Municipal Water District

EXECUTIVE SUMMARY



View of the Santa Ana Watershed from space.

Purpose

The purpose of the Santa Ana Integrated Watershed Plan (IWP), Environmental and Wetlands Component is to provide a framework for the integration and coordination of future environmental enhancement planning efforts and partnerships within the Watershed with the intent of restoring the ecological functions of systems, where possible.

This document attempts to capture a "snapshot" of the current state of the Watershed by providing an inventory of resources and opportunities brought to the forefront through the Plan's outreach activities and four scoping meetings. Representatives from the Watershed's water community, cities, counties, special districts, and community-based organizations came together in July and August 2002 to exchange important ideas and project information, and over 150 groups and individuals provided input. A common desire expressed by the Watershed community was the need for more funding to ensure that good projects within the Watershed are not only identified, but more importantly, that they are implemented. This Plan is not exhaustive, but rather a forward thinking document that moves the Watershed farther along in the quest for conservation and enhancement of the Santa Ana Watershed's rich environmental heritage.

What's special about the Santa Ana Watershed?

The Santa Ana Watershed is home to a dazzling array of habitat types, including coastal bluff, riparian woodland, and coastal sage scrub. World-renowned ecologist E.O. Wilson has named Southern California one of the top 18 biodiversity hot spots in the world, and Myers, et. al. recognized coastal California (encompassing the Santa Ana Watershed) as one of 25 worldwide hotspots in their notable paper "Biodiversity hotspots for conservation priorities" published in the journal *Nature* in 2000. A hotspot is an area featuring exceptional concentrations of endemic species and experiencing exceptional loss of habitat. The Prado Wetlands provides an excellent example of a resource that has not, to date, been rated a conservation priority among state resource agencies and yet it is the largest freshwater wetland in Southern California and serves as a critical staging area for migratory birds along the Pacific Flyway, in addition to providing habitat for endemic endangered species. Conservation of the Santa Ana Watershed's resources is vital to the ecological health of the region, the State, and the world.

Extraordinary Resources Within the Santa Ana Watershed Requiring Continued Coordination, Planning, and Protection:

Prado Wetlands is the largest freshwater wetlands in Southern California and the largest constructed wetlands in the world; it has led to the stunning recovery of the federally endangered least Bell's vireo population.

Bolsa Chica Wetlands is a 300-acre coastal sanctuary for wildlife and migratory birds; 163 pairs of endangered Belding's Savannah sparrows live, breed, and nest at Bolsa Chica.

Although largely an urban watershed, the Santa Ana Watershed also includes many wild, untouched areas such as the San Bernardino National Forest and Cleveland National Forest. These wild areas are linked by riparian corridors and significant habitat such as the San Timiteo wetlands—home of the least Bell's vireo. From conifer forests to riparian forests, from chaparral to coastal sage scrub habitat, and from aquatic and wetland habitat to salt marshes, the Watershed is home to a large concentration of endangered species. Both Prado and Bolsa Chica wetlands among many others also serve as a critical staging area for migratory birds along the Pacific Flyway.

Irvine Ranch Land Reserve, totaling approximately 50,000 acres is prized for its beauty and unique geological and natural diversity including the 5,500-acre Limestone Canyon and the "Sinks," a striking formation frequently compared to a miniature Grand Canyon

Western Riverside County Multi-Species Habitat Conservation Plan conserves approximately 510,000 acres of open space including significant oak woodland and coastal sage scrub habitat

San Bernardino Valley-wide Multi-Species Habitat Conservation Plan encompasses

approximately 500 square miles containing six unique habitat types, six state endangered species, 13 federally endangered or threatened species, and over 53 species of special concern.

Orange County Central Coastal NCCP Subregional Plan establishes a 37,380-acre reserve system covering 39 sensitive plant and animal species

Orange County Southern Subregion NCCP/HCP will protect 91,000 acres of habitat

Federally and/or State-listed species within the Watershed include: Santa Ana River sucker, arroyo toad, lease Bell's vireo, southwestern willow flycatcher, bald eagle, San Bernardino kangaroo rat, Stephen's kangaroo rat, Santa Ana River wooly star, slender-horned spineflower, and Delhi Sands flower-loving fly.

Plan Recommendations

Plan recommendations provide form for the document and are intended to allow jurisdictions to advance, promote, and enable four integrated concepts: Improve water quality, protect and restore habitat, engage the community through education and recreation, and plan for the future. Strategies translate plan recommendations into specific project activities or programs. A number of these projects and opportunities are already in progress or will be established during the preparation of this Plan, including

- Creation, restoration, and enhancement of native and treatment wetlands (and riparian systems) to improve habitat, water quality, and recreational opportunities
- Enhancement of habitat for the threatened Santa Ana Sucker and other endangered species, in addition to other aquatic resources that are not yet listed, such as native fish, reptiles, and amphibians in the Watershed
- Identification of other open space, land acquisition, and habitat improvement opportunities with the intent of addressing environmental, recreational, and educational needs of the Watershed while planning for increased water supplies and improved water quality
- Removal of invasive exotic species, such as giant cane (*Arundo donax*) from the Watershed to restore riparian habitat and to increase available surface water
- Completion of the Santa Ana River Trail and Parkway to provide public river access for non-motorized transportation, where feasible, and to provide recreational and educational opportunities to showcase the Santa Ana River and provide a place for people to enjoy this wonderful resource

Each of these opportunities requires partnerships among federal, State, and local governments, in addition to the Watershed community at large. The Santa Ana Watershed Project Authority (SAWPA), as the coordinating body for this Plan, works with its five member agencies, the four counties that comprise the Watershed, the governments of the Watershed's 59 cities, nearly 100 water-related agencies, and the Watershed's 5.1 million residents, in addition to State and federal agencies such as the California Resources Agency, the State Water Resources Control Board, the California Department of Fish and Game, the U.S. Fish and Wildlife Service, and the U.S. Army Corps of Engineers.

Restoration means the reestablishment of the structure and function of the Santa Ana Watershed ecosystems. Ecological restoration is the process of returning an ecosystem as closely as possible to predisturbance conditions and functions. It is not possible to recreate an ecosystem exactly because they are naturally dynamic. Nor is it possible or desirable to be exact because human use of the landscape may have precluded or provided many options. The restoration process is used to reestablish the general structure, function, and dynamic but self-sustaining behavior of the ecosystem. As this is accomplished, the natural biological attributes of the system return, such as native plants, fish, birds, and other wildlife that enriches the quality of life for everyone. Many times this natural environment is the reason that people move into an area, only to see it disappear as ecosystems are disrupted and displaced.

As natural ecosystem processes are altered by human activity, vegetation is changed, and hardscape increases, infrastructure maintenance costs increase and the original values of living in an area are altered. A return to a more natural self-sustaining system can often lower infrastructure costs, raise property values, and reconnect people with the natural wildland beauty of the Santa Ana Watershed.

Watershed Structure and Function Restoration Recommendations

These restoration recommendations are intended to allow jurisdictions, communities, and groups to advance, promote, and enable the concepts below.

Recommendation #1: Improve Water Quality and Preserve and Improve Ecosystem Function

1-A. Develop water treatment wetlands and channels to improve water quality in a sustainable manner and provide multiple benefits.

1-B. Protect, restore and widen riparian vegetation corridors to reduce impacts of stormwater runoff, improve water quality, provide habitat, and improve aesthetics.

- Reintroduce vegetated buffer strips wherever possible along stream banks to reduce the force of a flooding current against the bank, slow water overflowing channel banks, and allow sediment to deposit.
- Ensure that riparian vegetated buffer strips are as wide as possible, although a narrow strip is better than none at all.

1-C. Carefully plan human activities to reduce erosion.

1-D. Continue to utilize technologically advanced sustainable solutions to resource management dilemmas, such as water quality improvements.

1-E. Reduce or eliminate beach closures through water quality improvements and reduction of contaminant discharge into the Pacific Ocean.

Recommendation #2: Protect and Restore Habitat Resources

2-A. Restore natural wetland habitats in flood plains of the River and its tributaries.

- Look for opportunities in natural undeveloped areas to add wetlands that will increase complex natural habitats in juxtaposition to the stream system.

- Connect wetlands to the stream corridor through the addition of channels and vegetation.

2-B. Protect and restore remaining native species and habitats.

- Recreate meanders and backwaters where possible within the River and its tributaries to enhance native fish habitat.
- Create drop structures and other oxygenation devices that do not inhibit fish passage.
- Reestablish riffle substrates.
- Develop instream structures to promote pool and flow complexes.

2-C. Identify public and private agencies and organizations to maintain acquired lands and funding sources.

2-D. Acquire key parcels of land for conservation.

- Establish conservation goals and target selection criteria.
- Identify key potential parcels based on selection criteria.
- Negotiate conservation easements as an alternative to outright purchase of lands.

2-E. Promote the identification, establishment, and protection of wildlife corridors.

2-F. Connect upland vegetation and habitats through edge habitats and corridors.

- Locate isolated habitat patches and establish corridors suitable to increase the habitat diversity available to all species.
- Plant native trees, shrubs, grasses, and forbs (herbs) to establish wildlife-friendly pathways along roads and channels.

2-G. Remove and control invasive exotic species.

- Continue active programs for removal of established invasive species.
- Identify and control recently established invasive species to prevent further spread.
- Prevent introduction of future invasive species.

Recommendation #3: Engage the Community through Education and Recreation

3-A. Improve recreational opportunities for the region, including access to streams, lakes, and beaches through dedication of easements and land acquisition.

3-B. Increase water conservation and decrease imported water use through public education and provision of water saving devices.

3-C. Involve the public through outreach and education coordinated with the agencies and schools in the watershed.

3-D. Increase available open space throughout the region, including balancing open space availability among various communities by increasing parkland acreage in densely urbanized areas.

Recommendation #4: Plan for the Future

4-A. Facilitate partnerships among groups with similar goals and support community based sub-watershed groups.

4-B. Work with the State Resources Agency through the California Watershed Management Forums and other State and regional agencies to achieve State and regional goals.

4-C. Use the best scientific data available and regional collaboration to make complex resource management decisions.

4-D. Promote effective watershed monitoring, data management, and project evaluation programs.

4-E. Identify and pursue future sources of funding to complete watershed projects. Funding source identification should include provisions for operation and maintenance of projects in addition to capital expenditures.

4-F. Utilize this Santa Ana Integrated Watershed Plan, Environmental and Wetlands Component as a living document, including regular updates to maintain current watershed-wide planning and coordination.

According to the California Environmental Dialogue, habitat protection, restoration, and enhancement leads to economic benefits relative to natural systems, recreational and leisure industry, and reduction of conflict caused by species extinction, among other concerns. In particular, "the protection, enhancement, and restoration of California watersheds, riparian stream zones, and wetlands will reduce the need for costly new water treatment plants, provide high quality drinking water at reduced cost, reduce costs of flood damage, and improve water quality for aquatic ecosystems and human recreation." When considering why the Santa Ana Watershed community is interested in pursuing strategies, recommendations, and projects/opportunities identified in this document, one can reflect upon the fundamental nature of the rich ecological resources within the Watershed as well as the community's interest in protecting these resources for present and future generations.

Strategies

1. Creation, Restoration, and Enhancement of Wetlands

Future Wetland Projects within Santa Ana Watershed

California has experienced an 85 to 90 percent reduction in wetland acreage and leads the United States in wetland loss, tying only with Ohio. Within the Santa Ana Watershed, little information is available on historic wetlands, and loss estimates are uncertain. However, watershed planners within the Santa Ana Basin are working towards restoring natural wetlands and providing treatment wetlands to provide cleaner water while providing high value habitat, recreation, and educational opportunities. SAWPA and its member agencies are committed to assist with the planning and implementation of native and treatment wetlands within the Santa Ana Watershed. For example, the County of Orange has adopted a policy requiring all streams, tributaries, and channels to include a treatment wetland system to improve water quality in the region. For more information on planned wetland projects, please consult Section 3A-1.

Implementation

1. When siting created/constructed wetlands, project proponents should take care not to destroy valuable native riparian habitat.

2. Created/constructed wetland projects should be designed to serve as multi-benefit projects in addition to improving water quality, including increased habitat value, improved aesthetics, and expanded recreational opportunities, hiking trails, educational components and opportunities for observation (where feasible).
3. Most desirable wetland projects are those that address as many functions as are obtainable (e.g., wetland habitat, water quality, treatment, aesthetics, etc.).
4. Wetland projects should be designed to be durable and either resistant to potential flood damage or quickly recoverable after flooding.
5. Wetland projects should be designed to minimize the production of vector species.
6. Wetland projects should be designed to be low maintenance.

2. Removal of Invasive Species

Because this exotic plant alters ecosystem dynamics and interrupts and redirects succession, the removal of *Arundo donax* from the Watershed offers numerous direct and indirect benefits to landowners, land managers, public agencies, and other Watershed residents. These benefits include reduction in risk of flooding and fire, improvements in water quality, increases in surface water supply, and restoration of habitat for native species, including several threatened and endangered species.

The numerous parties making up Team *Arundo* within the watershed are clearing *Arundo* from many areas, including the upper tributaries of the Watershed. Section 3A-2 lists *Arundo* distribution and historical specific removal efforts within the Watershed, as described by Neill and Giessow (2001). Appendix D provides an *Arundo* Removal Protocol, produced by SAWPA. By providing necessary funding, the Southern California Integrated Water Program *Arundo* Removal Program will greatly accelerate *Arundo* removal efforts within the Watershed.

Citrus groves, shown here in the Santa Ana River wash area near Redlands, historically served as an economic base of the Watershed.
Photo courtesy of SAWPA

Although not nearly as pervasive, perennial pepperweed has been referred to as "the next *Arundo*." Like other invasive species, pepperweed harms native flora and fauna by outcompeting native species, and forming a monoculture that is inhospitable to native and special status wildlife species such as the least Bell's vireo.

Implementation

1. Continue seeking funding for further removal of *Arundo* and other invasive species and long term monitoring of previous removal efforts.
2. As groups remove *Arundo* within the watershed, post-removal monitoring should include identification, documentation, and removal of perennial pepperweed for a minimum of three years. This recommendation is crucial for the Hidden Valley area to prevent spread of pepperweed to the Riverside County Parks land above Van Buren Bridge. Control of the species below Prado Dam is crucial to prevent spread to the Orange County River Channel.
3. Facilitate other groups beyond Team Arundo members to perform removal and maintenance.
4. Facilitate efforts by agencies and groups who maintain the river.

3. Increasing Connectivity of Regional Trail System

Many recreational efforts are focused on the Santa Ana River Trail, an important regional recreational element. First conceived over a century ago and formally proposed in 1955, the Santa Ana River Trail is a much-anticipated project with watershed-wide support. Within the Santa Ana Watershed, no other issue seems to spark as much enthusiasm or inspire as much collaboration between diverse interests as trail planning. Trails are viewed as valuable resources—providing connectivity, transportation alternatives, scenic relief to urban dwellers, recreational opportunities, and linear parkways with opportunities for environmental restoration as well as education. Opportunities for multi-benefit projects that incorporate trail planning, open space acquisition, wetlands/habitat enhancement, and educational/interpretive components are desirable. Watershed planning participants agree that the trail should provide access for a wide variety of users, including walkers, hikers, joggers, bicyclists, horseback riders, users in wheelchairs, rollerbladers, and skateboarders. Some of these users require special features, such as wheelchair access or equestrian staging areas.

Implementation

Trail Completion

1. Construct those sections of the Santa Ana River Trail for which funding has been secured (namely, Phase I in San Bernardino County).
2. Secure funding for completion of those sections that have been planned: Phases II, III, and IV in San Bernardino County and Phase I: Part 2, Phase IIIB: Part 2, Phase IV, and Phase V in Riverside County.
3. Complete other vital links such as Temescal Wash/San Jacinto Wash to San Jacinto Mountains and connections to the new San Timoteo State Park
4. Best utilize up to $10.0 million in funding recently provided by Proposition 40 to complete the trail in the Watershed.
5. Employ better communication and integrated review to assist city/county planners in assessing trail impacts when

considering proposed projects. Trail users are concerned about pieces of potential trail connections disappearing permanently once development is approved without provision for trails. Therefore, there is a need to coordinate trail planning efforts with other project efforts to avoid conflicting land uses. For example, each county's Parks and Recreation/Trail Planning Department should coordinate with other County and City partners regarding potential projects (e.g., planning and public works projects).

6. Integrate individual cities' trail planning efforts to ensure connectivity and to ensure that the Santa Ana River Trail's usefulness reaches its full potential.

7. Institute a trail overseer role. For example, SAWPA could assist the watershed community in developing a trail overseer role, so that when proposed projects undergo environmental review through the CEQA process, not only will the lead agency/City/County look at trail impacts, but the trail overseer could also do the same.

Amenities

8. Ensure consistent trail mileage. Orange County's mileage system begins with the Pacific Ocean as Mile Zero, and this mileage system should be carried out along the length of the Trail, with the connection to the Pacific Crest Trail approximating Mile 110. A mileage system is an important safety issue because it allows users to know their location, distance traveled, and distance left to travel. In addition, those training for marathons and other fitness events that require specific mileage goals during training may use the trail.

9. Trail should include the availability of water fountains for user refreshment and safety.

10. Trail should include restroom access, such as maintained port-a-potties.

11. Trail should include frequent shade trees to provide relief from the sun and heat of inland Orange, Riverside, and San Bernardino Counties. Native species should be used for these shade trees.

12. Trail should include staging areas for equestrian use and paddocks to serve as rest areas for horses.

13. Trail should include bike racks to allow riders to secure bicycles when using trailside amenities.

14. Trail should include ample disposal facilities for garbage, including garbage cans, recycling bins, and elevated "bicycle-friendly" garbage cans that are convenient for bikers to utilize.

15. Trail should include access to air hoses for bikes that need to inflate their tires.

16. Trail should include interpretive signage for environmental and wildlife education.

More equestrian connections to the riverbed are needed, such as this one near Anza Narrows Park in Riverside.
Photo courtesy of EIP Associates

17. Trail should include some bike n' hike primitive campgrounds for those interested in biking or riding from coast to crest (these campgrounds should be accessible by foot, not requiring a car). One challenge in implementing these campgrounds will be security issues, including personal safety and emergency vehicle access.

ESSENTIAL RESOURCE CONSERVATION AREAS

These areas have been identified by Watershed planning participants as vital areas for acquisition and conservation

Source: Watershed Stakeholders, SAWPA Scoping Meeting, August 14, 2002

1. Santa Ana River Mouth to Fairview Park
2. Bolsa Chica Wetlands
3. Upper Newport Bay
4. Lower Newport Bay
5. Santiago Creek
6. Temescal Canyon
7. Palomar- Santa Ana Mountains linkages
8. Featherly Park
9. Prado Basin
10. Coal Canyon
11. City of Chino- Sphere of Influence
12. Box Springs Mountains
13. San Timoteo Canyon
14. Carbon Canyon Creek
15. Connection from City of Whittier to Chino Hills State Park
16. Lytle Creek
17. Mystic Lake

Other Implementation

18. Continue outreach and contact with law enforcement to pursue trail access and safety.

19. To draw attention to the trail, its planners should host annual 2-day Bike n' Ride events with camping on the first night. This event could be timed such that participants could join in at various points along the trail.

4. Multi-objective Conservation Planning and Projects

Several areas within the watershed offer excellent opportunities for habitat acquisition, enhancement, and restoration. Watershed participants recognize that habitat acquisition is equally important as habitat restoration.

Recommended Strategies

Recommended strategies for restoration included habitat enhancement, beach renourishment, and revegetation projects. Potential restoration projects include culvert daylighting, as discussed in Section 2G, Flood Control. In addition to restoring ecological function, appropriate implementation of these restoration activities can prevent listing of threatened and endangered species, as well as providing economic and other benefits to the region. Economic and public safety benefits of removing invasive species are discussed in Section 3C-2, Invasive Species Removal. Additionally, beach renourishment provides recreational and economic benefits to the region. Recovery efforts should favor multiple species projects.

Strategies for thinking ahead to create a conservation plan that ensures the long-term

viability of the watershed's native flora, fauna, and aquatic communities will prevent degradation of the watershed's delicate ecosystem. A framework for these strategies is found in Section 3A-4. By overlaying significant resource data such as the Riverside County land acquisition priority map with other watershed studies, better decisions will be made with regard to habitat restoration and enhancement efforts. Planning and discussion amongst key watershed participants will ensure that the best possible targets for restoration land acquisition will be selected.

A related strategy proposed in this plan, which could help to prevent sensitive or threatened species from becoming endangered, would be the creation of an Aquatic Resources Committee (ARC) under the administration of SAWPA, expanding the role of the Santa Ana Sucker Discussion Group to include other native fish. While participation in the ARC would be voluntary, the objective would be to encourage the active involvement of State and federal resource agencies, cities, counties, other local jurisdictions, and the private sector in coordinating and developing programs and specific projects focused on preventing future listing of native fish such as the arroyo chub and the speckled dace. Refer to Appendix G, Aquatic Resources Assessment, for more detail.

5. Education

Public Outreach

Public education will make clear the linkages between the condition of the watershed and the health and well being of the population, wildlife, habitat, the River, and the ocean. Public service campaigns address non-point source pollution and the reduction of trash, animal waste, organic matter, and other contaminants that wash into the ocean via storm drains and river systems. Public involvement programs should also encourage residents to become involved in the cleanup of the rivers, and build upon existing programs, such as the use of volunteers in monitoring river water quality.

In addition to those issues most directly related to the condition of the watershed, outreach programs should also address broader environmental issues, including watershed resource sustainability. At the simplest level, resource sustainability is the ability to meet current needs without compromising the ability of future generations to meet their own needs. This goal encompasses a range of concepts, such as recycling, energy and water conservation, use of appropriate building types and materials, minimizing use of hazardous materials, appropriate transportation planning and the purchase of environmentally friendly products and packaging.

Educational Programs

Educating children and young adults is equally important as continuing education for adults. Incorporating more environmental and water resource education into school curriculum, including as many field trips and hands-on programs as feasible, is the most effective way to ensure that the watershed's next generation will be commendable environmental stewards.

Education programs for children should build upon the extensive network of existing resources, such as the California Plan for Environmental Education, the California Regional Environmental Educational Center—Regions 9a and 10 (www.creec.org), Global Learning and Observations to Benefit the Environment (http:/

Educational Program Types	Notable Santa Ana Watershed Examples
Nature centers and interpretive exhibits	Expansion of Santiago Oaks Regional Park's educational facilities to include a Watershed and Nature Education Center with high-tech innovative exhibits (in progress)
Tours	The Orange County Water District (OCWD) offers tours of the Prado Wetlands led by a naturalist. To sign up for a tour, go to http://www.ocwd.com/_html/tour.htm. Eastern Municipal Water District (EMWD) offers tours of the Hemet/San Jacinto Constructed Wetlands, and Elsinore Valley Municipal Water District (EVMWD) offers student tours.
Brochures/flyers	"The Good, the Bad, and the Invasive," Santa Ana Watershed Association of RCD's invasive plant educational brochure
Events/meetings	Annual Coastal Clean-up, held each September and hosted by a number of organizations including inland cleanups sponsored by Trails 4 All
Curriculum development	California Coastal Commission compilation of K-12 curriculum specific to Upper Newport Bay with hands-on restoration activities (in progress) . EVMWD offers classroom presentations, books, and student/teacher workbooks. Riverside Corona RCD and OCWD are developing curriculum on invasive speices and the importance of wetlands. Western Municipal Water District (WMWD) offers the Water Conservation Garden Activity Book: a teacher's guide to activities and lesson plans relating to water conservation.
Homeowner guides and workshops	San Bernardino Municipal Water District's web site www.sbvmwd.com, hosts "The Easy Guide To Lawn Watering--Save Water & Cost," including a table that explains the total number of minutes to water your lawn each week. EVMWD offers a landscape workshop series, homeowner water audits, and conservation booklets and materials. WMWD recently published a brochure titled "Guide to Landscape Water Conservation in western Riverside County." The Riverside Lands Conservancey offers a useful and informative booklet titled "Stream Care- Every Person's Guide to Healing Waterways.
Videos	Huell Howser's video on the Santa Ana Watershed, Elsinore Valley Municipal Water District (EVMWD) Videos, and SAWA Video, "Arundo's Fatal Grip" with Congressman Calvert (available for purchase for $17.00)
Job training/scholarships	Orange County Conservation Corps- employs southern California youth to implement environmental projects, including recycling more than 1.6 million pounds of recyclable materials and completion of over 215 projects to maintain parks, beaches, rivers, and trails.
Internships	UC Irvine School of Social Ecology (http://www.seweb.uci.edu/) offers paid internships for university credit.

Table 3-4 Education Program Types and Examples

/www.globe.gov), the Global Rivers Environmental Education Network (http://www.earthforce.org/green/), the North American Association of Environmental Educators (http://www.naaee.org/), the U.S. EPA's Water Office Kid's Page (http://www.epa.gov/kids/), Earth 911 (http://www.earth911.org/usa/master.asp), and Water Education for Teachers (http://www.projectwet.org/).

Education programs for adults should include development of backyard habitat for wildlife, gardening techniques that minimize pesticide and herbicide use, natural methods of pest control, composting, organic gardening, planning and construction of stormwater drainage systems that promote groundwater infiltration, low water gardening and landscaping using improved irrigation technology and mulches.

Interpretive Opportunities

The Santa Ana Watershed Project Authority and its member agencies could work with Caltrans to implement a signage program for the Watershed. The Watershed and Waterway Signage Program would enlighten Santa Ana Watershed residents as to which watershed they reside in and familiarize them with the names of local waterways. With the help of Caltrans and the California Resources Agency, this program could be implemented Statewide to create a network of watershed signage. California residents and visitors would not only grasp the concept that "wherever you are, you're in a watershed," but would become familiar with the names of the watersheds they live in and travel through, thus creating these important connections to the land and water.

6. Partnerships

Assembling seemingly conflicting interests at same table to resolve issues of concern has proven

very successful within the Santa Ana Watershed, and has resulted in unique and effective partnerships. Whereas watershed planning may be *easier* within smaller watersheds, the difficulty of planning within larger watersheds is balanced by the ability to affect large-scale regional resource management and the opportunity to pool resources on a regional scale. This Watershed benefits from the significant efforts of agencies, organizations, and the communities who are dedicated to improving the ecological health of this region. From invasive plant species *(Arundo)* removal to trails, river parks, dairy waste clean-up, and conservation measures for endangered species, such as the Santa Ana sucker fish, the Santa Ana Watershed is leading the way in building partnerships which produce real results.

Chino Basin Partners

- Inland Empire Utilities Agency
- Santa Ana River Watershed Group (SARWG)
- Milk Producer's Council
- Synagro
- Orange County Water District
- Chino Basin Watermaster
- All of the Chino Basin Cities
- Santa Ana Watershed Project Authority
- U.S. Department of Agriculture/Natural Resources Conservation Service
- U.S. Department of Energy and the California Energy Commission
- Santa Ana Watershed Association of Resource Conservation Districts
- San Bernardino County
- Orange County Flood Control
- Orange County Sanitation District

Examples of notable partnerships are outlined in Section 3A-6. Many more partnerships are forming as awareness of the need to plan on a watershed level is increasing.

Implementation

1. The Santa Ana Watershed community should continue to create new partnerships and projects that improve the ecological health of the natural systems of the Watershed. SAWPA and other interested agencies, organizations, and individuals could help facilitate this process.

Santa Ana River Trail Partners

Counties:
Riverside
Orange
San Bernardino

Cities:
Colton
Highland
Loma Linda
Redlands
Riverside
Anaheim
Orange
Santa Ana
Villa Park
Corona
Huntington Beach
Norco
Rialto
San Bernardino

Agencies:
Orange County Water District
U.S. Forest Service, San Bernardino National Forest
Santa Ana Watershed Project Authority
U.S. Army Corps of Engineers
California Department of Parks and Recreation
National Park Service, Rivers and Trails Conservation Assistance
Orange County Sheriff's Office

Organizations:
Orange County Equestrian Coalition
Loma Linda University Community Outreach
Trails 4 All
San Bernardino Riders
Mike Carona Foundation
Wildlands Conservancy

Consultant Groups:
Dangermond Group
EDAW
Withers and Sandgren

Santa Ana Sucker Discussion Group

SUPPORTING PARTICIPANTS:

City of Riverside

City of San Bernardino

County of Orange PFRD

Orange County Sanitation District

Orange County Water District

Riverside County Flood Control and Water Conservation District

San Bernardino County Flood Control District

SAWPA

OTHER PARTICIPANTS:

U.S. Fish and Wildlife Service

California Department of Fish and Game

Santa Ana Regional Water Quality Control Board

Riverside-Corona RCD

City of Corona

2. SAWPA should continue to facilitate Watershed discussions to educate and inform Watershed leaders in the community about funding opportunities and partnerships that would be beneficial to initiating and completing projects identified through this Plan and beyond.
3. SAWPA should continue to work with the counties and appropriate cities to expand Watershed cooperation.
4. County and city planners should participate in Watershed project discussions so that the process of implementing the projects identified in this Plan is carried forward.
5. SAWPA should continue to develop and sponsor watershed and subwatershed groups and task forces.
6. Watershed participants should invest resources to ensure that watershed interests such as connectivity, trails, open space, biological diversity, water quality and supply, wetlands, are supported and included in the County of San Bernardino General Plan Update.
7. As projects are proposed through collaborative funding opportunities, watershed partners should utilize the MSHCP in making decisions regarding land acquisition areas within Riverside County.
8. Watershed stakeholders should continue to engage in watershed-wide (interjurisdictional) collaboration regarding connectivity, trails, and other watershed needs so that landscape linkages, public/private partnerships, acquisition, in-holdings, and public coastal access goals are realized in the County of Orange General Plan Update and related planning efforts.

7. Funding

Watershed participants agree that one of the greatest obstacles to implementing good projects in the region is the lack of reliable funding. While significant seed money and partnerships are currently in place for a number of watershed projects such as the Santa Ana River Trail completion and *Arundo* removal, there are many more projects, both large and small, which require funding. This document highlights many of the projects that would result in improvements within the Watershed. It also identifies funding needs for these projects. If funding can be secured for these projects through increased awareness of the needs of this community, then one fundamental goal of this watershed plan will have been accomplished. Long term funding needs include provisions for operation and maintenance of projects.

In an effort to facilitate greater understanding of potential funding sources available to project proponents, Table 3-6, Potential Watershed Project Funding Sources was compiled (U.S. Environmental Protection Agency, Catalog of Federal Funding Sources for Watershed Protection, Second Edition, and from the Los Angeles Regional Water Quality Control Boards website, Summary Document on Grant Funding Sources).

8. Assessment and Monitoring

Outcome indicators are a useful way to measure change within an area. In this case, outcome indicators are used as part of the Santa Ana Integrated Watershed Plan, Environmental and Wetlands Component to measure changes in the Santa Ana Watershed as a result of the efforts of SAWPA, SAWPA's member agencies, other governmental agencies, and citizens' groups. These changes are the result of projects identified within the plan and other opportunities implemented throughout the Watershed.

South fork of the Santa Ana River
Photo courtesy of SAWPA

Examples of Measurable Goals and Indicators

Examples of measurable goals and indicators are identified for each of the watershed structure and function restoration principles that follow.

1. Protect and Restore Habitat Resources

Remove Invasive Exotic Species

- Acres of land from which exotics have been removed
- Percentage of this land that has remained invasive-free after 5 years, 10 years, etc.
- Amount of new riparian habitat created

Prado Wetlands
Photo courtesy of SAWPA

2. Improve Water Quality and Avoid Future Reductions to Ecosystem Function

Improve Water Quality

- Number of impaired water bodies within watershed (waterbodies removed from the State Water Resources Control Board's 303(d) List of Impaired Waterbodies)
- Use water quality indicators such as dissolved oxygen, salinity, turbidity, and temperature.
- Percentage of groundwater basins that meet drinking water standards

Increase Water Conservation/Decrease Imported Water Use/Reduce Salinity

- Watershed wide use of recycled water (measured by millions of gallons per day)
- Per capita daily water use (measured by gallons per day)
- Amount of water imported to the Watershed (measured by acre-feet per year)
- Use of local water sources and storage of local water (measured by acre-feet per year)
- Water "banked" in groundwater basins (measured by acre-feet per year)
- Reduction and elimination of sources of salt in the Watershed

3. Engage the Community through Education and Recreational Opportunities

Improve Outdoor Recreational Opportunities

- Miles of biking and hiking trails within the Watershed
- Number of mega-connected trails (e.g. over 5 miles long)
- Number of publicly provided camping sites
- Number of equestrian staging areas

Increase Open Space

- Acres of land under protection on various levels within the watershed (e.g., private, city, county, state, and conservation easements)
- Acres of land covered in permeable vs. nonpermeable surfaces
- Public space acreage per 1,000 people (from SCAG data)
- Acreage of open space that provide multi-purpose benefits

Promote Watershed Education / Community Outreach

- Percentage of watershed residents that can accurately answer the questions, "What is a watershed?" and "What watershed do you live in?"
- Incorporation of water conservation curriculum into Orange County, Riverside County, and San Bernardino County Schools
- Participation of watershed residents in annual Coastal Clean-up (sponsored by the Center for Marine Conservation)

4. Plan for the Future

Identify Future Sources of Funding

- Number of grant applications made for watershed projects from

  a. Local funding sources

  b. State funding sources

  c. Federal funding sources

- Number of grants won for watershed projects from

  a. Local funding sources

  b. State funding sources

  c. Federal funding sources

- Operational and maintenance funding budgeted (measured per millions of dollars invested)
- Number of broad programmatic funding sources identified

Opportunities

A number of projects have been proposed by watershed stakeholders including cities, counties, agencies, organizations, and individuals. These are projects that may be in need of partnering or funding. While some projects are further along than others, all of these projects would enhance the ecological function of systems within the Watershed. Types of projects include wetlands, education, trails, habitat, and invasive species removal. Many of these are multi-objective conservation projects serving two or more ecological purposes. Refer to Table 3-9, Watershed Projects and Opportunities as well as the Watershed Projects Maps in Section 3A-8. The legend in the map identifies the project categories. In addition, Appendix A, Scoping Meeting Notes includes more detail on a number of projects and opportunities.

Next Steps

Plan Life Continues Beyond Today

In as much as this Plan presents a snapshot of the innovative projects and summarizes the plans and projects of many agencies, it will quickly age. SAWPA has received excellent feedback from agencies, groups, and individuals in this process.

The dynamic nature of projects and plans in the Watershed necessitates their update and renewal on a relatively frequent basis. This Plan will be

Santa Ana River, San Bernardino County, near the proposed Santa Ana River Trail Alignment.
Photo courtesy of EIP associates

used by agencies in the Watershed to help integrate plans and to focus funding on projects that are most effective and ready to proceed. This information must remain current to be effective.

Additionally, revisions to this Plan's strategies aimed at restoring the ecological function of the Watershed will develop over time forming a culture for the Watershed community. Future revisions of this document will capture these developments, new projects that are created, and projects currently listed that develop and evolve.

The SAWPA Commission will adopt this document as part of the Integrated Watershed Plan for the Santa Ana River Watershed and will use it to guide funding and development priorities.

Prado Wetlands
Photo courtesy of SAWPA

As the need arises for updates and the funding becomes available, SAWPA will initiate efforts to update and refine this Plan. Necessary elements for inclusion in Phase II of the Environmental and Wetlands Component are as follows:

- More information on the natural history of the watershed, including vegetation descriptions.
- An assesment of remaining significant habitat is needed. This assessment is essential for setting priorities. A more detailed description of natural resources, including vegetation, and a more comprehensive analysis of the ecological function of the Santa Ana River is needed.
- An expanded, more comprehensive assessment of ecological/open space/ recreational resources and their significance to the region, the state, and the nation would be useful in seeking further funding.
- Further information to explain what is special about the Santa Ana Watershed as a system, and what it contributes to California's and the nation's resources overall.
- Development of a multi-benefit, multi-agency strategy to help achieve agreed-upon watershed goals.
- Gap analysis for the watershed.
- Development of a coordinated, multi-benefit, multi-agency strategy to help achieve agreed upon watershed goals.

Given that everyone associated with the Santa Ana Watershed is inextricably linked from the mountains to the Pacific Ocean, additional partnering with State, federal, and regional agencies to further watershed planning efforts is vital. The actions of upstream users impact the quality of life of downstream users, and keeping this connection in mind is very important to improving both the overall ecological function of the watershed and the quality of life of its residents.

Finally, further efforts to engage the planning community (i.e., community development and planning staff at Watershed cities and other agencies at every level of government as well as private sector planning) should include training, workshops, and other educational forums to facilitate free exchange of innovative ideas and information related to the implementation of watershed planning. Realization of the recommendations and projects in this document and future iterations of this document require planning staff engagement and dedication to ensure implementation of the overall Santa Ana Integrated Plan and the Environmental and Wetlands Component. By protecting its resources, the Santa Ana Watershed community is making progress toward a healthier and more ecologically sustainable watershed through continued collaboration and leadership.

SECTION ONE

BACKGROUND

Upper Newport Bay Regional Park
Photo courtesy of EIP Associates

A. Introduction

> WHEREVER YOU ARE ON EARTH, you are in a watershed. Practically speaking, the watershed is the most useful unit for land use management and conservation actions of all sorts: it follows the way nature organizes and divides the landscape. Beyond that, finding your watershed, even in an urban environment, seems to be a very good pathway to deeper understanding of your place in the world and where it is you call home. The more you study watersheds, the more you see the many ways that life and the land are related.
>
> —*Christopher M. Richard and Janet M. Sowers*
> *California Coast and Ocean, Spring 1997*

What Is the Santa Ana Watershed Project Authority's Focus?

The Santa Ana Watershed Project Authority (SAWPA) was founded in 1974 as a Joint Powers Authority focusing on water supply and water quality. The agency subsequently expanded its focus to include habitat restoration and enhancement. SAWPA recognizes that an investment in green infrastructure is crucial to the protection of water supply and water quality. A primary catalyst behind SAWPA's efforts was Proposition 13, also known as the Costa-Machado Water Act of 2000. Proposition 13 included the Southern California Integrated Watershed Program (SCIWP) (California Water Code Sections 79104.20 through 79104.34), which provided $235 million for local assistance grants to be administered by SAWPA. This funding, which was contingent upon appropriation by the State Legislature to the State Water Resources Control Board (SWRCB), was to be spent on projects to rehabilitate and improve the Santa Ana Watershed.

South Fork of the Santa Ana River
Photo courtesy of SAWPA

Why Is SAWPA Doing This Plan?

It is generally recognized by watershed participants that there are many impressive projects underway or under development within the Santa Ana Watershed. However, while most project proponents are very familiar with their local planning area, very few groups or individuals within the Watershed understand or are aware of the myriad projects underway throughout the entire watershed. In general, as one expands outward from a planner's geographic area of expertise, his or her knowledge grows less certain about projects and important issues. Given the large geographic area of the Santa Ana Watershed, few understand the entire system. This document is meant to provide a snapshot of projects watershed-wide by identifying as many projects as possible relating to wetlands, recreation, trails, open space, invasive species removal, habitat restoration, and education.

Prado Wetlands
Photo courtesy of SAWPA

Bolsa Chica Ecological Reserve Park
Photo courtesy of EIP Associates

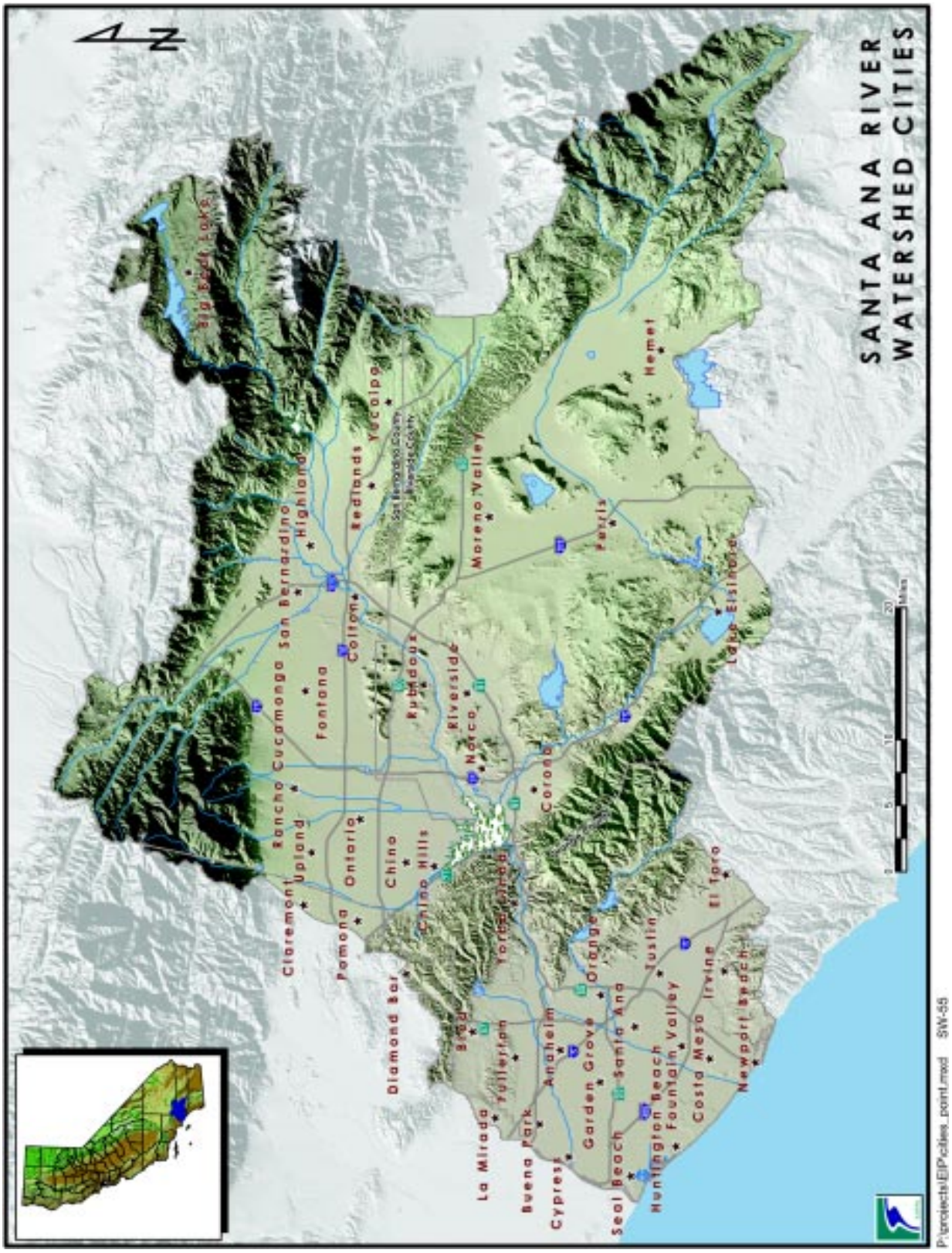


Figure 1-1 Santa Ana River Watershed Cities

The SAWPA Commission allocated $30 million of the aforementioned $235 million into an environmental/habitat fund to be spent on removal of invasive species such as *Arundo donax*, habitat restoration, and native and treatment wetlands. A major component of the SCIWP is habitat restoration through the removal of invasive plant species; accordingly, the SAWPA Commission allocated $20 million of the environmental/habitat fund to the Santa Ana Watershed Arundo Removal Program. SAWPA plans to use this Environmental and Wetland Component of the Integrated Watershed Plan as a basis to allocate the remaining funding million in the environmental/habitat fund of the SCIWP. This funding, up to $10 millon, will finance habitat restoration projects that specifically do not serve as mitigation for any other development projects.

The Santa Ana Integrated Watershed Plan, Environmental and Wetlands Component will serve four primary functions. First, it will serve as a tool for the SAWPA Commission to allocate up to $10 million in SCIWP funding noted above. Second, the plan identifies future funding needs for green infrastructure. Third, the plan will help identify partnering opportunities throughout the Watershed to facilitate completion of good projects for the Watershed. Fourth, the plan will serve as a platform for watershed-wide planning, and would allow readers and users to make connections with other project proponents. Within a few years, the goal is that planners and other watershed participants will recognize that the plan is out of date due to the number of new projects, partners, and funding opportunities that should be included. The 2002 Santa Ana Integrated Watershed Plan, Environmental and Wetlands Component is not intended to be a final document. Rather, this plan will be a living document to adapt and update over time.

Watershed participants provided input during a series of four scoping meetings. Shown here: Scoping Meeting Three at Citrus State Historic Park.
Photo courtesy of EIP Associates

SAWPA and their consultants hosted a series of four scoping meetings in July and August 2002 to determine the scope of the plan and to facilitate the gathering of "green" watershed projects. Over 350 watershed participants were invited to the meetings including SAWPA member agencies, regulatory agencies, nongovernmental organizations, watershed citizens, cities, counties, and special districts. Refer to Appendix A for meeting notes and attendance lists.

During scoping meetings, attendees participated in facilitated small group sessions.
Photo courtesy of EIP Associates

The scoping meetings were very successful and garnered much interest in the Environmental and Wetland Component of the IWP. Participants presented projects and the purpose of their organizations to the large group. Meeting attendees completed SCIWP forms for project information and project information forms for those projects in need of further planning and/or future funding. Participants broke into small groups with a facilitator to discuss and identify important ideas. Small groups answered questions such as the following:

- Are there any missing components or topics you would like to see addressed in this plan?
- Are you aware of any key resource conservation areas (geographic locations) that we should identify in the plan?
- What do you see as the benefits of this plan (e.g., collaboration/funding partners/specific improvements to the Watershed…)?
- What obstacles do you face in implementing good watershed projects such as trails, parks, habitat restoration, wetlands, open space acquisitions, (e.g., lack of funding, need for more partners, communication, etc.)?

The input gathered from over 150 participants helped shape the Santa Ana Integrated Watershed Plan, Environmental and Wetlands Component. Many participants felt that meetings should continue on a more regular basis to provide a means by which environmental resources and future projects could be addressed on a watershed-wide level.

B. Historical Context

> Sunday, March 20, 1774: At half past eight in the morning we set forth...keeping on our right a high, snow-covered mountain, which drains into the lake mentioned....We came to a valley similar to that of San José, which likewise has a good river, to which was given the name of Santa Anna.
>
> —*Juan Batista De Anza, upon viewing the Santa Ana River and Valley (excerpt from his 1774 expedition journal)*

Introduction

Historically, the Watershed included approximately 3,900 miles of streams, both perennial and intermittent, that could support various aquatic resources, and only one natural freshwater lake of significant size, Lake Elsinore. The Santa Ana River and its tributaries would have been intermittent with little or no flow at some locations in the alluvial valleys during the summer and fall dry season, particularly during

Anza's expedition leaving Tubac. Detail of an oil painting by Cal Peters.
Photo courtesy of the National Park Service

years with below average precipitation (USGS 1998). The consumptive demand for water for agricultural purposes and local domestic supply dates to the Spanish Mission Period in the Santa Ana River watershed. As early as 1820, Mill Creek was diverted into the Mill Creek Zanja by the Mission Fathers, to provide water to the tract of land that would later become known as Old San Bernardino.

Other early irrigation efforts involved settlers and farmers digging trenches and channels by hand to divert the natural flow of the River, constructing crude dams out of sand and brush. Since that time as consumptive demand increased for various purposes, so did the number of diversions from the Santa Ana River and its tributaries. Eventually, as the number of settlers increased, small-scale diversions overwhelmed the River's flow and all of the surface flows were taken (SWRCB 1993). Diminishing surface flows have compounded

Advertisement from 1931 explaining the need to build the Colorado River Aqueduct to bring water to Southern California.

problems for the region's groundwater. As surface flows ebbed, groundwater recharge decreased due to a reduction in available water and opportunities for percolation. Concurrently, reduced surface flows prompted settlers and farmers to begin pumping groundwater to meet needs of agricultural operations.

As urbanization near watercourses increased, the demand for flood control measures to protect lives and property also increased, eventually leading to such large flood control facilities as Prado and Seven Oaks dams. Eventually, the strong agricultural-based economy was able to support the continuation of large-scale State and federal water importation projects such as the Colorado River Aqueduct, beginning the region's reliance on imported water. Currently, water

Historic ad for a Corona citrus company.

agencies within the Santa Ana Watershed are working to reduce that dependence by "drought-proofing" the region. Weaning Southern California off of imported water during drought years will be no easy feat; drought-proofing involves storing enough water to withstand a major statewide drought cycle of up to three years without having to resort to water imports from elsewhere in California. Even as water has grown scarcer, urban growth has continued, heightening the challenge for water resource planners in the coming years.

Natural History

Sunday, December 31, 1775: In the first and second range of hills and their canyons, which are of moist earth, I saw a great abundance of rosemary and other fragrant plants, and in the second long canyon many sunflowers in bloom, and grapevines and wild grapes of such good stock that it looked like a vineyard.

The Santa Ana River is a stream with plentiful water and a very deep channel...it is so deep that it has very few and difficult fords because of the rapidity with which the water runs...The waters of the River are very crystalline and beautiful. It arises in the Sierra Nevada, and runs from northeast to southwest with some variation and declination to the west, until it reaches the sea, and most of the way it runs boxed in between hills.

—*Excerpt from* Journal of Father Font *describing the Santa Ana River and Valley*

South Fork of the Santa Ana River
Photo courtesy of United States Geological Survey

The natural consequence of the consumptive use of water described above was that much less water was available to fish and other aquatic resources, and the quality of the water remaining was reduced. The physical diversion of water from a stream, even temporarily, and the need for flood control, usually included the building of a dam completely or partially across a stream. The physical blocking of the stream, coupled with the withdrawal of water has resulted in one or more of the following effects on aquatic resources of the Santa Ana River watershed (Moyle 2002):

- Blocking or altering local movements and migrations of aquatic resources;
- Alterations of water temperatures and flow patterns;
- Entrainment of aquatic resources into diversion facilities and canals;
- Creation of reservoirs that favor exotic species;
- Altering upstream stream reaches; and
- Altering downstream estuaries.

These effects have dramatically altered ecosystem function of the Santa Ana Watershed and have changed species composition. Refer to Appendix F for a listing of sensitive species potentially occuring within the Santa Ana Watershed. This includes State and federal endangered, threatened, and rare species listed in the California Department of Fish and Game's Natural Diversity Database as of July 2002.

Chino Hills
Photo courtesy of SAWPA

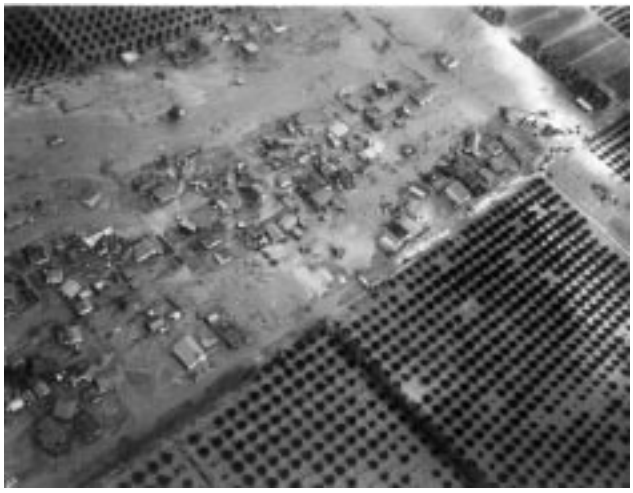
[1] Also cited as the Pacific brook lamprey *(Lampetra pacifica)*.
[2] Anadromous = fish species that move from the ocean to freshwater to reproduce and whose offspring return from freshwater to the ocean to rear to reproductive age.

Table 1-1 Fishes Historically Present in the Santa Ana Watershed

Fishes Historically present in the Santa Ana Watershed
PETROMYZONTIDAE (lamprey family)
▪ Western brook lamprey (Lampetra cf. richardsoni)[1]
▪ Pacific lamprey (Lampetra tridentata)
SALMONIDAE (salmon and trout family)
▪ Rainbow trout (resident form of Oncorhynchus mykiss irideus)
▪ Steelhead (anadromous[2] form of Oncorhynchus mykiss irideus)
CYPRINIDAE (minnow family)
▪ Arroyo chub (Gila orcutti)
▪ Santa Ana speckled dace (Rhinichthys osculus ssp.)
CATOSTOMIDAE (sucker family)
▪ Santa Ana sucker (Catostomus santaanae)
FUNDULIDAE (killifish family)
▪ California killifish (Fundulus parvipinnis)
GASTEROSTEIDAE (stickleback family)
▪ Partially armored threespine stickleback (Gasterosteus aculeatus microcephalus)
▪ Unarmored threespine stickleback (Gasterosteus aculeatus williamsoni)
▪ Shay Creek threespine stickleback (Gasterosteus aculeatus ssp.)

Historically, the Santa Ana River contained a limited fish fauna of only eight species of native freshwater fishes (refer to Table 1-1). Of these eight, the rainbow trout had a resident form and an anadromous[1] form (called steelhead). The threespine stickleback is believed to have had three forms as listed in Table 1-1.

The Santa Ana River has historically provided habitat for many amphibian species including the arroyo toad (*Bufo californicus*), the western toad (*Bufo boreas*), the southwestern toad (*Bufo microscaphus*), the coast range newt (*Taricha torosa torosa*), the Arboreal salamander (*Aneides lugubris*), the Pacific slender salamander (*Batrichoseps pacificus*), the black-bellied slender salamander (*Barachoseps nigriventris*), the large-blotched salamander (*Ensatina eschscholtzi klauberi*), the California-red-legged frog (*Rana aurora draytonii*), the mountain yellow-legged frog (*Rana muscosa*), the western spadefoot (*Scaphiopus hammondii*), the California treefrog (*Hyla cadaverina*), and the Pacific chorus frog (*Pseudoacris regalia*). Many of these amphibians are highly specialized and adapted to the unique hydrologic conditions intermittently present in Southern California and the Santa Ana Watershed. Historic flood events caused by precipitation in the high mountains, allowed for the development of breeding and overwintering habitats, which many of the amphibian species have adapted to utilize. Dam construction and changes in land use patterns in the last 70 years have altered the hydrologic patterns in the Santa Ana River watershed, and have changed the habitats used by these native amphibian species.



Loss of property from historical flooding events, such as the homes and agricultural land shown here in the 1938 flood, prompted dam construction.
Photo courtesy of California Coastal Conservancy

With respect to reptiles, the Santa Ana river system has provided habitat for several types of aquatic and semi-aquatic species including the southwestern pond turtle (*Clemmys marmorata Pallenscens*), the south coast garter snake

[1] Also cited as the Pacific brook lamprey *(Lampetra pacifica)*.
[2] Anadromous = fish species that move from the ocean to freshwater to reproduce and whose offspring return from freshwater to the ocean to rear to reproductive age.

(*Thamnophis sirtalis* ssp.), the two-striped garter snake (*Thamnophis hammondii*), the western aquatic garter snake (*Thamnophis couchi*), and the mountain garter snake (*Thamnophis elegans elegans*). None of these species is protected under

The Santa Ana Watershed continues to provide habitat for a wide range of bird species, including the bald eagle, which frequents the Big Bear Mountains.
Photo courtesy of U.S.Fish and Wildlife Service.

the Endangered Species Act; however, many of them are California Department of Fish and Game species of "Special Concern."

Historically, the Santa Ana Watershed provided habitat to a large range of riparian bird species. Three of these species are now federally threatened or endangered: the least Bell's vireo (*Vireo bellii pusillus*), southwestern willow flycatcher (*Empidonax traillii*), and bald eagle (*Haliaeetus leucocephalus*). Grinnell and Miller (1944) characterized the least Bell's vireo as one of the most common riparian birds throughout the state. Likewise, all three resident subspecies of the willow flycatcher were once considered widely distributed and common within California wherever suitable habitat existed. Unitt (1987) concluded that the southwestern willow flycatcher was once fairly common in the Los Angeles basin, the San Bernardino/Riverside area, and San Diego County.

HISTORY OF WATERSHED SETTLEMENT

Santa Ana River Timeline

10,000 B.C.
1768 A.D.

10,000 B.C.-1768 A.D. Native American Period: Native Americans have inhabited the Santa Ana Watershed for at least 12,000 years- perhaps longer- based on artifacts in the Calico area (San Bernardino). Native Americans used the Santa Ana River as a source of food and water, and did not raise crops or practice agriculture or irrigation. Within the past 3,000 years, the Serranos occupied the foothills of the San Bernardino Mountains, the Gabrielenos lived in the West Valley, and the Luisenos occupied an area south of Mt. San Jacinto.

1769-1833

1769-1833 Mission Period: European settlement of watershed began, centered around conversion of Native Americans to Christianity. The Spanish brought knowledge of aqueducts to California, introducing the practice of irrigation to the State.

Notable Dates within the Mission Period:

1769

July 1769: The first party of European explorers reached boundaries of present day Orange County. Members of the expedition named the region "The Valley of Saint Anne" (Santa Ana).

1772

1772: Captain Pedro Fages, military *comandante* of the Spanish Alta California, became the first European known to set eyes upon the San Bernardino Mountains.

1776

January 1, 1776: The first party of colonists to come overland to the Pacific Coast crossed the Santa Ana River. Led by Lt. Col. Juan Bautista de Anza, the group of 242 men, women, and children camped near the River. The group reportedly proceeded north to found the City of San Francisco.

1834-1850

1834-1850's Rancho Period: Large portions of land were settled by private ranchers. Floodplain development began in Santa Ana Watershed. Settlers began diverting water from the Santa Ana River for irrigation of gardens. The City of Santa Ana was founded.

1850

1850's Pioneer Settlers: Mormon colonists settled near Mill Creek, establishing agricultural and logging operations and founding the City of San Bernardino in 1854. Settlers diverted water from Mill, Lytle, and Warm Creeks. Water was diverted from Santa Ana River for domestic use by a colony later to become Anaheim.

Sources:
Santa Ana Watershed Profile, California Coastal Conservancy, http://eureka.regis.berkeley.edu.wrpinfo/
Santa Ana River Basin Plan, 1995. State Water Resources Control Board.

1862: 1862

The catastrophic flood of 1862 caused over 4 feet of water to flood Anaheim, killing 200,000 cattle and altering the course of the Santa Ana River from a well-defined course to a fan of several channels.

1873: 1873

The U.S. Department of Agriculture sent two small navel orange trees to Riverside resident Eliza Tibbets. Those trees, growing in near perfect soil and weather conditions, produced an especially sweet and flavorful fruit…and changed the history of southern California.

1881: 1881

Completion of railroad lines by Southern Pacific and Santa Fe companies increased opportunities for migration to California, causing an increase in population and increasing the need for further irrigation.

Late 1800's to early 1900's: 1800-1900

Efforts to promote citrus ranching brought hundreds of would-be citrus barons to southern California for the "second Gold Rush." In 1889, Orange County was carved from Los Angeles County, named for its famous citrus groves. By 1895, Riverside, fueled by citrus money, became the wealthiest city in the nation per capita.

1938-1941: 1938-1941

The great flood of 1938 claimed 50 lives and caused a great deal of damage within the Watershed, particularly to the City of Riverside. In response to the flood, the Army Corps of Engineers completed Prado Dam in 1941. The construction of Prado Dam allowed for more urbanization within the flood plain.

1969: 1969

The most recent major flood of the Santa Ana River claimed five lives and an estimated $30 million in property damage.

1969- present. 1969-PRESENT

River has become effluent dominated, with most dry weather flow between the mountains and Prado Dam diverted for consumptive uses or decreased due to groundwater pumping. As Watershed population has increased, so has wastewater flow and therefore river flow. Water quality is steadily improving due to improved technology, regulation, and planning.

Historic view of the City of Riverside
Photo courtesy of USGenNet

Planning History

The Santa Ana Watershed is renowned for its innovative solutions to water supply and water quality dilemmas, particularly through unique partnerships. Indeed, during the early 1970s, the Santa Ana Watershed was considered to have one of the most comprehensive watershed planning documents in the world. However, many relationships between current watershed partners have not always been so harmonious. Prior to 1969, water use and rights within the Santa Ana Watershed were subject to much litigation and strife. Water quantity was the primary concern of early conflicts and the issue was resolved by legal judgments.

Water Wars

Litigation over water rights within the Watershed began as early as 1932, when Orange County ranchers represented by Orange County Water District (OCWD) initiated legal action against upstream interests. A series of lawsuits followed; however, a satisfactory resolution was not reached until 1969. The Santa Ana Stipulated Judgment provided a physical solution to water use conflict: water users in the Orange County area have rights, as against all upper basin users, to receive a minimum average supply base flow at Prado, in addition to all storm flow reaching Prado Dam. Almost 40 years in the making, this solution was exceptional because it guaranteed a minimum flow to downstream users instead of limiting the consumption of upstream water users.

SAWPA representatives at the annual Santa Ana River Symposium, April 2002
Photo courtesy of EIP Associates

SAWPA Formation

As a result of the litigation and stipulated judgment to ensure the supply of good quality water to Orange County, the Chino Basin Municipal Water District (CBMWD), Western Municipal Water District (WMWD), San Bernardino Valley Municipal Water District (SBVMWD), and Orange County Water District (OCWD) determined that planning the use of water supplies in the Watershed would be beneficial to all water users. The Santa Ana Watershed Project Authority (SAWPA) was formed in 1974 as a joint exercise of powers authority. SAWPA's original members were the four water districts, CBMWD, WMWD, SBVMWD, and OCWD, since they have the primary responsibility of managing, preserving, and protecting groundwater supplies in the Santa Ana Basin. Eastern Municipal Water District (EMWD) joined as SAWPA's fifth member agency in 1984. The Chino Basin Municipal Water District is now known as Inland Empire Utilities Agency (IEUA).

Originally, the primary concern of watershed agencies was water quantity. As each member agency looked toward the future, they realized that water quantity was not the only issue of concern within the Watershed; declining water quality posed a threat that no district could handle alone. The districts suspected that declining water quality could pose a greater danger than overdraft and that without planning and project implementation to control the problem, the gradual accumulation of pollution in the basin could cause a total devaluation of area water supplies. In the early 1970s, the Regional Water Quality Control Board contracted with SAWPA to develop the Basin Plan for the Santa Ana Watershed (RWQCB 1993). This long-range plan included both regulatory programs and projects. The regulatory portion was recommended to the Regional Water Quality Control Board and was largely adopted by that agency in the form of standards. At the time, the Basin Plan for the Santa Ana River was considered the most comprehensive water quality protection program of any river basin in the world, largely due to the active, ongoing interest and participation by the member water districts. Beginning in the 1970s, SAWPA constructed the Santa Ana Regional Interceptor (SARI) to transport brine from inland areas to the Pacific Ocean, improving River water quality.

Many environmental organizations were showcased at the annual CSUSB Environmental Expo.
Photo courtesy of EIP Associates

Tri-County Conservation League's Origin

In the early 1960s the League of Women Voters of Riverside conducted a study of the Santa Ana River environment identifying its purpose and mission, and found that the river should be saved in its wild state. This finding was in total opposition to the over 400 local, State and federal studies which all determined the river had little or no worth economically. The Army Corps had plans already drawn up to concrete the river bottom for flood control as they had done to the Los Angeles River. This was not a new phenomenon, as indeed, other rivers in southern California were also subject to similar proposals.

However, some members of the community were strongly opposed to the idea of losing the natural functions of the Santa Ana River to flood control and utility purposes. In 1966, three League women by the name of Ruth Bratten (now Ruth Anderson Wilson), Martha McLean (now deceased), and Kay Black, formed an environmental conservation group called the Tri-County Conservation League to fight for preservation of the Santa Ana River.

> "Keep the river with its soft bottom for recreational use when it is not in flood conditions. Let the natural effects of flooding be accommodated so it can bring new soil and new seeds that create young forage for wild life. Widened banks slow the speed of floodwaters letting the silt be deposited. Keep the water here in the river to refill our underground water reservoirs."
>
> *—Ruth Anderson Wilson*
> *Tri-County Conservation League's Primary Message*

The three women attended City and County hearings regularly, made presentations to many interest groups, and quickly gained the original support of 78 community groups who also believed the River should stay natural. The Riverside County Board of Supervisors and their Flood Control Districts were often at odds with these vocal women who then continued to build a throng of more supporters in favor of saving the River with the help of the local newspaper. By 1970, the Tri-County Conservation League had become the leading environmental organization in Riverside County.

With the help of Pete Dangermond, then Riverside County Parks Director, the drift in the political tides began to change in favor of wildlands conservation. Saving of the river followed. Small victories for public law reinforced the validity of the Tri-County Conservation League as an organization representing the public's interest.

In the words of Ruth Anderson Wilson, "…This was a time of women coming out into their own…It was reflective of a changing society. I don't know if this could have happened in another era." As a result of the Tri-County Conservation League's work in combating the proposed concrete channelization of the Santa Ana River as well as the successful relocation of proposed primary utility lines, the River remains natural to this day from Barton Flats in San Bernardino County, through Riverside County to the ocean in Orange County. It is almost entirely in public ownership now and is available for hiking, horseback riding, camping, and other recreational uses when the river is not in flood, realizing the dreams of the three "housewives" in the mid-1960s.

The natural condition of the River also had a positive effect on how the Counties of San Bernardino and Orange viewed potential recreational uses of the River. The volunteers of the Tri-County Conservation League continue to be dedicated the role of "watchdog" of the River. The organization's bylaws have acted as a model for many environmental organizations that have followed after them. The Santa Ana River's status as a primarily wild river is due largely to the efforts of the Tri-County Conservation League members and the supporting public.

During the last three decades, conservation based nonprofit groups and other organizations active in the Santa Ana Watershed, such as the Santa Ana River Watershed Group, Sierra Club, Riverside Lands Conservancy, Audubon Society, The Nature Conservancy, Trails 4 All, San Timoteo Badlands Coalition, Surfrider Foundation, and Wildlands Conservancy have taken a more active role in land use and water resource planning. These groups continue to have a strong voice within the Watershed today, and serve as the project proponent for many beneficial habitat restoration and land acquisition projects.

Southern California Integrated Watershed Program

A gradual and steady shift has been occurring within the Santa Ana Watershed whereby member and other agencies are focusing upon habitat conservation and endangered species in tandem with water quality and quantity. Indeed, today efforts are underway to form a foundation, based on a coalition of community leaders interested in the long term sustainability of the watershed: the Santa Ana Watershed Coalition. The year 2000 marked another landmark in Watershed history. Proposition 13, approved by the electorate of the State of California on March 7, 2000, contained the Southern California Integrated Watershed Program (SCIWP),

providing $235 million for local assistance grants. Upon appropriation by the State Legislature to the State Water Resources Control Board (SWRCB), the funding was allocated to the Santa Ana Watershed Project Authority (SAWPA) for projects to rehabilitate and improve the Santa Ana River Watershed. The Act specifically identified funding to the following types of projects:

1. Basin water banking
2. Contaminant and salt removal through reclamation and desalting
3. Removal of nonnative plants, and the creation of new open space and wetlands
4. Programs for water conservation and efficiency, and storm water capture and management
5. Planning and implementation of a flood control program to protect agricultural operations and adjacent property, and to assist in abating the effects of waste discharges into waters of the State

SAWPA reviewed nearly 100 applications from agencies wishing to obtain Prop 13 funding. Both SAWPA and the State Board ultimately approved approximately twenty-five projects. The majority of these projects were for water supply and water quality improvements, with about $30 million set aside for environmental and habitat enhancement projects. Of these monies, $20 million will fund the SCIWP *Arundo* Removal Program and as much as $10 million has been reserved for the SCIWP Environmental and Wetlands Program. Both the *Arundo* Removal Program and the Environmental and Wetlands Program are discussed later in this document.

Two years after the approval of Proposition 13, on March 5, 2002, a second bond was passed that will greatly aid conservation within the Santa Ana Watershed. The $2.6 billion Proposition 40, or "Park Bond," will fund natural and historical resource protection, including land acquisition for conservation. Proposition 40 funding, which was recently undergoing appropriation at the state level, could fund millions in projects to benefit the Santa Ana Watershed. This funding may supplement the Proposition 13 funding to serve as an excellent basis to support and finance the projects identified in the Environmental and Wetlands Component of the Santa Ana Integrated Watershed Plan. In addition, Proposition 50, which passed on the Fall 2002 ballot, contains funding that should again fund the integrated watershed planning projects in the Santa Ana Watershed.

C. Planning Context

Message to the Planning Community

There has never been a better time than the present to welcome the planning community, including both public and private sector planners, to the table to advance the benefits of planning on a watershed scale and integrating watershed thinking into the everyday planning process. Bringing together varied interests and agendas, this watershed planning process has opened the doors to still greater partnerships, funding opportunities, connectivity, and increased awareness of planning projects and opportunities both in the city next door and in the community on the other side of the Watershed. This plan does not attempt to address all watershed planning issues and concerns, nor will it fit together all existing plans and policies. Rather, the intent of this discussion is to capture a glimpse of many of these existing plans and policies as possible. Most importantly, the goal is to bring important messages from these

documents home to the Santa Ana Watershed in terms of relevant needs within the planning community.

As many cities and counties are in the process of updating their General Plans, funding opportunities and greater collaboration between water agencies, nongovernmental organizations, and local land use authorities are facilitating beneficial projects such as conservation, open space, restoration, enhancement, connectivity, and multi-benefit approaches. In this way, planners are finding themselves in a new place—one of noting the quality of these projects and how to get them through the regulatory planning process with more agreement and greater speed. Refer to Table 1-2 for a listing of applicable plans and policies.

State law is helpful. Conservation, Safety, Open Space and Land Use Elements are required elements of every General Plan in the State of California. These Elements provide essential components of good watershed plans.

Newly proposed Fire Hazard Planning,[1] as well as the more traditional floodplain management guidelines for preparation of General Plans,[2] includes helpful explanations and instructions for planners trying to make sense of how watershed planning can be and should be integrated into General Plan Updates.

> "Floodplain management may be approached as a stand alone program or as one component of the broader notion of watershed planning, which also includes objectives such as improved water quality, erosion control, flood management and habitat conservation and enhancement. Where possible, a community should take a broader watershed approach to floodplain management, which would result in a coordinated regional approach to land use planning and flood loss reductions. When incorporated into the general plan, either as an optional element or as a section in the land use, open-space, conservation, or safety element, floodplain management principles will be reflected as long-term development policies.
>
> Land use decisions directly influence the function of floodplains and may either reduce or increase potential flood hazards. The functions of floodplains include, but are not limited to, water supply, improved water quality, flood and erosion control, and fish and wildlife habitat."

Statewide Planning

The Resources Agency of the State of California is in the process of developing statewide watershed planning guidelines. The California Resources Agency, in conjunction with the SWRCB, recently issued a draft report for the State Legislature titled "Addressing the Need to Protect California's Watersheds: Working with Local Partnerships," available for downloading at http://resources.ca.gov/watershedtaskforce/. The first recommendation to come out of this report was the development of statewide

[1] The Office of Planning and Research in conjunction with the California Department of Forestry and Fire Protection, Governor's Office of Emergency Services, Regional Council of Rural Counties, and the California State Association of Counties has developed a publication entitled Hazard Mitigation: Fire Hazard Planning and the General Plan and has posted it here for public review and comment. This publication was designed as a "planning tool" to help concerned citizens, Fire Safe Councils, planning professionals, and other interested parties develop local fire plans which can easily be incorporated into a city's or county's General Plan. http://www.opr.ca.gov/publications/PDFs/HazardMitigation.pdf

[2] General Plan Guidelines, STATE OF CALIFORNIA GOVERNOR'S OFFICE OF PLANNING AND RESEARCH, APPENDIX C, Floodplain Management, http://www.fpm.water.ca.gov/generalplan.html.

watershed policy, including the establishment of a single set of overall principles, policies, and flexible guidelines for watershed management. It is unlikely that these policies will be adopted prior to the completion of this document. Therefore, future iterations of the Santa Ana Integrated Watershed Plan should consider statewide watershed planning policies.

With authority granted through the California Water Code and the Clean Water Act, the State Water Resources Control Board (SWRCB) and the nine regional Water Quality Control Boards (RWQCBs) are responsible for the protection and enhancement of California's water quality. The SWRCB sets statewide policy and works with the RWQCBs to implement State and federal laws and regulations. The Water Quality Control Plan for the Santa Ana River Basin (Basin Plan), adopted by the Santa Ana RWQCB, forms the basis for the Regional Board's regulatory programs. The Basin Plan, developed in 1975, was revised in 1983 and 1995, and is currently undergoing revision (2002). Most policies outlined in the Basin Plan are addressed in the Integrated Water Resources Plan rather than the Environmental and Wetlands Component of the Santa Ana Integrated Watershed Plan. The most serious problem in the basin is the buildup of dissolved salts in the groundwater and surface water, and associated adverse impacts.

Local and Regional Plans and Policies

The Environmental and Wetlands Component of the Santa Ana Integrated Watershed Plan has been developed in accordance with other applicable local, State, and national plans and policies. On a fundamental level, the two most closely related plans are the Santa Ana Integrated Watershed Plan Water Resources Component and the Santa Ana Regional Interceptor Planning Study. These two documents, both produced by SAWPA, address water quality and water supply issues within the Santa Ana Watershed.

General Plans for each of the Watershed's three major counties and 59 cities certainly form the cornerstones of policy development within the Watershed. The Orange County General Plan, San Bernardino County General Plan Update (undergoing revision soon), and Riverside County General Plan Update (Draft currently in public review) have each been reviewed during preparation for this document. One ultimate goal of the IWP is to allow watershed planning policies and goals a place in the general plans of local governments.

Riverside County Integrated Project

The County of Riverside is taking an integrated approach to land use planning. Riverside County's "Blueprint for Tomorrow" includes an update to the General Plan, the Community and Environmental Transportation Acceptability Process (CETAP) and the Multi-Species Habitat Conservation Plan.

Western Riverside County Multispecies Habitat Conservation Plan

In response to growing development pressures and a regional understanding of the need for coordinated conservation efforts, Riverside County is currently developing a Multispecies Habitat Conservation Plan (MSHCP). A draft was circulated in March 2002 (available for review at www.rcip.org), and a final version is expected in Fall 2002. The primary goal of the plan is to coordinate the conservation of approximately 510,000 acres of open space, in addition to coordinating special status species conservation efforts such as Santa Ana sucker

conservation. About 357,000 acres would be preserved on existing publicly owned lands, while 153,000 acres would be acquired from existing private landowners. The core area reserves include oak woodland habitat and 15,000 acres of coastal sage scrub. This acquisition of private lands has been analyzed throughout watershed plan preparation in order to coordinate watershed plan recommendations with MSHCP strategy. Refer to the Draft MSHCP, which identifies priority acquisition lands within Riverside County.

Recommendation: As projects are proposed through collaborative funding opportunities, watershed partners should utilize the MSHCP in making decisions regarding land acquisition areas within Riverside County.

San Bernardino County General Plan Update

The County's General Plan will be updated to reflect the results of Phase I scoping which define the focus of the General Plan Update. Open space and conservation elements will be addressed with extensive public involvement to ensure that these essential elements address all significant issues.

Recommendation: Watershed participants should invest resources to ensure that watershed interests such as connectivity, trails, open space, biological diversity, water quality and supply, wetlands, are supported and included in the County of San Bernardino General Plan Update.

San Bernardino Valleywide Multispecies Habitat Conservation Plan (MSHCP)

The San Bernardino Valley MSHCP encompasses approximately 500 square miles containing six unique habitat types, six State endangered species, thirteen federally endangered or threatened species, and over fifty-three species of special concern. Plan boundaries are the valley portions of western San Bernardino with the San Bernardino and San Gabriel mountains as the northerly and easterly boundaries, and the county boundary of Riverside, Orange, and Los Angeles counties to the south and west. The work has been primarily focused on biological data collection, using San Bernardino County Natural History Museum staff and their biologist to develop a habitat-based chronological inventory of resources. In addition, a subset of the planning effort has been compilation of a focused plan to adjust Delhi Sands flower-loving fly habitat. The County Board of Supervisors allocated seed money in early 2000, and thirteen of fifteen cities in the region joined in a Memorandum of Understanding (MOU) to prepare and help fund the MSHCP. The U.S. Fish and Wildlife Service is also participating in the planning effort. As the group is currently not funded, they are renegotiating with Fish & Wildlife Service regarding adequate funding and obtaining Board direction to proceed with the program.

Another planning effort underway is the Land Management and Habitat Conservation Plan for the Upper Santa Ana River Wash, directed by the San Bernardino Valley Water Conservation District in conjunction with two mining companies operating within the wash, the City of Highland and the City of Redlands. The planning boundaries are from Route 30 on the west to the Seven Oaks Dam in the Mill Creek

area on the east. The plan is promising and will be cooperatively funded, primarily through the Conservation District and the two mining companies. It will also address the potential conflict between mining activity and habitat preservation.

Orange County Central—Coastal NCCP Subregional Plan

This Natural Communities Conservation Plan (NCCP), approved in July 1996, establishes a 37,380-acre reserve system that includes significant areas of twelve of Orange County's major habitat types covering thirty-nine sensitive plant and animal species.

Orange County Southern Subregion

The County of Orange and major South County landowners are preparing a subregional preserve plan (NCCP/HCP) and special area management plan/master streambed alteration agreement that will integrate wetlands and endangered species permits for a 91,000-acre portion of southern Orange County. An update to the County's General Plan and Zoning Ordinance is also underway. Public workshops discussing alternatives to be addressed for planning efforts in southern Orange County have been completed.

Irvine Ranch Land Reserve

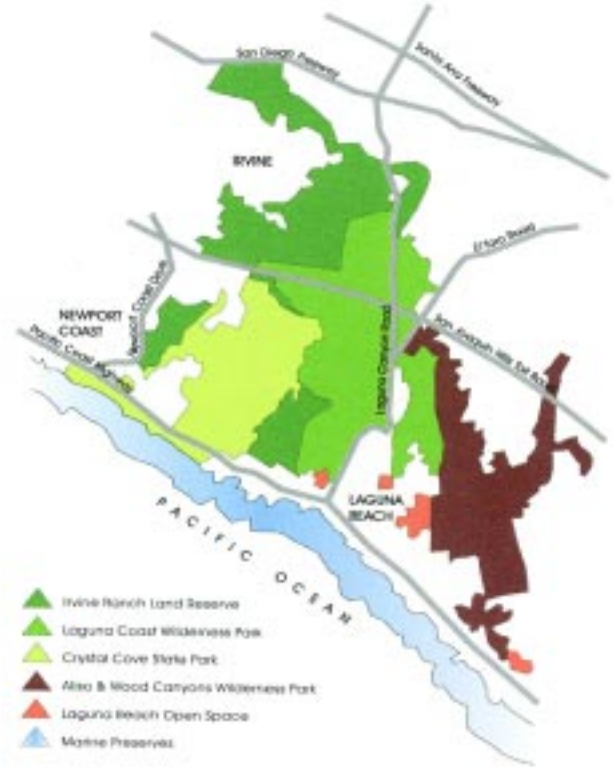
The Irvine Ranch Land Reserve, totaling approximately 50,000 acres extends from the Cleveland National Forest to the shores of Crystal Cove State Park. The reserve lands, prized for their beauty and unique geological and natural diversity include the 5,500-acre Limestone Canyon and the "Sinks," a striking formation frequently compared to a miniature Grand Canyon, the San Joaquin Wildlife Sanctuary, Irvine's Bommer and Upper Shady canyons, Quail Hill, and more than 7,000 acres of open space and coastal sage scrub at the Newport Coast. The Jeffrey Recreation Center will ultimately link the large open space reserves at Irvine's northern and southern boundaries.

Conservation opportunities build on existing open space in the General Plan, NCCP Reserve, and Cleveland National Forest.

Orange County has been the focus of numerous natural resource plannnig efforts. Shown here: Upper Newport Bay Regional Park in Orange County.
Photo courtesy o f EIP Associates

At the headwaters of Laguna Canyon is a key linkage to the Irvine Ranch's giant Southern Open Space Reserve on Irvine's southern boundary. Laguna Laurel, as the 1,400-acre site is commonly known, also is a key linkage to Laguna Coast Wilderness Park, Crystal Cove State Park, and Aliso and Wood Canyons Wilderness Park.

Recommendation: Watershed stakeholders should continue to engage in watershed-wide (interjurisdictional) collaboration regarding connectivity, trails, and other watershed needs so that landscape linkages, public/private partnerships, acquisition, in-holdings, and public coastal access goals are realized in the County of Orange General Plan Update and related planning efforts.



Southern Ranch (Boundaries may have been altered)

Endangered Species Recovery Plans

Applicable recovery plans for listed species within the Santa Ana Watershed have been reviewed for the preparation of the Santa Ana Integrated Watershed Plan, although most species do not have recovery plans. The Recovery Plan for the federally endangered Delhi Sands flower-loving fly, published by the USFWS in 1997, details the actions needed to de-list the species, including habitat preservation in several specific locations. A draft Conservation Program for the federally threatened Santa Ana Sucker has been prepared and has been forwarded to the USFWS for approval.

Santa Ana River Canyon Habitat Management Plan

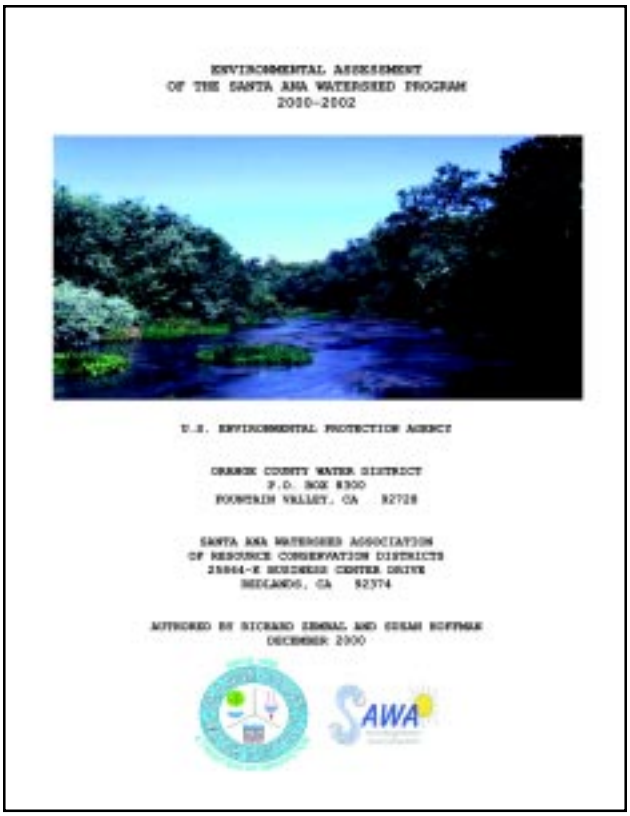
The HMP has been prepared as a requirement of the Final Supplemental EIS on the Phase II General Design Memorandum for the U.S. Army Corps of Engineers Santa Ana River Mainstem Project. The HMP addresses the floodplain and open space wildlife habitat in Santa Ana Canyon below Prado Dam. The Plan provides for planning and management continuity for the canyon habitat from Prado Basin downstream to Weir Canyon Road.

Environmental Assessment for the Santa Ana Watershed Program

The Environmental Assessment for the Santa Ana River Watershed Program, prepared by the Orange County Water District and the Santa Ana Watershed Association of Resource Conservation Districts in 2000, describes potential environmental effects from the Watershed Program during years 2000 through 2002. This document was prepared for an Environmental Protection Agency (EPA) Grant, and includes scientifically based information on watershed habitat, plant communities, species surveys, threatened and endangered species, and invasive species removal. This document serves as an important reference document for anyone requiring information about the biological resources of the Santa Ana River.

Waterfowl-Raptor Conservation Area

The City of Ontario, in conjunction with development of the Ontario Sphere of Influence, plans a 145-acre Waterfowl-Raptor Conservation



ENVIRONMENTAL ASSESSMENT
OF THE SANTA ANA WATERSHED PROGRAM
2000-2002

U.S. ENVIRONMENTAL PROTECTION AGENCY

ORANGE COUNTY WATER DISTRICT
P.O. BOX 8300
FOUNTAIN VALLEY, CA 92728

SANTA ANA WATERSHED ASSOCIATION
OF RESOURCE CONSERVATION DISTRICTS
25864-E BUSINESS CENTER DRIVE
REDLANDS, CA 92374

AUTHORED BY RICHARD ZENKAL AND SUSAN HOFFMAN
DECEMBER 2000

Area (WRCA) off-site adjacent to the Prado Wetlands. Implementation of the project near the Prado Wetlands will increase effectiveness of the WRCA.

Lake Elsinore & San Jacinto Watersheds Authority (LESJWA)

LESJWA has completed or is in the process of completing a number of studies, including the following:

- Lake Elsinore Feasibility Study
- Canyon Lake Feasibility Study
- Impacts of Alum Addition on Water Quality in Lake Elsinore
- Impacts of Calcium Addition on Water Quality in Lake Elsinore
- Laboratory and Limnocosm-Scale Evaluations of Restoration Alternatives for Lake Elsinore
- Restoration of Canyon Lake and Benefits to Lake Elsinore Downstream

LESJWA currently has underway a Program Environmental Impact Report, which examines recycled water, wetlands treatment, in-lake treatments, aeration/oxygenation, and biomanipulation projects. Also underway is an Environmental Impact Report that examines bio-manipulation and fishery enhancement, as well as in-lake treatments projects. The source of much of the lake quality degradation has been traced to contributions of nutrients from upper watershed runoff. Various types of nonpoint source contributors have been identified in detail as part of an EPA Clean Lakes 314 Study. Major contributors of nonpoint source contributions include agricultural cropland, dairies, feedlots, grazing, land development, and urban runoff. Solutions to controlling the nutrients carried by runoff and sediment are both structural and nonstructural in nature and are described as follows:

- Establish Best Management Practices program for agricultural areas
- Create buffer strips along strategic upper watershed locations
- Create detention ponds for dairy and feedlot drainage
- Establish nutrient removing wetlands along drainage paths
- Implement sediment control structures

The SAWPA IWRP includes more descriptions of 2010 projects aimed at meeting the LESJWA goals.

Stormwater Quality Standards Study

The Orange County, Riverside County and San Bernardino County and other interested agencies have discussed forming a group to work with the Santa Ana RWQCB in conducting additional evaluations of stormwater quality standards. Under the Triennial Review List, a specific item was listed that proposes to consider Water Code Section 13241 factors in relation to compliance with water quality objectives during wet weather (especially costs and need for housing). Orange County representatives indicated that during consideration of reissuance of the areawide stormwater NPDES permit for those parts of Orange County within the Santa Ana Region, the co-permittees expressed concern about their ability to comply, and the costs of compliance, with established water quality objectives during wet weather. The co-permittees expressed interest in working with the RWQCB in validating that the factors cited in Section 13241 of the California Water Code, especially costs and the need for housing in the area had been taken into account in establishing the objectives. After further discussions of the common issue between all three counties in the Santa Ana River watershed, it was decided by all that this evaluation should be made on a watershed wide basis. Based on a strong watershed-wide support for this item, this item was moved to number four in priority on their Triennial Review List and the RWQCB will be devoting one-half person-year to this effort.

In subsequent meetings, discussion focused on the development of a request for proposals for a workplan to conduct the study. Interests were expressed in a regional agency that was not a co-permittee to serve as the study administrator. Consequently, SAWPA was approached about serving as the administrator for a new task force to conduct the study. In October 2002, SAWPA Board indicated their support for SAWPA to serve as the task force administrator.

RWQCB TMDL Development and Monitoring

The Regional Water Qualtiy Control Board is conducting intensive water quality monitoring to provide data to develop new Total Maximum Daily Loads (TMDLs) in both the Chino Basin and the San Jacinto Watershed. SAWPA is serving as the neutral facilitator and administrator for the RWQCB in coordinating TMDL workgroups.

This San Jacinto TMDL work will provide development of the nutrient TMDL project for Lake Elsinore and Canyon Lake, the pathogen TMDL for Canyon Lake, and the toxics TMDL for Lake Elsinore. The project would provide an understanding of the sources of nutrients for both lakes, pathogens for Canyon Lake, and toxics for Lake Elsinore. As a result, the project would provide the information necessary to help restore the water quality in both lakes.

In Chino Basin, new TMDLs are being developed through intensive monitoring of pathogens to protect downstream beneficial uses. New TMDLs are scheduled to be incorporated into the RWQCB's basin plan over the next year.

San Jacinto Watershed Management Plan

LESJWA, in conjunction with a just formed nonprofit organization called the San Jacinto Watershed Council, is conducting a watershed management plan to develop implementation strategies to control nutrients from the San Jacinto River Watershed that negatively impact downstream water bodies such as Canyon Lake and Lake Elsinore. The Plan is expected to be complete by December 2003.

U.S. Army Corps of Engineers Ecosystem Restoration Feasibility Study, Riverside and San Bernardino Counties

A feasibility study is being considered to reduce damages from invasion of *Arundo donax* and other nonnative invasive species in the Santa Ana River. Opportunities will be investigated for ecosystem restoration, to improve surface water quality, reduce sedimentation and erosion control issues and provide recreational opportunities within the Santa Ana basin.

SECTION TWO

CURRENT CONDITIONS

A. Physical Setting, Hydrology, and Geomorphology

Dunne and Leopold (1978) define a watershed as an area of land that drains water, sediment, and dissolved materials to a common outlet at some point along a stream channel. The Santa Ana River watershed, depicted in Figure 2-2, catches stormwater draining a 2,847-square-mile area and channels it into the Pacific Ocean at the City of Huntington Beach. The Santa Ana River, flowing over 100 miles, drains the largest coastal stream system in Southern California including parts of Orange, Riverside, and San Bernardino Counties, as well as a sliver of Los Angeles County. The total length of the River and its major tributaries are about 700 miles.

Much of the movement of materials, energy, and organisms associated with the channel environment and adjoining upland environment depend on the movement of water within the Santa Ana Watershed. To the extent that this movement is altered, so does the potential exist for the system to become "dysfunctional" for species that depend on it for life support. That is, alteration of water movement via damming or channelization can reduce ecosystem functionality. Refer to Figure 2-1, Channel and Floodplain Characteristics Change from Headwaters to Mouth, for an illustration of water and sediment transport throughout a watershed.

Today, only 20 percent of the Santa Ana River is a concrete channel, the majority near the mouth of the River. Discharge from publicly owned treatment works (POTWs) have changed natural surface flows and provides base flow in many parts of the River's drainage network. This treated wastewater has altered the natural system by providing year-round river flow, and, for a number of reasons, many indicators show water quality generally decreases as it travels

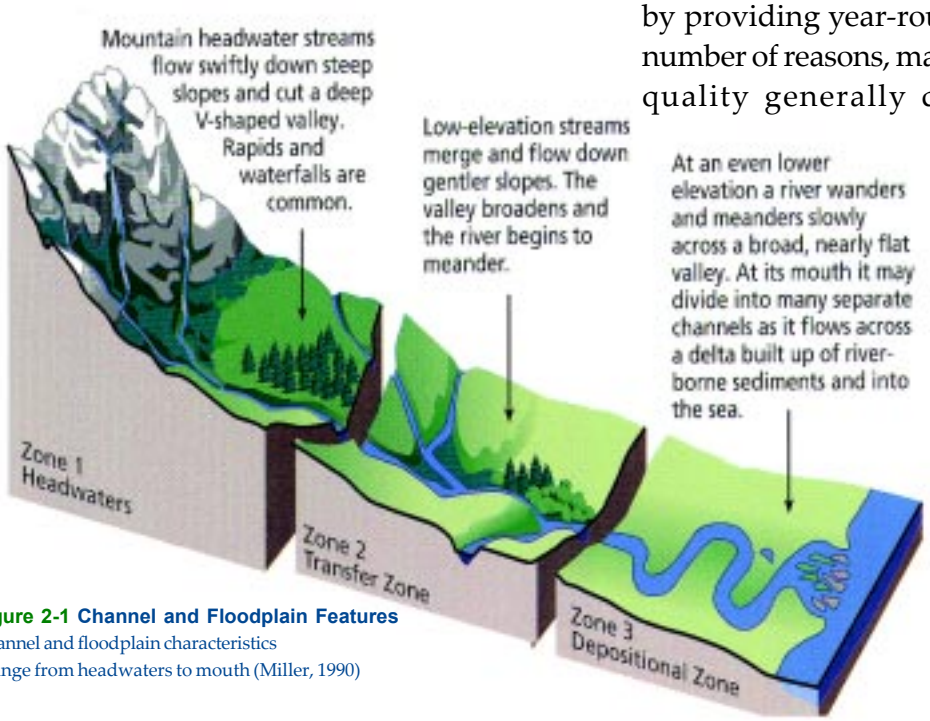


Figure 2-1 Channel and Floodplain Features
Channel and floodplain characteristics change from headwaters to mouth (Miller, 1990)

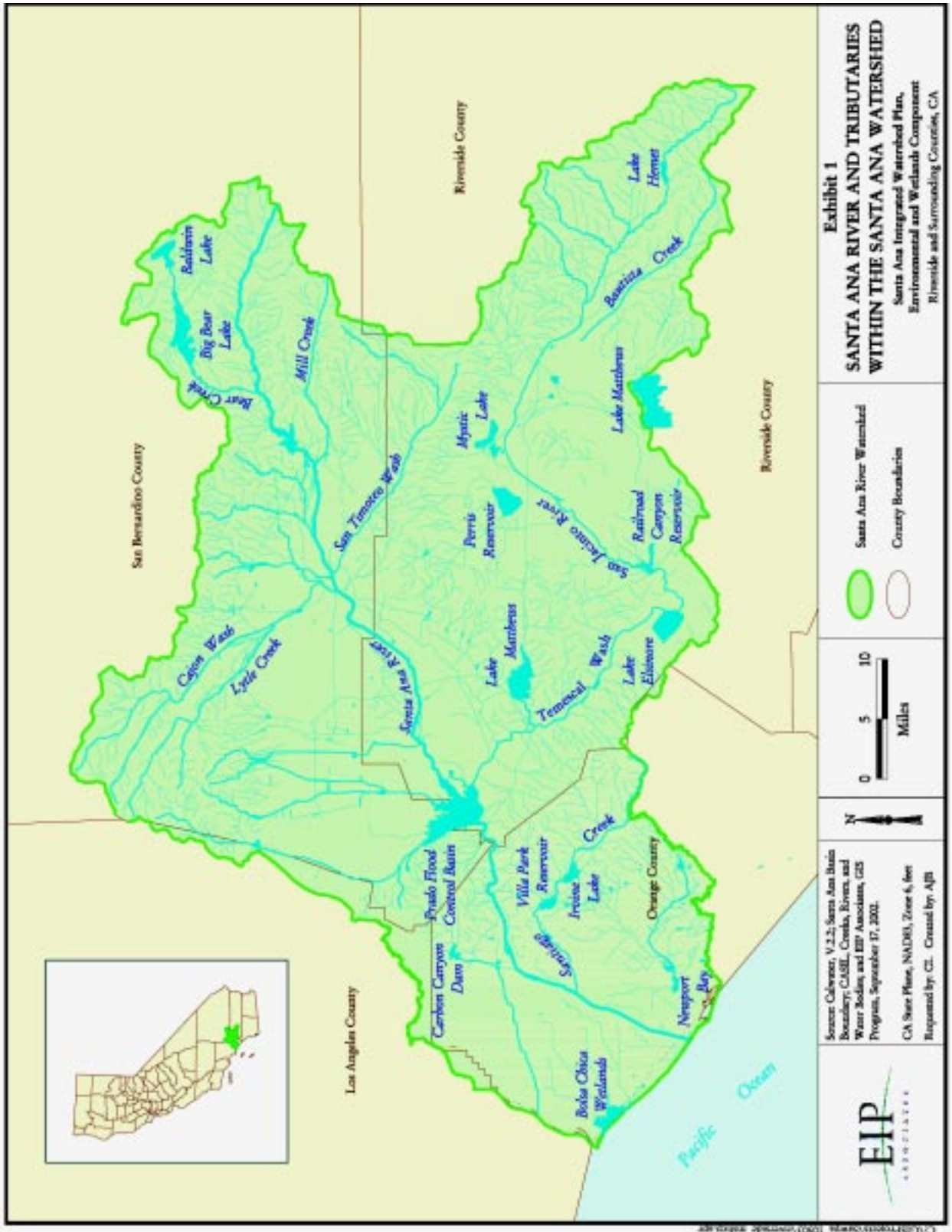


Figure 2-2 Santa Ana River and Tributaries within the Santa Ana Watershed

downstream. As populations have increased, urban runoff and wastewater flows have increased. Between 1970 and 1990, the total average volume rose from less than 50,000 to over 130,000 acre-feet per year, as measured at Prado Dam. Base flow is expected to rise to 230,000 acre-feet per year by 2020, a projected increase of 77 percent since 1990.

Geologic and Hydrologic Features of the Watershed

The upper watershed or headwaters, including the highest point in the drainage system, is delineated by the east-west ridgeline of the San Gabriel and San Bernardino Mountains. Over this ridgeline lies the Mojave Desert, which is part of the Lahontan Basin. This upper "erosion" zone of the watershed has the highest gradient, highest erosion level of new sediment to the system, and fastest stormwater runoff. As flows consist mainly of snowmelt and storm runoff from the undeveloped land in the San Bernardino National Forest, water quality tends to be high, with low concentrations of total dissolved solids, nitrates, and other pollutants. In this zone, the Santa Ana River channel is confined in its lateral movement, contained by the slope of the high, mountainous terrain. Within the upper watershed, the River and its tributaries travel around large boulders and over sand and gravel bars punctuated by pools and riffles reaching depths of about six feet.

Onyx Summit
Photo courtesy of SAWPA

Sedimentary and crystalline materials from the upper watershed move down slope through a process fed by storm pulses; therefore, sediment does not move at a continuous speed. River flow from Seven Oaks Dam to the City of San Bernardino consists mainly of stormflows, flows from the Lower San Timoteo Creek, and groundwater that is rising due to local geological features. From the City of San Bernardino to the City of Riverside, the river flows perennially and much of the reach is operated as a flood control facility. The principal tributary streams in the upper Santa Ana Watershed originate in the San Bernardino and San Gabriel Mountains. These tributaries include San Timoteo, Reche, Mill, Plunge, City, East Twin, Waterman Canyon, Devil Canyon, and Cajon Creeks and University Wash from the San Bernardino Mountains and Lone Pine, Lytle, Day, Cucamonga, Chino, and San Antonio Creeks from the San Gabriel Mountains.

From the City of Riverside to the recharge basins below Imperial Highway, River flow consists of highly treated POTW effluent, urban runoff, irrigation runoff water, imported water applied for groundwater recharge, and groundwater forced to the surface by underground barriers. Near Corona, the River cuts through the Santa Ana Mountains and the Puente-Chino Hills, which together form the northern end of the Peninsular Ranges in Southern California. The River then flows down onto the Orange County coastal plain: the channel lessens in gradient, the valley floor is reached, and the soft features of the channel where sediment has deposited are more prevalent. Floodplains are strewn with boulders and characterized by sand and gravel washes. Within this valley floor, the transport and depositional processes are less confined by higher terrain as water, dissolved material and sediment move toward the sea. Over time, aquatic and terrestrial wildlife have adapted to this dynamic process and channel form (see Figure 2-1). However, rapid urbanization has artificially increased the rate of sedimentation and loss of habitat in this part of the Watershed, negatively affecting water quality and wildlife habitat.

Riverside MWD Crossing
Photo courtesy of SAWPA

In the southern portion of the Watershed, the regional boundary divides the Santa Margarita River drainage area, which is not part of the Santa Ana Watershed, from that of the San Jacinto River. The San Jacinto River, part of the Santa Ana Watershed, starts in the San Jacinto Mountains, runs westerly through Canyon Lake and normally ends in Lake Elsinore. In wet years, the San Jacinto River will overflow the lake and connect with the Santa Ana River. Flood flows produce a broad, shallow wetlands area called Mystic Lake near the northernmost point of the River.

Foreground: Prado Wetlands. Background: Chino Hills State Park.
Photo courtesy of SAWPA.

The Orange County coastal plain is composed of alluvium derived from the mountains. Upstream from the Santa Ana Canyon lay Prado Dam and Prado Wetlands; River flows are passed through the Weltands to improve water quality and remove nitrates before being used for Orange County groundwater basin recharge. Santiago Creek, the only major tributary to the lower Santa Ana River, joins the River in the City of Santa Ana. The lower limit of both the groundwater recharge area and the River's ordinary flows is 17th Street in the City of Santa Ana. Prior to channelization of the lower part of the River, the channel used to meander slowly across broad flood plains. Currently, the River is a concrete channel from 17th Street in the City of Santa Ana to the mouth of the River in Huntington Beach. From 17th Street in Santa Ana to the Victoria Street Bridge, the River is ordinarily dry. The Greenville-Banning Channel, which carries stormwater discharge and urban runoff, is channelized to the Victoria Street Bridge where it joins the Santa Ana River. Discharge from the Greenville-Banning Channel combines with tidal flow from the Pacific Ocean and the River is wet from the Victoria Street Bridge to the mouth of the River.

Groundwater in the watershed is highly controlled by the geology of the area, both the configuration of bedrock and by the extensive faulting. Most groundwater basins are unconfined, much like a bowl full of sand that has water poured in halfway. However, the variable depth to bedrock, and the presence of faults cause pressure zones where water flows towards (or to) the ground surface. In general, groundwater flows the same directions as surface water- from the mountains in the east/north to the Pacific Ocean in the west. There are about 40 groundwater basins in the watershed (depending on how they are defined and boundaries are drawn); many are inter-related.

Some of the largest groundwater basins include the Chino Basin (Chino/Ontario/Fontana area), the Orange County basin, the Bunker Hill Basin (San Bernardino) the San Timoteo Basin (Yucaipa/Banning/Beamont area) and the San Jacinto/Hemet Basins.

The upper Santa Ana River retains much more of its historical character than does the lower part of the River.
Photo courtesy of SAWPA

Four primary faults transverse the watershed, with other minor faults either branching off of, or running parallel to, the major faults. Within the upper watershed, the San Andreas Fault divides the San Bernardino Mountains from the San Gabriel Mountains and branches off into the San Jacinto Fault near San Bernardino. Known as Southern California's most active fault, the San Jacinto Fault affects groundwater in the San Jacinto River and the Santa Ana River, forcing groundwater to the surface at the Bunker Hill Dike. Toward the central watershed, the Elsinore-Whittier Fault passes under the Prado Dam from the northwest to the southeast. Toward the coast, the Newport-Inglewood Fault enters the region from the Los Angeles area and passes offshore near Newport Beach.

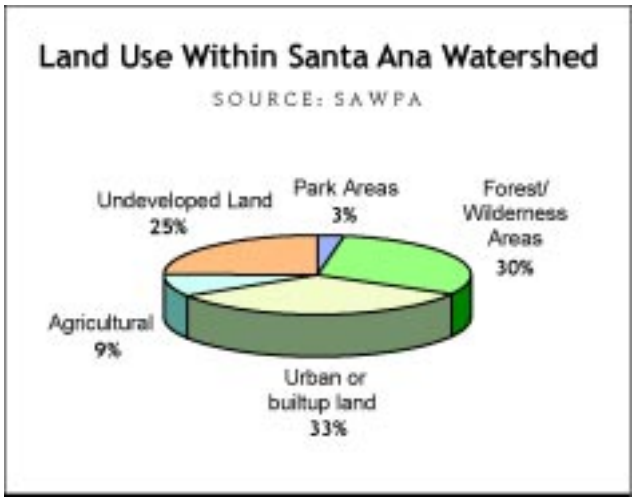
Climate

The climate of the watershed is Mediterranean with hot, dry summers, and cooler, wetter winters. The extent of this climate type is limited worldwide. Other than the central and south coast of California, it only occurs in coastal zones along the Mediterranean Sea, Western and Southern Australia, the Chilean Coast, and the Cape Town region of South Africa. Average annual precipitation ranges from 12 inches per year in the coastal plain, to 18 inches per year in the inland alluvial valleys, reaching 40 inches or more per year in the San Bernardino Mountains. Most of the precipitation occurs between November and March in the form of rain with variable amounts of snow in the higher mountains of the watershed. The climatological cycle of the region results in high surface water flows in the spring and early summer period, followed by typically low flows during the dry season. Winter and spring floods generated by precipitation in the high mountains are not uncommon. Similarly, during the dry season, severe thunderstorms in the high mountains have periodically generated torrential floods in local streams.

Agricultural land, such as the citrus groves shown here, is being replaced by development throughout the watershed.
Photo courtesy of SAWPA

Land Use

The Santa Ana River watershed is substantially urbanized: about 32 percent of the land use is residential, commercial, or industrial. Agricultural land, once accounting for virtually all of the use of the watershed during the days of the *ranchos*, now accounts for a mere 10 percent. Instead of a scattered population of indigenous peoples, the watershed now supports over 5 million people. Refer to Figure 2-3 for a map of Santa Ana Watershed Land Use.



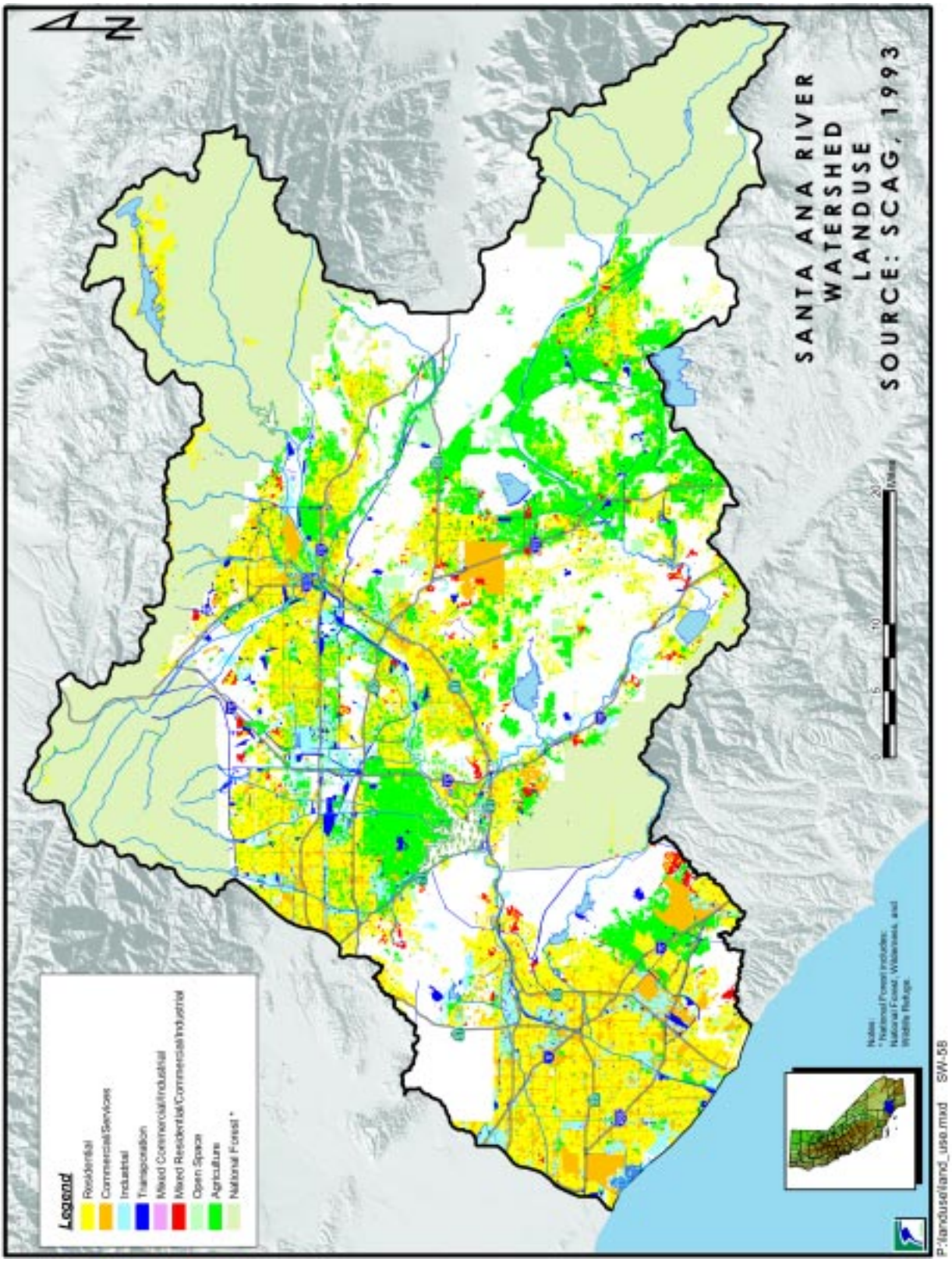


Figure 2-3 Santa Ana River Watershed Landuse

B. Biological Resources

Habitat Modification

As noted by Moyle (2002), most of California's inland waterways today bear little resemblance to the streams and lakes encountered by the first European explorers and settlers. In the Santa Ana River watershed this observation is certainly true. For flood control and channelization activities have left portions of streams channelized and concrete-lined where once riparian forests grew along a meandering stream, although fortunately only 20% of the Santa Ana River is concrete-lined. Dam construction and flood control activities were not the only factors influencing the Santa Ana River watershed in ways that adversely impact habitat critical for aquatic resources. The following factors have also played a role:

- Stream channel alteration
- Draining of streams and lakes, especially adjacent wetlands
- Livestock grazing and the impact on aquatic and riparian vegetation, sedimentation, and water pollution
- Historical logging practices
- Mining, particularly instream aggregate mining

Historical logging practices have impacted aquatic species habitat. This area is now under the waters of Lake Arrowhead, adjacent to Watershed boundaries in the San Bernardino Mountains.

- Watershed changes resulting in cumulative affects to aquatic resources

Special Status Species

Second only to Hawaii, the State of California is home to the highest number of endangered species in the United States. As defined within the Federal Endangered Species Act of 1973, an endangered species is any animal or plant listed by regulation as being in danger of extinction

The Santa Ana Watershed provides habitat for a wide range of biological resources, including the federally endangered Delhi Sands flower-loving fly. *Photo courtesy of the U.S. Fish and Wildlife Service*

throughout all or a significant portion of its geographical range. A threatened species is any animal or plant that is likely to become endangered within the foreseeable future throughout all or a significant portion of its geographical range. Without a special permit, federal law prohibits the "take" of any individuals or habitat of federally listed species. In addition to federal laws, the State of California has its own California Endangered Species Act, with a separate listing of species and separate laws governing take of listed species. Enforcement of the Federal Endangered Species Act is administered by the U.S. Fish and Wildlife Service and the National Marine Fisheries Service, while the California Department of Fish and Game enforces the California Endangered Species Act. Refer to Figure 2-4 for a map of Critical Habitat within the Watershed.

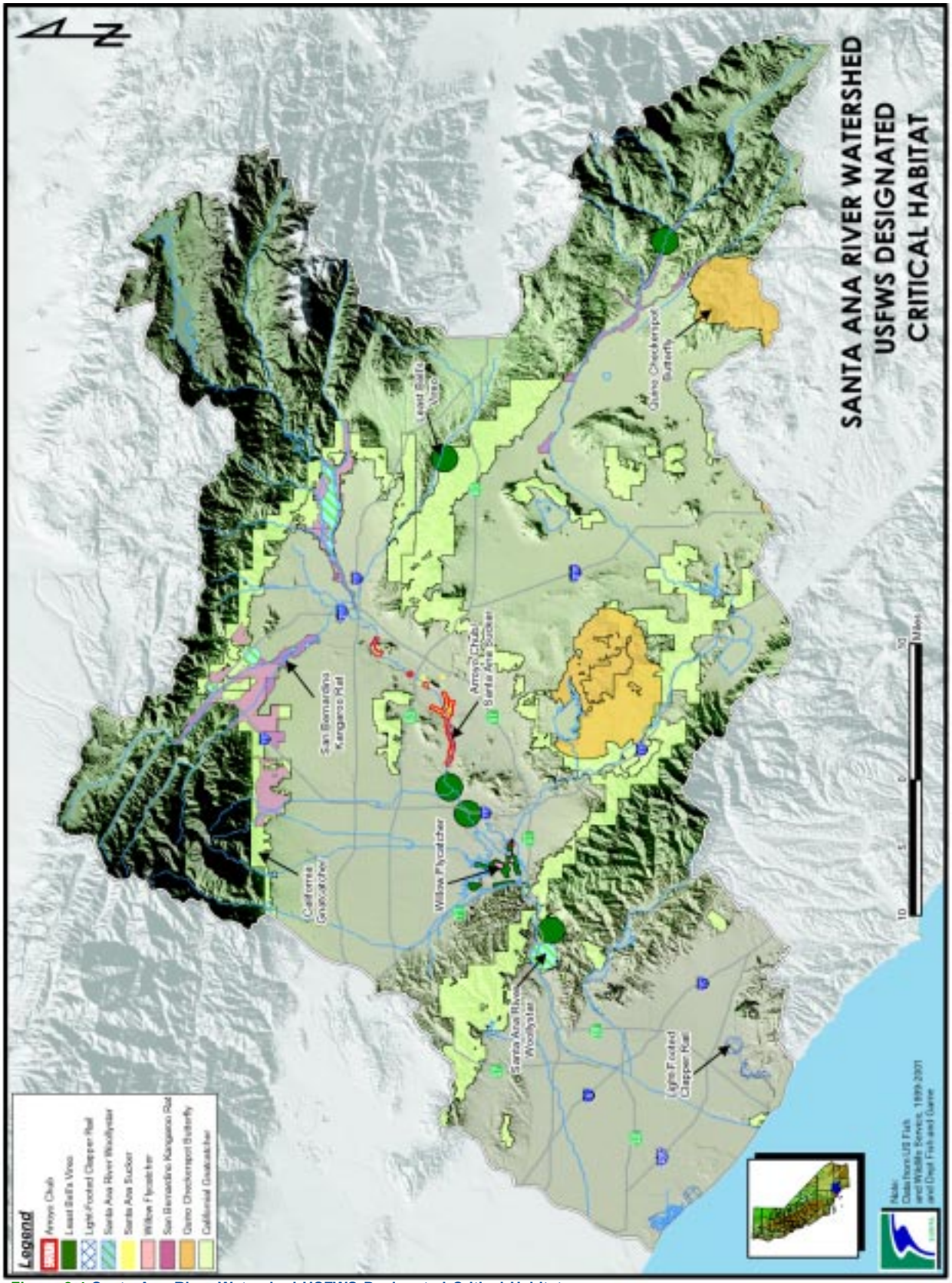


Figure 2-4 Santa Ana River Watershed USFWS Designated Critical Habitat

The varied geography and natural features of the Santa Ana Watershed provide habitat for a number of federally and/or State-listed species. As the Integrated Watershed Plan focuses on the resources in and around the Santa Ana River, listed species of concern herein are those that occupy aquatic, wetland, riparian, or riparian-adjacent areas. Of these, two are plants, the Santa Ana River woolly star (*Eriastrum densifolium*) and slender-horned spine flower (*Dodecahema leptoceras*); one fish, the Santa Ana River sucker (*Catostomus santaanae*); one amphibian, the arroyo toad (*Bufo californicus*); three birds, the least Bell's vireo (*Vireo bellii pusillus*), southwestern willow flycatcher (*Empidonax traillii*), and bald eagle (*Haliaeetus leucocephalus*); two mammals, the San Bernardino kangaroo rat (*Dipodomys merriami parvus*) and Stephen's kangaroo rat (*Dipodomys panamintinus*); and one insect, the Delhi Sands flower-loving fly (*Rhaphiomidas terminatus abdominalis)*. For a full listing of special status species within the Watershed, refer to Appendix F. Any project or policy recommended by the Santa Ana Integrated Watershed Plan will need to assess potential impacts to listed species, and incorporate measures to avoid impacts to these species.

Current Aquatic Resources

Fishes

As described in Section 1B: Historical Context, the Santa Ana River historically provided habitat for eight species of native fish (species have multiple forms). Only four native nongame freshwater fishes are currently found in non-estuarine waters: arroyo chub, Santa Ana speckled dace, Santa Ana sucker, and threespine stickleback. All of these remaining fishes have limited distributions and face possible extirpation. As previously mentioned, the Santa

The Santa Ana sucker is a federally endangered fish native to the Santa Ana River.
Photo courtesy of SAWPA

Ana sucker is listed by the federal government as a "threatened" species pursuant to the Endangered Species Act. Currently, the western brook lamprey, steelhead, and unarmored threespine stickleback are known to be extirpated from the Santa Ana River watershed. The Pacific lamprey has been observed once in the past 47 years and it is likely extirpated as well (refer to Table 1, Appendix G). Introduced forms of the rainbow trout have been extensively stocked in the watershed for sport fishing for over 100 years, and it is unknown if any genetically pure rainbow trout stocks endemic to the watershed remain. The partially armored threespine stickleback was widely planted in the watershed for mosquito control in the early 1900s and is now found out of its natural historical range, e.g., Big Bear Lake.

In contrast, at least 33 fishes have been introduced into the Santa Ana River watershed and are currently present, as shown in Table 2 in Appendix G. Swift *et al*. (1993) notes that many more exotic species of fishes have been introduced, but do not appear to have survived. New species can be expected to be found at any time due to interbasin water transfers, ship ballast water hitchhikers, bait bucket introductions, and hobbyists disposing of unwanted fishes. Many

of the introduced fishes are widespread, while a few are restricted to specific locations or habitats. Of the current inventory of introduced fishes, most were introduced by government agencies to serve as a food resource, for insect control, for sport fishing, or to serve as forage for sport fishes. A smaller number of fish have become established after arriving inadvertently via interbasin water transfers or in ships' ballast water. For a detailed discussion of the introduction of fishes to California, the reader is directed to Dill and Cordone (1997). Additional information about introductions of fishes to Southern California is presented by Swift *et al*. (1993). Supplemental records can be found in Moyle (2002).

Amphibians

During the last 50 years, population growth and urban development in Southern California has displaced many amphibian species, and encroached upon much of former amphibian habitat. Several species are thought to be extinct, and many others have fragmented populations, which are at risk of extirpation. Amphibians are especially sensitive to environmental changes that alter the hydrology, ecology, and geology of a region, because they have evolved highly specialized adaptations that have allowed them to exist in these relatively arid regions. Introduced species have also been a major contributor to the decline in amphibian populations in Southern California. These nonnative species increase competition for food sources, as well as prey upon many of the native amphibians.

Reptiles

The California Department of Fish and Game considers the Southwestern pond turtle *(Clemmys marmorata)* a species of "special concern." Recent reports on *C. marmorata* in Southern California indicate that a few viable populations remain in the regions (see also Brattstrom 1988). Approximately 6–8 viable populations of the turtle remain south of the Santa Clara River system in California. Four years of drought (1986–90) have exacerbated the negative effects of habitat alteration accumulated over many years over much of this region from changes in land and water use, and abusive grazing practices. In particular, most western pond turtle populations examined in this region appear to show an age structure increasingly biased towards adults, indicating little or no recruitment is taking place. Recent surveys indicate that the southwestern pond turtle is also seriously threatened throughout most of its range outside of California.

Birds

Riparian ecosystems harbor the highest number of bird species in the arid and semi-arid parts of the southwestern United States. Riparian habitat provides productive breeding grounds and offers vital overwintering and migration stopover areas for migrating birds. Loss and degradation of riparian habitat have negatively impacted bird populations throughout the watershed. Other factors affecting bird populations are brood parasitism by the brown-headed cowbird and disruption of natural hydrological regimes from dams and levees.

Least Bell's vireo, a federally listed riparian bird species
Photo courtesy of the Inland Empire Chapter of AEP.

Wetland areas, such as the Bolsa Chica Ecological Reserve Park shown here, provide vital habitat for migrating birds.
Photo courtesy of EIP Associates.

The federally endangered least Bell's vireo has experienced recent population growth within the watershed due to aggressive management activities within Prado Basin and on adjacent lands. Within the basin, the population rose from 19 pairs in 1986 to 123 pairs in 1993. By the end of 1996, the count stood at 195 nesting pairs. This stunning recovery is due to the provision of high-quality habitat for the bird species in part due to invasive species removal, a project in place to control populations of the predatory cowbird, and efforts on the part of the U.S. Fish and Wildlife Service, Orange County Water District, a number of Resource Conservation Districts (RCDs), and others.

The federally endangered southwestern willow flycatcher is also affected by cowbird brood parasitism. The implementation of cowbird management programs in addition to preservation and restoration of riparian deciduous shrub habitat is needed to reduce current populations. The bald eagle, listed by the USFWS as endangered in 1978 has experienced population growth over the past two decades. The bald eagle could be considered a USFWS success story: reclassified as "threatened" in 1995 and proposed for delisting in 2000. Delisting of a species is the USFWS's ultimate goal and only happens when specific recovery goals have been met for a species. Unfortunately, delisting is an infrequent occurrence. In the case of the bald eagle, delisting has been delayed while the USFWS determines how the species would be managed once it is no longer classified as threatened.

Factors Affecting Aquatic Resources

Introduced Species

The 33 species of introduced fishes greatly outnumber the four remaining native fish species. The number of species, per se, is not the problem but, rather, the impact that introduced fishes and other aquatic organisms, have on the native fishes of the Santa Ana River watershed. Introduced fishes have dramatically changed the composition of the watershed's fish community and now act as a deterrent to the restoration and enhancement of the native fishes that remain. The manner in which introduced fishes can affect the aquatic resources of the Santa Ana River watershed are

- Competition between native and introduced fishes for food and space
- Predation by introduced species on native fishes
- Habitat interference by introduced fishes that change habitat characteristics
- Introduction of disease that may infect native fish or other aquatic animals
- Hybridization between closely related species

Water Pollution

Fortunately, water quality in the Santa Ana River has improved in recent years due to technological developments and water quality planning. Most of the native fishes of the Santa Ana River watershed are adapted to clear, unpolluted water that can support food resources and provide the various habitat conditions necessary to complete their respective life cycles. While fish kills due to the spill of toxic substances into streams are dramatic examples of the effects of pollution, these instances are acute, or short-term, rather than chronic. More insidious, however, are the chronic effects on aquatic resources of nonlethal forms of pollution that decrease growth, inhibit reproduction, or impair movement. Chronic elevated water temperatures or high sediment loads are an example of this type of pollution, even though toxic chemicals are not involved. Other examples include elevated but nontoxic levels of ammonia, increases in salinity, and low levels of dissolved oxygen. Because most of the remaining native freshwater fishes live, at some time, in treated wastewater, the issue of chronic, low-level pollution is of great concern, although the quality of wastewater has increased markedly in past years.

Fish native to the Santa Ana River are adapted to clear, unpolluted water.
Photo courtesy of EIP Associates

Exploitation

Overexploitation of rainbow trout/steelhead, primarily by angling, was a major factor in driving the native populations to low levels, and perhaps to extinction. Over-fishing, in turn, led to the stocking of hatchery fish and the introduction of various exotic species as angling alternatives to the native trout. The intensity of overexploitation is illustrated by a report in the July 17, 1892, edition of the *Citrograph*, a Redlands newspaper, which reported that three boys fishing in Bear Creek, a tributary to the Santa Ana River in San Bernardino County, had caught 592 trout in three hours. Similar reports are common in the historical press.

It was not until 1872 that the California Legislature banned the use of nets, weirs, baskets, traps, explosives, and poisons as acceptable means of harvesting trout. Unfortunately, there was no one to enforce the statute, nor was there any limit on the number of fish that could be harvested by legal means. The overexploitation of trout became such a problem in the watershed that in 1894 San Bernardino County, on its own authority, finally took action and limited the number of trout a person could catch to 50 per day. The State of California did not take similar action until 1905, when the harvest was limited to 50 trout per day and 25 total pounds. By then, the native stocks had already become depleted in the Santa Ana River watershed.

Each of the aforementioned factors have acted in concert over a long period of time to reduce the native fish community of the Santa Ana River watershed to that which remains today. The Santa Ana River Watershed Plan recognizes that history cannot be undone and the aquatic community cannot be restored to its pre-settlement condition; however, a conservation

strategy can be implemented that will ensure the long-term viability of the watershed's aquatic communities

C. Open Space and Recreation

The Santa Ana Watershed possesses a wealth of natural resources affording numerous outdoor recreational opportunities. On a given day, it is possible to snowboard Big Bear in the morning and surf the "Wedge" in Newport Beach in the afternoon without leaving the Watershed. Varied terrain and a mild climate combine to create the perfect backdrop for outdoor recreation possibilities.

Parkland Ratios

Within the Watershed, parkland totals 75 square miles (48,000 acres) of the Watershed while forest/wilderness areas total 850 square miles. Undeveloped land, while technically open space but not included in open-space calculations, totals 687 square miles. Refer to Figure 2-5 for a map of current open space, based on 1993 Southern California Association of Governments land use information.

The U.S. Department of Housing and Urban Development (HUD) recommends 2.5 acres of parkland for every 1,000 residents, although many consider this ratio to be low. Overall, the Watershed residents experience a ratio of 100 acres of parkland to every 1,000 residents. Two facts make it difficult to compare this number to HUD recommendations. First, HUD recommendations are for urbanized areas, and much of the Watershed is not urbanized. With such a large land area, disparities exist between the ratio of parkland to residents and the accessibility of parkland to residents. That is,

RECREATIONAL OPPORTUNITIES: EXAMPLES

Throughout Watershed

- Parks (active and passive uses)
- Fishing
- Hiking
- Biking
- Horseback Riding
- Bird Watching
- Nature Observation
- Hunting

Big Bear

- Snow Riding
- Snowboarding
- Ice Skating
- Sledding
- Fishing

Pacific Ocean/Coastal Orange County

- Fishing
- Surfing
- Boogie-Boarding
- Sailing
- Boating

Lake Elsinore

- Water-Skiing
- Jet-Skiing
- Boating

Other Lakes and Reservoirs

- Big Bear Lake
- Lake Perris
- Lake Matthews

The upper Santa Ana Watershed provides winter recreational activities, such as sledding (shown here near Crestline).
Photo courtesy of EIP Associates.

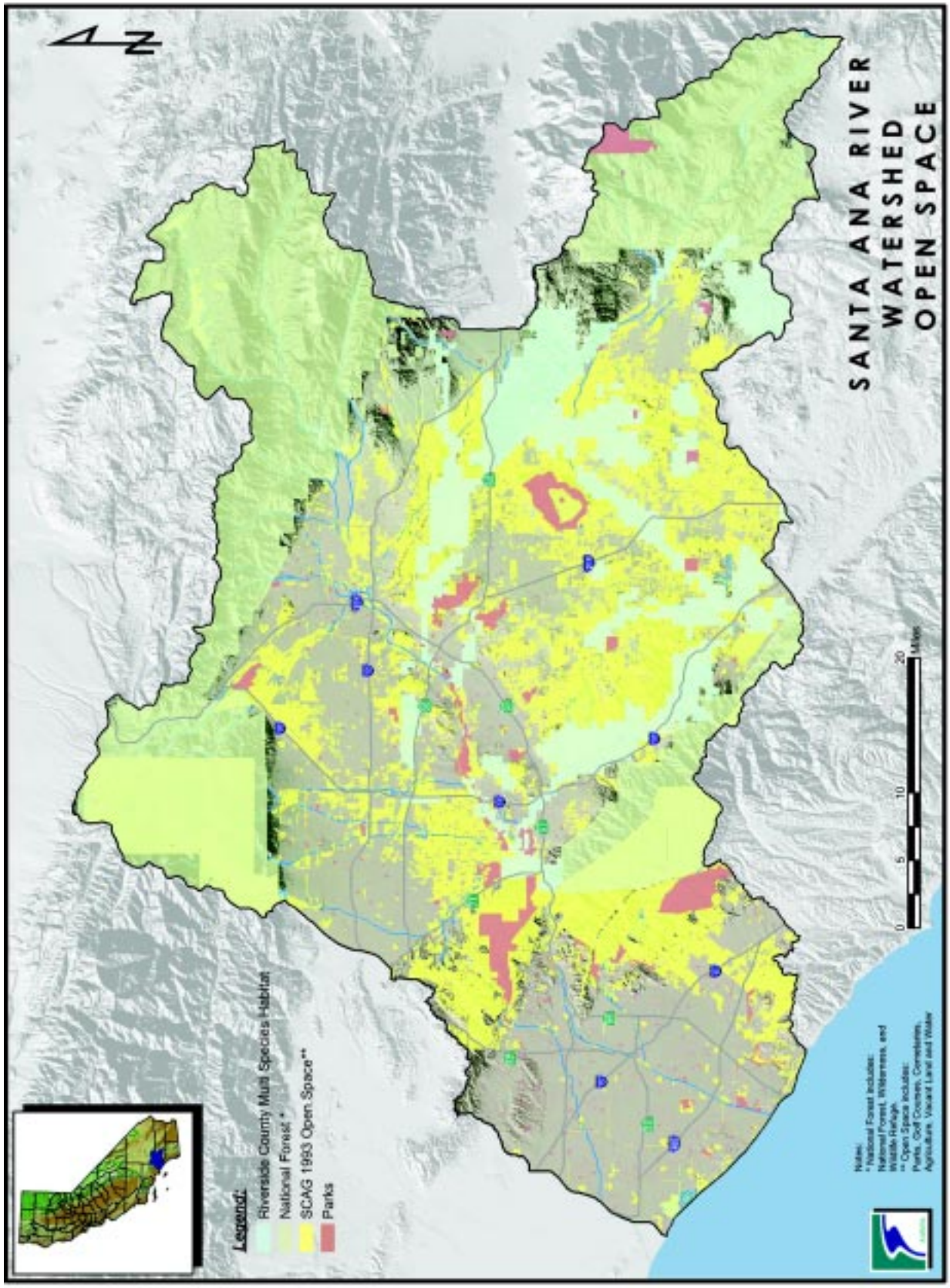


Figure 2-5 Santa Ana River Watershed Open Space

not all watershed residents have access to 0.1 acre of parkland. The second fact that makes comparison difficult is that forest/wilderness lands are not taken into account in this calculation.

Public Access

An important aspect of preserving recreational opportunities is to ensure access to local waterways. The Watershed's rivers, streams, lakes, and beaches are heavily used by watershed residents and visitors. A visit to the Santa Ana River near Van Buren Bridge on a summer afternoon reveals dozens of families picnicking, wading, and swimming in the River, although swimming in the River is not necessarily recommended. Beach access is mandated by the Federal Coastal Zone Management Act, and is a primary mandate of the California Coastal Commission. However, access to lakes and rivers is not given as much attention as beach access, and in some cases, river access is prohibited due to water quality issues. Lake and river access should be monitored as the Watershed continues to urbanize to ensure that homes and commercial development dedicate lateral easements for public access to Watershed resources.

Lake Elsinore provides recreational opportunities, such as swimming, boating, and picnicking.
Photo courtesy of EIP Associates

Forest Land

The Santa Ana Watershed is fortunate to include two national forests: San Bernardino National Forest and Cleveland National Forest. The San Bernardino National Forest includes the wilderness areas of Cucamonga, San Jacinto, San Gorgonio, and Santa Rosa. The National Forests, managed by the U.S. Department of Agriculture, provide recreational opportunities for watershed residents and visitors, such as hiking, camping, and mountain biking. The Santa Ana River headwaters are in the San Bernardino National Forest. Since most of this land is undeveloped, the high water quality at the headwaters of the River provides high-quality habitat for native wildlife.

Santa Ana River Trail

Many recreational efforts are focused on the Santa Ana River Trail, an important regional recreational element. First conceived over a century ago and formally proposed in 1955, the Santa Ana River Trail is a much-anticipated project with watershed-wide support. Within the Santa Ana Watershed, no other issue seems to spark as much enthusiasm or inspire as much collaboration between diverse interests as trail planning. Trails are viewed as valuable resources—providing connectivity, transportation alternatives, scenic relief to urban dwellers, recreational activities, and linear parkways with opportunities for environmental restoration as well as education. Opportunities for multi-benefit projects that incorporate trail planning, open space acquisition, wetlands/habitat enhancement, and educational/interpretive components are desirable.

More equestrian connections to the riverbed are needed, such as this one near Anza Narrows Park in Riverside.
Photo courtesy of EIP Associates

Watershed planning participants agree that the trail should provide access for a wide variety of users, including walkers, hikers, joggers, bicyclists, horseback riders, users in wheelchairs, rollerbladers, and skateboarders. Some of these users require special features, such as wheelchair access or equestrian staging areas.

The Santa Ana River Trail provides a Class I Bikeway along the river for 40 miles, with further segments planned.
Photo courtesy of EIP Associates

While the 110-mile trail is far from complete, several segments totaling approximately 40 miles have been constructed. Plans are almost complete for the remaining 70 miles (as well as a number of feeder trails and connections), and full funding has been secured for some segments. Refer to Figure 3-3 for a map of the current status of the Santa Ana River Trail, including planned segments. One goal of the Santa Ana Integrated Watershed Plan is to assist in securing funds for those trail segments that have not yet received funding. For more information on the Santa Ana River Trail, refer to Section 3A-3.

Proposed site of Santa Ana River Trail in San Bernardino County.
Photo courtesy of EIP Associates.

Challenges and Opportunities

The Santa Ana Watershed is rapidly urbanizing; Lindell Marsh of the Santa Ana River Watershed Group (SARWG) refers to the region as the "urbanizing tier of Los Angeles." As more and more land is developed for homes and commercial enterprises, ratios of parkland to residents become more difficult to maintain. First, there is the direct challenge of maintaining parkland ratios while the number of people increases. Second, planners face an indirect economic challenge: urbanization tends to drive up land prices, making land preservation cost-prohibitive. Watershed wide, cities and counties should consider the issue of retaining the ratio of 100 acres of parkland for every 1,000 residents. This requires a commitment from park planners and other City and County staff, developers, and nonprofit organizations to maintain or improve current open space ratios, even as populations burgeon. In addition, urban and park planners should work to ensure access to waterways including lakes, streams, rivers, and the ocean.

Several opportunities exist within the Santa Ana Watershed to expand recreational opportunities. Many of these are either in project development stage or currently underway. Notable examples of these projects include the following.

San Timoteo State Park—This undertaking of the Riverside Lands Conservancy among others would involve the creation of a new State park centered in San Timoteo Creek Watershed. In addition to other restoration activities in the area will increase water quality in San Timoteo Canyon and subsequently the Bunker Hill Basins, a major source of drinking water. The park will provide a number of linkages with other habitat areas in Riverside County, as well as reestablishing, creating, restoring, and protecting wetlands in the floodplains of the canyon and its major tributaries from Loma Linda to I-10.

Orange Coast River Park—The Friends of Harbors, Beaches, and Parks, with cooperation from many partners, including local cities, Orange County nonprofit organizations, and private entities, have proposed a large park at the mouth of the Santa Ana River. The Orange Coast River Park would link several existing parks, incorporating ponds, boardwalks, and restoration. The project's vision is broadening to include Banning Ranch, which could potentially increase the Park from 1,000 to 1,400 acres. Implementation of this project will involve coordination with many agencies, such as the Orange County Sanitation District.

Santiago Creek Parks —Restoration efforts have been underway in and along Santiago Creek, the Santa Ana River's major tributary in the lower watershed. Local cities and organizations are acquiring land to add new parks along the Creek. These parks would provide recreational and educational benefits, in addition to habitat and

The future site of the Orange Coast River Park is the south side of the Santa Ana River mouth .
Photo courtesy of SAWPA

water quality benefits. The City of Orange has recently acquired land including eight acres within the Santiago Creek just north of Chapman. This land will be included in the 42-acre Grijalva Park at Santiago Creek. The City also owns Yorba Park that borders the Santiago Creek just south of Chapman Avenue and Hart Park, which includes several acres of unimproved land in the creek. The County of Orange and City of Santa Ana contribute additional park acreage upstream and downstream from the City of Orange. These three agencies, along with the City of Villa Park, are working to connect these parks with a contiguous recreational trail system.

Chino Creek Park—The Inland Empire Utilities Agency, Orange County Water District, and the Wildlands Conservancy are developing an integrated recreational plan that will link Prado Basin with the Santa Ana River Trail System providing habitat, recreational and educational opportunities. There will be an educational center at Chino Creek Park and a nursery designed specifically to grow native plants for restoration projects. A Prado Basin interpretative

center and youth camp for inner-city children will be developed where currently a gun club is located. This project utilizes a wide-angle integrated planning approach to integrate habitat protection and recreational opportunities for the trail system in the Prado Basin.

D. Water Supply

Groundwater supplies meet most of the direct water demand in the basin, providing 68 percent of the consumptive water needs. Groundwater comes from the inland and coastal aquifers in the region, which range from a few hundred to over one thousand feet in thickness. Inland aquifers, upstream from Prado Dam, underlie about 1,200 square miles of the Watershed, while coastal aquifers downstream from Prado Dam underlie about 400 square miles. Imported water from Northern California and the Colorado River provides about 23 percent of consumptive water demand. Other sources of supply include surface water derived from precipitation within the basin (5 percent) and recycled water (4 percent). Future water supply projections indicate a shift from reliance on groundwater and imported water to increases use of recycled and surface water (refer to Figure 2-6). The amount of groundwater recharged to the Watershed's aquifers is only 37 percent of the volume pumped. Given the imbalance between water pumped and water recharged, it should not be surprising that, under such intense settlement pressures and water demands, the native aquatic community of the Watershed has been significantly impacted. Future water supply planning includes increased groundwater recharge and measures to reduce impacts to native aquatic communities, while meeting increased water demands due to regional population growth.

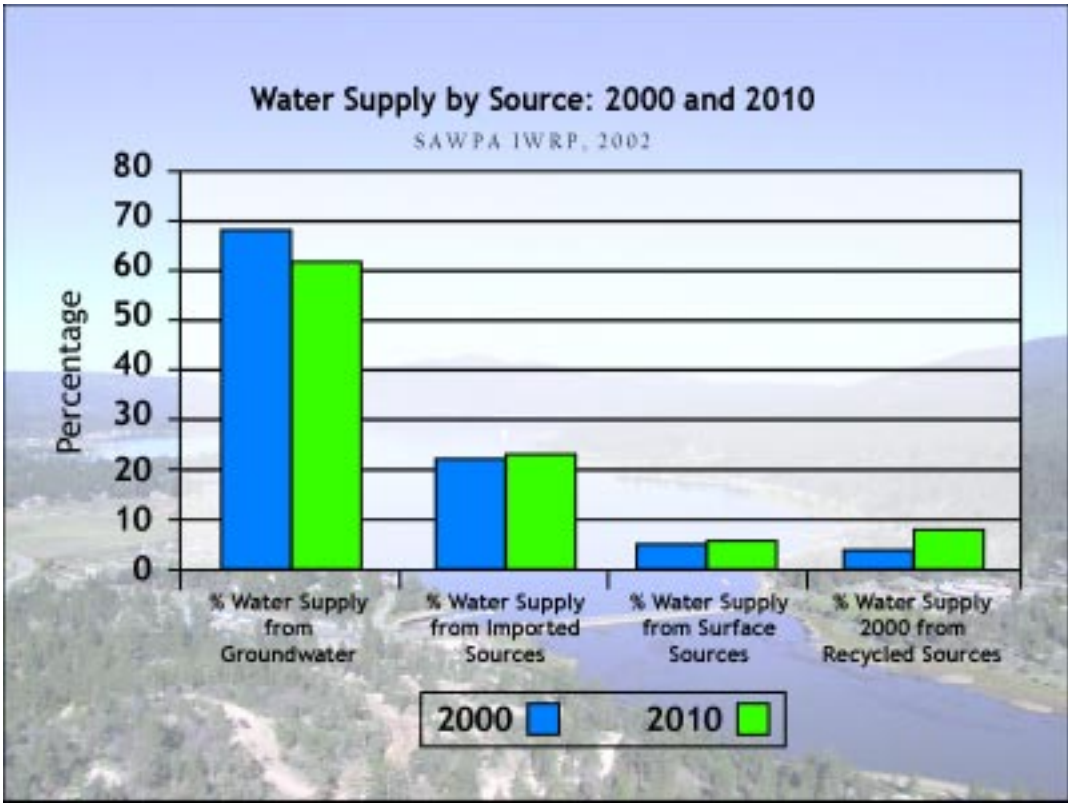


Figure 2-6 Water Supply by Source

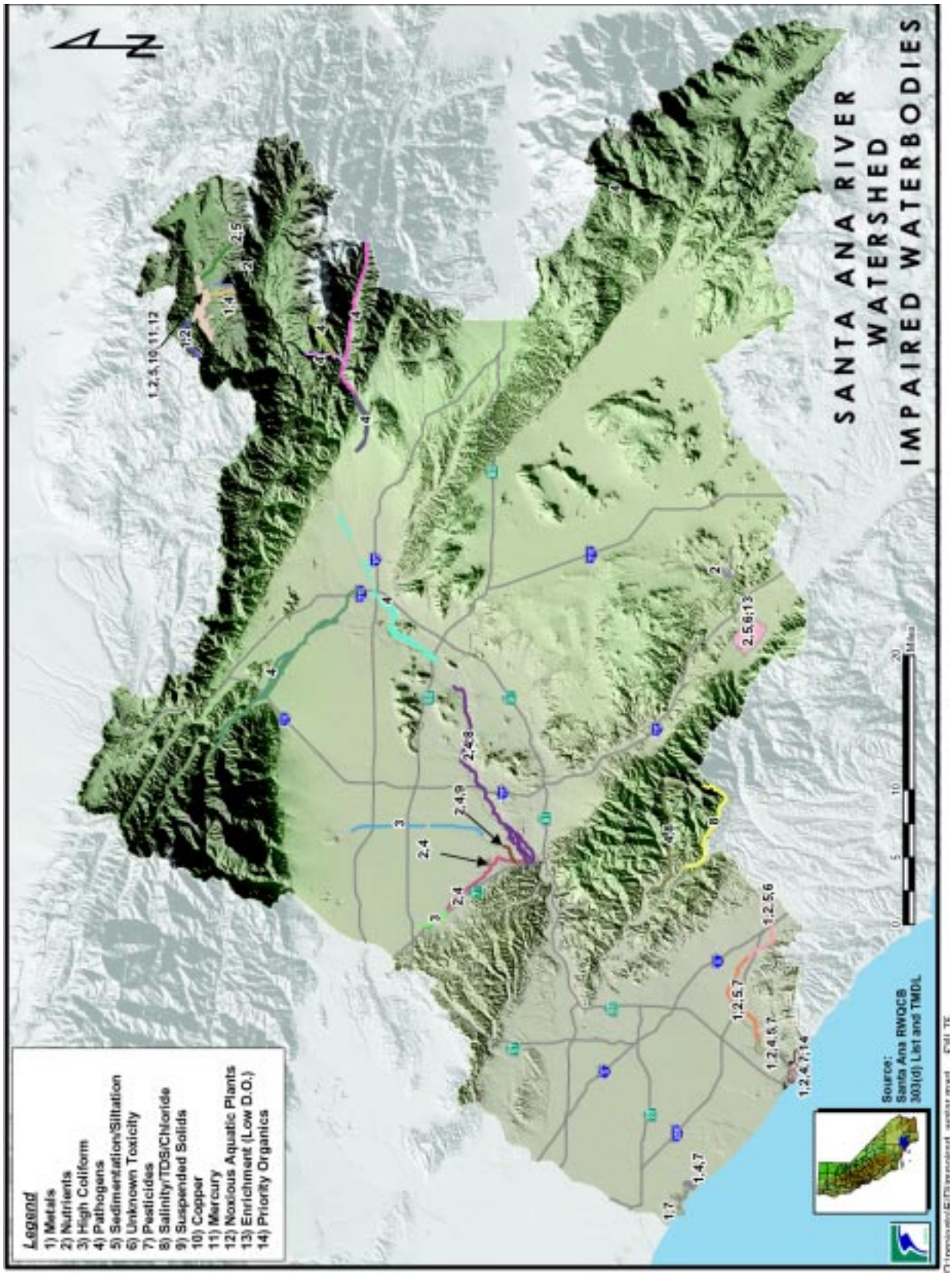


Figure 2-7 Santa Ana River Watershed Impaired Waterbodies

E. Water Quality

Almost a century of agricultural and industrial land use has resulted in salts and other pollutants infiltrating many aquifers and streams within the Santa Ana Watershed. These sources of water quality degradation can be classified into point and nonpoint sources. Point sources are confined to point discharges to the soil, groundwater, or stream systems. Examples include conventional wastewater and industrial discharges to streams or ponds, and leaky underground storage tanks. Nonpoint sources are areawide discharges to soil, groundwater, and surface waters, such as land application of waste and fertilizers, and atmospheric deposition of contaminants to the soil and water bodies. Point sources can be traced back to a single source, such as the end of a pipe, while nonpoint sources can rarely be traced back to an individual origin, and require regional solutions, including regionwide behavioral changes, to reduce pollutants.

Within the Santa Ana Watershed, water quality is generally high in the headwaters and upper watershed, lessening as the distance from the Pacific Ocean decreases. The California Water Resources Control Board and its regional offices (RWQCB) are responsible for enforcing water quality standards within the state. As mandated by Section 303(d) of the Federal Clean Water Act, the RWQCB maintains and updates a list of "impaired waterbodies" that exceed State and federal water quality standards. These impaired waterbodies are shown for the Santa Ana Region in Figure 2-7. Within the upper Santa Ana Watershed, including the Santa Ana River and Lytle Creek, pathogens from unknown nonpoint sources are the primary pollutants. Due to urban development and agricultural operations, pathogens from dairies and other nonpoint sources are joined above Prado Dam by high coliform counts, elevated nutrient levels (especially nitrates), suspended solids, and high salinity. In coastal areas, common pollutants include metals from urban runoff and boatyards, pathogens from urban runoff and storm sewers, nutrients from agriculture and urban runoff, and pesticides from agriculture, contaminated sediments, and other unknown nonpoint sources.

As the Santa Ana Watershed continues to grow, cities encroach ever closer to dairies and other agricultural operations. To counter this added stress to the surface and groundwater supplies, dairy producers and water agencies are working together to develop advanced methods of reducing the dairies' impacts to water quality. Technologically advanced wastewater control techniques have been rigorously employed and negative impacts from agricultural runoff continue to be minimized. In fact, the Santa Ana Watershed is considered to be a world leader with respect to implementation of innovative technology to improve water quality and manage organics from the dairies.

Located in the center of the Santa Ana Watershed, the Chino Basin is home the highest concentration of dairy cows in the world.
Photo courtesy of SAWPA

For example, Orange County Water District and Orange County Sanitation District state-of-the-art Groundwater Replenishment System would purify for reuse 65,000 acre-feet per year of wastewater that is currently discharged into the ocean. Using water treatment methods including microfiltration, reverse osmosis, and UV disinfection, secondarily treated wastewater from the Sanitation District's sewage treatment plant will be purified to levels that far exceed drinking water standards. The water will then be stored in the Orange County Groundwater Basin either by injection along the coast or by percolation in ponds near the Santa Ana River. The underground basin provides 75 percent of the water used by north and central Orange County cities.

The Chino Basin Dairy Program and Organics Management Center is an example of world-class technology where a closed loop waste management system tackles agricultural waste, produces energy, and provides high-quality fertilizer products. Nevertheless, the existing salts and contaminants present in the watershed and adjacent groundwater basins from past practices still need to be removed, as improving water quality is inextricably linked to improving water supplies and implementing a comprehensive groundwater storage program. As regional water leaders seek to develop further groundwater storage in the Santa Ana Watershed, steps must be taken to pump contaminated water from underground, purify the water, and perform groundwater recharge with the purified water.

The Santa Ana Regional Interceptor (SARI) is a waste pipeline designed to convey 30 million gallons daily (MGD) of nonreclaimable wastewater from the upper Santa Ana River basin to the ocean for disposal, after treatment. To date over 55 miles of the SARI line have been completed. The upstream extension, completed in 1995, is to the City of San Bernardino Wastewater Treatment Plant. An extension of the SARI line southerly from Corona through the Temescal Canyon to the Lake Elsinore area was recently completed.

It is estimated that the Santa Ana Watershed will require 59 more desalters, such as the Chino I Desalter shown above, to resolve the region's salt imbalance. *Photo courtesy of SAWPA.*

The Santa Ana Watershed's potential for groundwater banking is substantial, but the volume of clean water that can be stored is commensurate with the amount of salty water that can be removed, and the process of pumping and desalting the old resource will take time. Before the task can be undertaken, the necessary infrastructure must be constructed. Two desalters are already operational in the Arlington and Chino areas and are processing 14 MGD. The current Chino Desalter is undergoing expansion, and a second Chino Desalter will be built soon. In addition, the Temescal Desalter, serving the City of Corona, has a capacity of 10 MGD and will be expanding

to 15 MGD. There are numerous additional desalters that will be installed as part of the SAWPA program and when these are fully operational the basin's cumulative production of purified water from these facilities will be 95 MGD.

SAWPA estimates that the Chino Basin will need many more desalters to solve the salt contamination problem, and will actively seek funding and planning for these additional desalters in the coming years. Some other components relating to the transportation of desalted water, including 22 miles of pipeline and 10 pumping stations will also need to be installed in order to get the usable resources to the entities that can best use them.

Watershed residents cool off in the Santa Ana River on a hot summer afternoon, despite the fact that river flow consists almost entirely of effluent in this area. *Photo courtesy of EIP Associates.*

One of the most challenging problems associated with maximizing the use of local water resources in the basin will continue to be addressing water quality elements that exceed public health or public acceptance standards, such as a high level of pathogens. The water quality problems can be addressed by a variety of strategies including wellhead treatment, blending, dilution or flushing, or even by natural processes such as native or treatment wetlands. Wellhead treatment can include a variety of approaches including desalination, anion exchange, and carbon absorption to name a few. In many cases, multiple contaminants can be addressed through a single-treatment strategy.

F. Flood Control

Many of the Santa Ana's tributaries are what Australians would call billabongs and North Africans and Middle Easterners would call wadis—dry riverbeds that only hold water during the rainy season. These riverbeds are completely parched throughout most of the year, but can quickly become raging torrents. The Santa Ana Basin is an arid environment and even qualifies as a desert in many areas. But the Watershed's close proximity to both the ocean and the mountains at times brings heavy storms, which are problematic from a flood control standpoint. Historically, efforts to deal with flooding in the region focused on damage control to reduce the threat of floodwaters damaging properties. As the area became urbanized, city planners simply channeled the periodic deluges into the ocean. Urban Southern California's concrete-lined creeks and rivers are a legacy to this way of thinking. While effective at preventing flooding, flood control channels that are concrete-lined or absent of riparian vegetation provide little benefit in the way of groundwater recharge, wildlife habitat, or water quality improvements. Additionally, these flood control channels are considered an eyesore and a potential danger by local homeowners. Fortunately, 80 percent of the Santa Ana River is

not a concrete channel. As explained in Section 1C, plans to channelize the entire riverbed were thwarted by forward thinking conservationists in the 1960s and 1970s. In urbanizing Southern California, efforts to control flooding must be balanced by water supply needs, habitat protection, and human enjoyment of wetland and riparian areas.

Historical flooding, as shown here on River Lane in the City of Santa Ana, has caused considerable damage-- costing human lives, property, and agricultural productivity. *Photo courtesy of the Santa Ana Historical Preservation Society (year of photo unknown, but presumed to be 1938 during the great flood).*

Flood protection agencies, including the U.S. Army Corps of Engineers and local flood control districts, are charged with the task of ensuring that floodwaters do not endanger life and property. It is evident that floodwaters can be physically devastating to homes, farms, and wetlands. Although wetlands are frequently inundated under natural conditions, major flooding events can damage wetlands by causing massive sedimentation, substrate disturbance, and periods of inundation that last substantially longer than many wetlands are capable of withstanding. Floods in agricultural and industrial regions also elevate the potential for hazardous discharges into the Santa Ana River and its tributaries. However, given the new era of groundwater storage, it is no longer recognized as advantageous to move floodwaters through an area as quickly as possible. Instead, filtering stormwater runoff through constructed wetlands or native riparian habitat provides both groundwater recharge possibilities and habitat opportunities. See Section 3A-1 for more information on constructed wetlands.

Flood control agencies have adopted a more holistic approach to curbing flooding issues while caring for the environment. In fact, flood control agencies throughout California and North America are undergoing a paradigm shift with respect to structural flood control. Although some areas are still paving their channels, communities such as Berkeley and Santa Barbara are ripping out concrete and restoring streams to their natural flow. The most radical example of this type of restoration is "daylighting," which

Approximately 20 percent of the Santa Ana River is channelized for flood protection. Most of this channelization is in Orange County, as shown here. *Photo courtesy of EIP Assoicates*

involves the deliberate exposure of a previously covered river, creek, or stormwater drainage. The Santa Ana Watershed has not seen any daylighting to date, but several excellent restoration opportunities are in the conceptual stage, including projects in Chino Creek and Santiago Creek. The portion of the Santa Ana River that is a concrete channel is relatively small when compared to other Southern California rivers. However, the channelized portion provides opportunities for the River to improve both flood control and its own aesthetic interest, while providing habitat and recreational benefits to watershed residents.

Major flood control facilities on the Santa Ana River include the Prado Dam and the Seven Oaks Dam. The Prado Dam, located near the intersection of Orange, Riverside, and San Bernardino Counties, was constructed in reaction to the Flood of 1938 and completed in 1941. Prado Dam is a key component for increasing local water supplies in Orange County. In the past, storm flows from the Santa Ana River have been lost to the ocean because flood control took precedence over water conservation. However, a series of agreements among the Orange County Water District, the U.S. Army Corps of Engineers, and the U.S. Fish and Wildlife Service have allowed the District to conserve water behind the dam in a seasonal storage pool. The Seven Oaks Dam, located upstream of the City of San Bernardino, was completed in 1999 against some opposition from environmental groups and with accolades from the engineering community. The Dam, constructed in reaction to both the 1938 flood and the later Santa Ana River flood in 1969, was selected as one of six merit finalists for the American Society of Civil Engineers 2002 Outstanding Civil Engineering Achievement Award due to its flood protection capacity. The Seven Oaks Dam is the largest dam in the country built strictly for flood control, and will save Watershed property owners millions of dollars in flood insurance premiums. For more information on planned and future Santa Ana Watershed flood control projects, please refer to the Integrated Water Resources Plan, published by SAWPA in 2002.

The Seven Oaks Dam, completed in 1999, works in conjunction with Prado Dam to provide flood protection for the Watershed.
Photo courtesy of SAWPA.

G. Watershed Demographics and Growth Pressure Impacts

This section presents population forecasts for the Santa Ana Watershed region with a planning horizon of 2050. In addition, information on per capita income for watershed households and current population density is briefly presented. Refer to Figure 2-8 for a map of watershed income by census tract, based on 1999 incomes as collected by the U.S. Census Bureau in 2000. Figure 2-9 presents a map of population density throughout the Watershed. Currently, watershed residents are concentrated in Orange County, with smaller population centers around the City of Riverside, City of San Bernardino, and San Bernardino–Los Angeles County border.

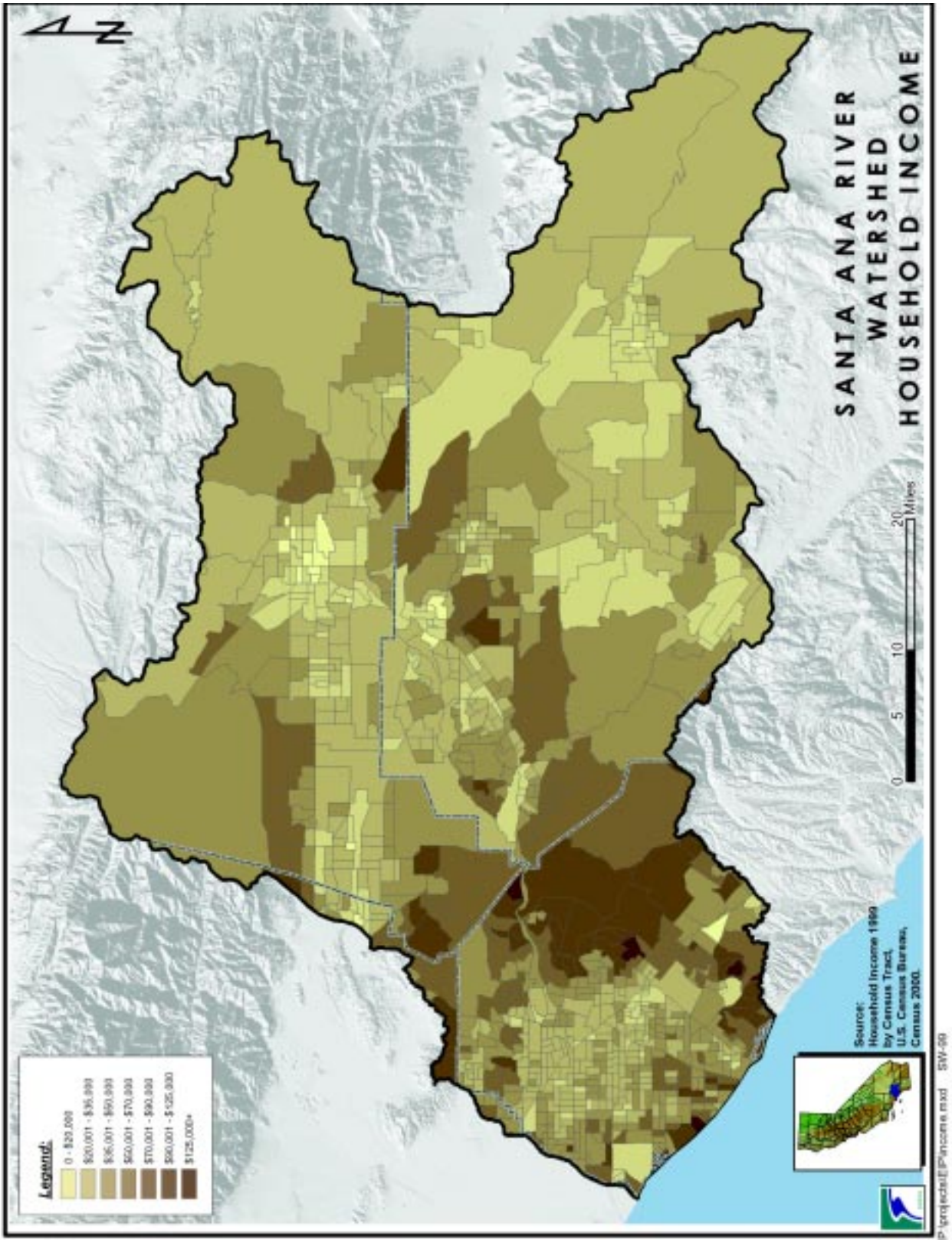


Figure 2-8 Santa Ana River Watershed Household Income

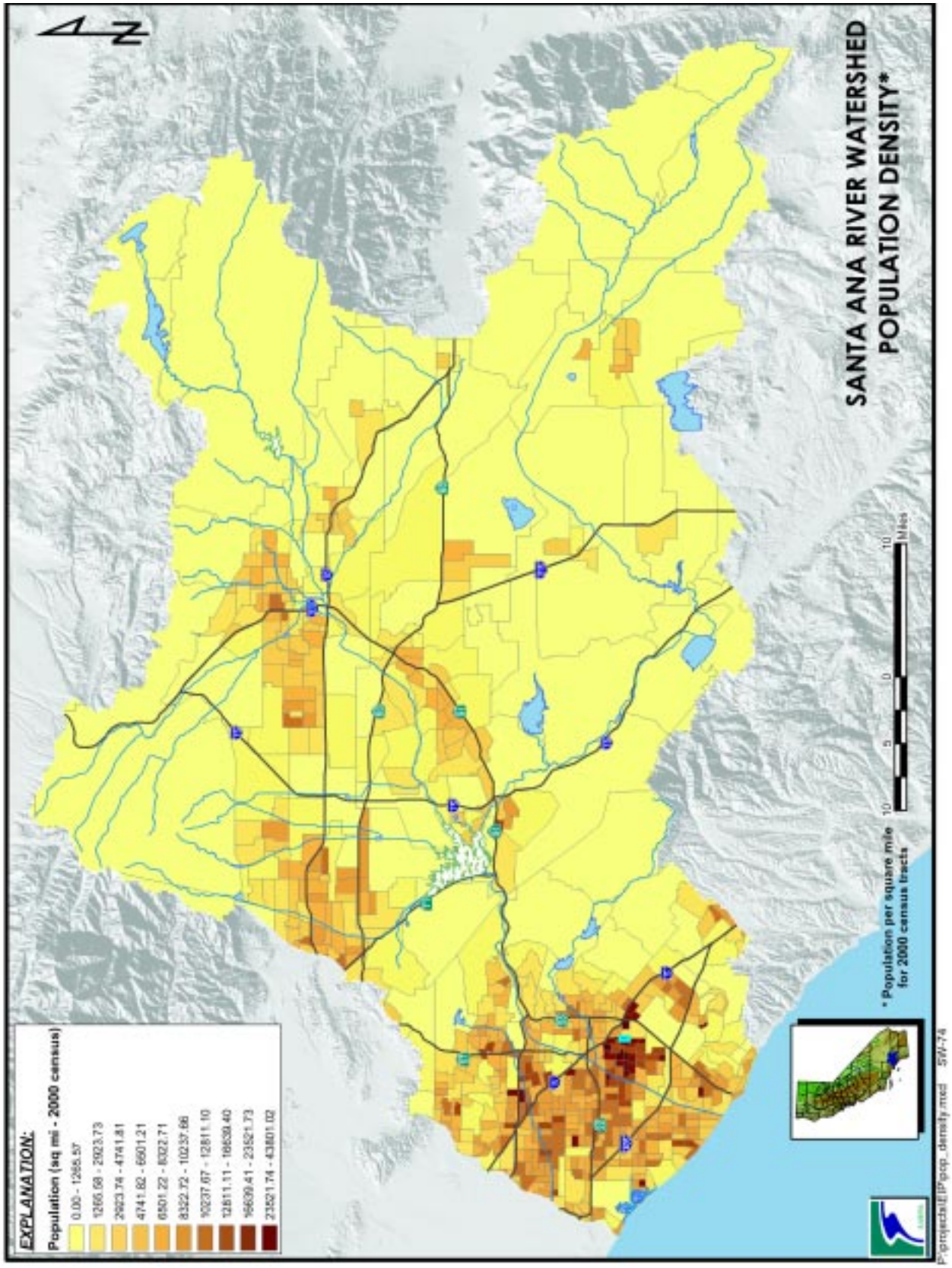


Figure 2-9 Santa Ana River Watershed Population Density

Mountainous areas and National Forest areas are sparsely inhabited, excepting recreational areas such as Lake Arrowhead and Big Bear.

The Watershed has experienced rapid population growth over the past century relative to the rest of the nation, and will continue to grow more rapidly than the rest of the State or nation over the next 50 years. Watershed population, 5.1 million in 2002, is expected to reach 9.9 million by 2050. This population growth will be concentrated mainly in San Bernardino and Riverside Counties, as Orange County is basically "built out" (i.e., most available land has been developed). Unavailable land includes those areas protected as open space or unbuildable due to steep slopes or other geographic constraints. However, redevelopment projects such as one that has been proposed in the City of Anaheim have the potential to increase population in areas that are considered built out. The conversion of agricultural lands to urban areas will fuel population growth, particularly in the Chino and Ontario Spheres of Influence. Without proper planning, rapid population growth can lead to habitat fragmentation, waste disposal issues (i.e., solid waste, biosolids, and wastewater treatment and disposal), water shortages, and increased pollution. However, planners within the Santa Ana Watershed have the opportunity to balance population growth with open space preservation and implementation of green infrastructure to ensure sustainable growth in the region. It is very important to be proactive in combating these future pressures by projecting population growth impacts on existing infrastructure and environmental resources. Integrated watershed planning provides a means by which these impacts can be addressed. One example has been the interest in forming a potential biosolids taskforce (with SAWPA as the administrator) to take a proactive approach to addressing biosolids and their impacts on the Watershed, both now and with projected population growth.

Figure 2-10 demonstrates the overall projected watershed population growth from 1990 to 2050 while Figure 2-11 compares 1990 population by county with 2025 population projections.

In 1990, approximately 4.2 million people resided in the Santa Ana Watershed: approximately 2.08 million in Orange County, 1.1 million in San Bernardino County, 0.9 million in Riverside County, and 0.2 million in Los Angeles County. By 2010, the population of the Watershed is expected to reach 5.9 million. The rate of growth in San Bernardino and Riverside Counties will be much higher than that in Los Angeles and Orange Counties. While in 1990 and 2000 the majority of the population resided in the Los Angeles and Orange Counties portion of the region, by 2010 the population split is expected to even out between Riverside–San Bernardino Counties and Los Angeles–Orange Counties. This balance would be due to a decline in the level of population growth in the two coastal counties while the level of growth remains high in the two inland counties.

From 2010 to 2025, the population is expected to grow by 1.41 million people, reaching 7.3 million. Much of this can be attributed to the availability of land in the eastern portion of the region in relation to the unavailability of land in southern and central Los Angeles County and most of Orange County. By 2025, the majority of the population in the Watershed will be in Riverside and San Bernardino County. Of the total population, 4.2 million will be located in these two counties, while the remaining 2.9 million will be located in Orange and Los Angeles Counties.

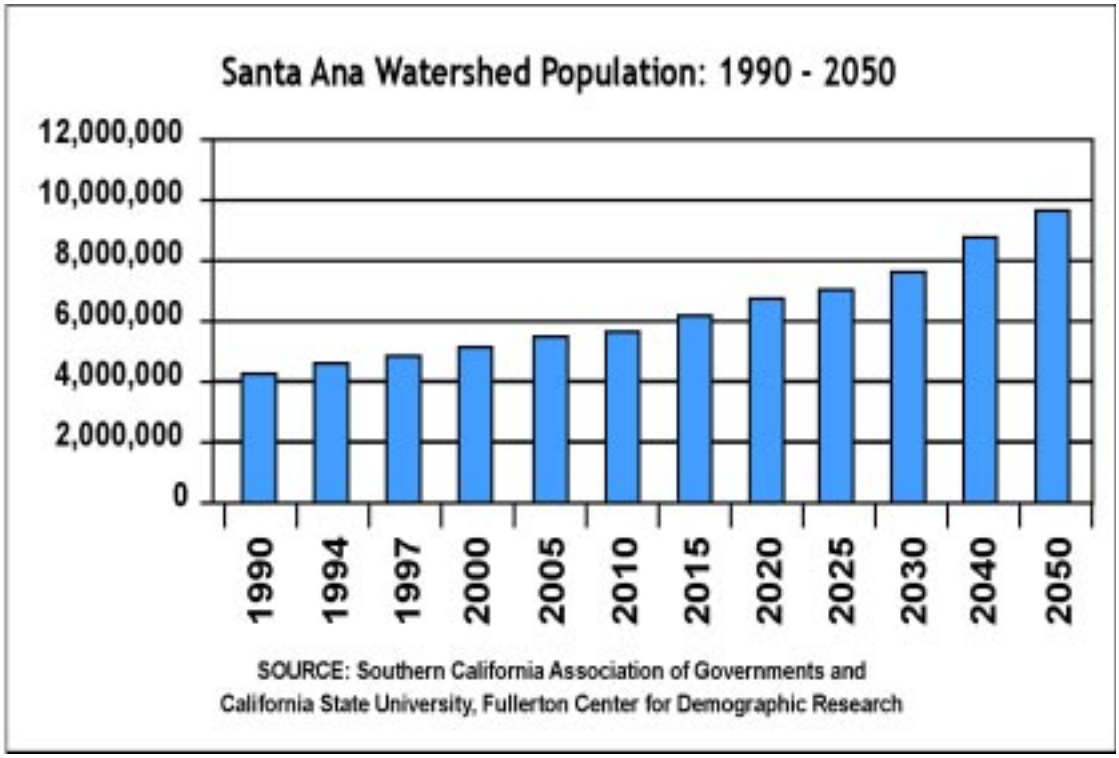


Figure 2-10 Santa Ana Watershed Population, 1990—2050

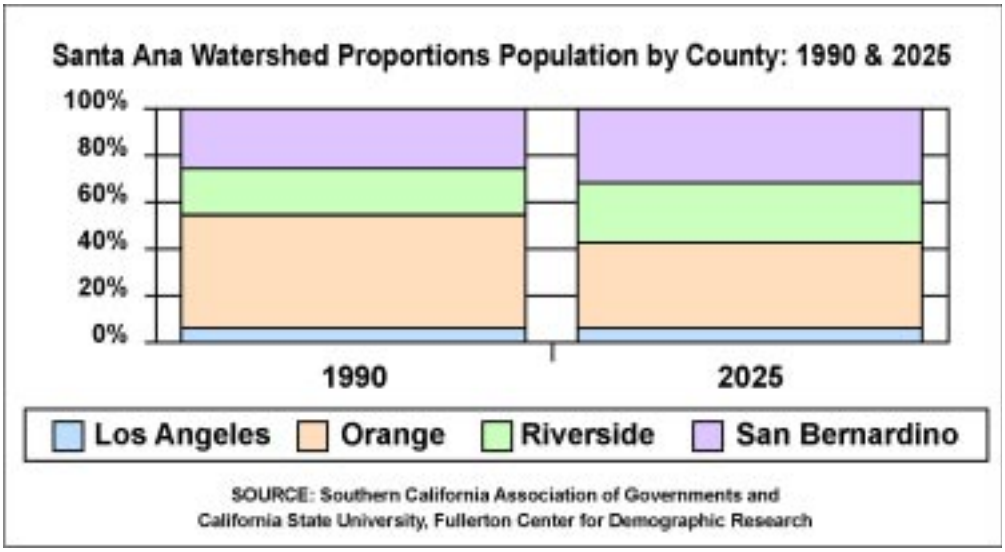


Figure 2-11 Santa Ana Watershed Population by County, 1990 and 2025

The primary source data for population forecasts are the Southern California Association of Governments' (SCAG) socio-economic forecast data sets used in the 1998 and 2001 Regional Transportation Plans, which included 1990 counts and forecasts to 2025. These forecasts were supplemented with data from the California State Department of Finance (DOF) 1998 population projections, DOF projection of population by county to 2040 and Census 2000 information, DOF estimates of population, housing and households, 2000 Census and employment projections developed by the California State University, Fullerton Institute for Economic and Environmental Studies. These data were used to forecast population, housing, households, and employment for 2030–50.

By 2050, the population of the region is projected to reach 9.9 million. This figure appears startling at first, because it would mean that the population will nearly double from what it is today. The California State Department of Finance also projects the populations of both Riverside and San Bernardino to each exceed that of Orange County. (Currently, their combined populations are about equal to that of Orange County.) A significant portion of the growth in Orange and Los Angeles Counties will be outside of the Santa Ana Watershed, while a significant portion of the growth in Riverside and San Bernardino Counties will be within the Watershed region.

SECTION THREE

GUIDE FOR THE FUTURE

A. Strategies

According to the California Environmental Dialogue, habitat protection, restoration, and enhancement leads to economic benefits relative to natural systems, recreational and leisure industry, and reduction of conflict caused by species extinction, among other concerns. In particular, "the protection, enhancement, and restoration of California watersheds, riparian stream zones, and wetlands will reduce the need for costly new water treatment plants, provide high quality drinking water at reduced cost, reduce costs of flood damage, and improve water quality for aquatic ecosystems and human recreation." When considering why the Santa Ana Watershed community is interested in pursuing strategies, recommendations, and projects/opportunities identified in this document, one can reflect upon the fundamental nature of the rich ecological resources within the Watershed as well as the community's interest in protecting these resources for present and future generations.

1. Creation, Restoration, and Enhancement of Wetlands

This strategy serves to further the overall principle of improving water quality and preserving and improving ecosystem function. Specific ways to improve water quality and preserve and improve ecosystem function are as follows:

1-A. Develop water treatment wetlands and channels to improve water quality in a sustainable manner and provide multiple benefits.

1-B. Protect, restore and widen riparian vegetation corridors to improve water quality, reduce impacts of stormwater runoff, provide habitat, and improve aesthetics.

- Reintroduce vegetated buffer strips wherever possible along stream banks to reduce the force of a flooding current against the bank, slow water overflowing channel banks, and allow sediment to deposit.
- Ensure that riparian vegetated buffer strips are as wide as possible, although a narrow strip is better than none at all.

1-C. Carefully plan human activities to reduce erosion.

1-D. Continue to utilize technologically advanced sustainable solutions to resource management dilemmas, such as water quality improvements.

1-E. Reduce or eliminate beach closures through water quality improvements and reduction of contaminant discharge into the Pacific Ocean.

History and Regulation of Wetlands

Within the State of California, estimates of historic wetland acreage range from 3 to 5 million acres; estimates of current acreage hover around 450,000 acres. Worldwide, a familiar pattern has emerged: destruction of wetlands in conjunction

with increasing urbanization has resulted in numerous water quality problems. California has had an 85 to 90 percent reduction in wetland acreage and leads the United States in wetland loss, tying only with Ohio. As a nation, the United States has experienced one of the world's worst wetland losses. Within the Santa Ana Watershed, little information is available on historic wetlands, and loss estimates are uncertain. However, watershed planners within the Santa Ana Basin are working towards restoring natural wetlands and providing treatment wetlands to provide cleaner water while providing high value habitat, recreation, and educational opportunities.

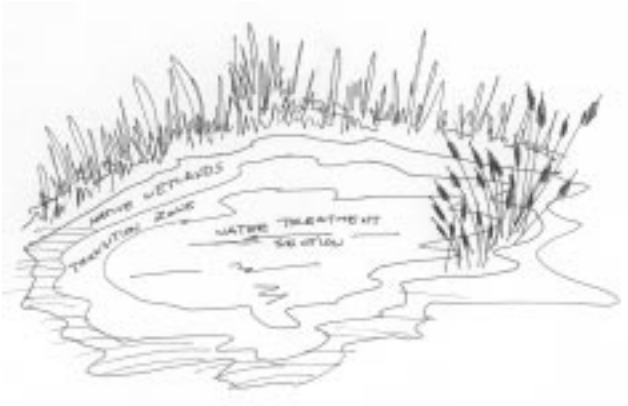
Historically, wetland ecology has not been well understood and humans did not grasp the importance of wetlands to improving water quality, maintaining healthy fisheries, and preserving populations of native flora and fauna. Considered unclean, wetlands were viewed solely as a breeding ground for mosquitoes and other vectors. Landowners wishing to develop their properties were permitted by law to fill in the wetlands and build homes or commercial development. In fact, federal laws such as the Swamp Lands Acts of the 1800s encouraged infill of wetlands by giving 65 million acres to 15 states (including California) for reclamation. Not until the Federal Clean Water Act was enacted in 1972 was there a piece of major legislation restricting the filling of wetlands. Section 404 of the Clean Water Act authorized the U.S. Army Corps of Engineers to issue permits for the discharge of dredged or fill material into waters of the United States, including wetlands. This section of the Clean Water Act has been interpreted to give the U.S. Army Corps of Engineers jurisdiction over permitting wetlands fill.

California wetlands policy is more restrictive than the federal wetland policy. The goal of California Wetlands Conservation Policy (1993) is to ensure no net loss of wetlands within the state. This policy, incorporated in an executive order by Governor Pete Wilson, also encourages a long-term net gain in the state's quantity, quality, and permanence of wetlands acreage and values. Interpretation of this order indicates that any developer wishing to fill in wetlands for construction of new development must perform mitigation in the form of constructed wetlands elsewhere at ratios ranging from 2:1 to 10:1. In addition to the U.S. Army Corps of Engineers, State regulatory agencies claiming jurisdiction over wetlands include the California Department of Fish and Game and the State Water Resources Control Board. Additionally, the U.S. Fish and Wildlife Service becomes involved when endangered species issues arise, as happens often in wetland areas. These regulatory agencies, while eager to work with landowners and developers, are directed to preserve natural wetlands over the creation of new wetlands through off-site mitigation. These policies have made it more difficult for developers to fill in natural wetlands by exercising discretionary disproval of permits for wetland activities.

Wetlands, such as the one shown here in Upper Newport Bay Regional Park, improve water quality by filtering contaminants.
Photo courtesy of EIP Associates

Wetland Types

When discussing wetlands projects, it is useful to define three types of wetlands, differentiated by how they were formed: natural wetlands, constructed (treatment) wetlands, and created wetlands. Natural wetlands are those formed by natural ecological processes independent of human intervention. Natural wetlands include swamps, marshes, and estuaries, such as those found at the mouths of rivers where both fresh water and saltwater meet or those found inland in areas of high groundwater. Today, natural wetlands are still threatened by development, although many developers are realizing that the cost of mitigating for lost wetlands is often higher than altering site designs to avoid building on wetlands (including a wetlands buffer zone). Constructed wetlands are those designed, built, and managed to provide specific water treatment capabilities. Wetlands in the Santa Ana Region are most often constructed to remove nitrogen and to treat stormwater. Many dairies are experimenting with constructed wetlands to treat washwater and other wastewater on site, such as OCWD's Fairview Farms dairy washwater treatment demonstration project in the Chino Basin. In addition, wetlands are constructed to polish water from publicly owned treatment works (POTWs). Created wetlands are those wetlands that are created incidentally to another project. The most common example of created wetlands is that created by a newly constructed dam.



This sketch illustrates a combined native and treatment wetland, with treatement wetland at the center surrounded by native wetland and separated by a transition zone.

Biology of Treatment Wetlands: How Do They Work?

Using treatment wetlands as an adjunct to wastewater treatment plants provides multiple benefits to an area. Treatment wetlands provide habitat to a multitude of species, such as birds, mammals, reptiles, amphibians, and fish. Wetlands are much more aesthetically pleasing to the public than wastewater treatment plants. When planned in conjunction with regional trails, wetlands also provide recreational benefits.

Wetlands have been shown to be effective at removing sediment, harmful bacteria, phosphorus, and nitrogen from runoff water. Additionally, advanced wetlands can reduce endocrine disruptors and other compounds that remain after treatment in common POTWs. Within Santa Ana River Watershed, nitrogen is a major contaminant of concern. In the case of nitrogen removal, denitrifying microorganisms present in the wetland substrate (denitrifiers) serve to remove nitrogen from nutrient-rich water. Wetland plants take in nitrogen rich water, transferring nitrogen to the soil through the photosynthetic process. The denitrifiers in the soil process the nitrogen and ultimately release it back into the atmosphere as gas. This release of nitrogen gas is not harmful to the environment, as earth's atmosphere is 71 percent nitrogen. Wetland plants also increase the efficiency of the denitrification process by providing a significant source of needed carbon to the denitrifiers. Wetland scientists have refined the construction of wetlands to maximize pollutant removal.

Siting of Treatment Wetlands

The Regional Water Quality Control Board cautions against converting existing healthy riparian habitat to treatment wetlands, citing abundant evidence that riparian habitat can be very effective in removing contaminants from stormwater. Riparian habitat is no less valuable than wetland habitat, and is as much at risk. In addition, many threatened and endangered species depend on riparian habitat in Southern California. The replacement of functioning riparian habitat with constructed wetlands on a site that has not historically supported wetlands does not improve overall ecosystem function. Healthy riparian habitat should be conserved in balance with wetland creation. In addition, placement of treatment wetlands must take into consideration seasonal variability and downstream water supply issues to ensure consistent water supply for downstream users. It should be noted that when wetlands are located inland, the primary function is to reclaim or polish treated wastewater. For 340 to 350 days of the year, water flowing from proposed areas for wetland treatment would not reach the ocean in this region.

Economic and Other Benefits Provided by Wetlands

Nationwide, over 75 percent of commercially harvested fish are dependent on wetlands during at least one part of their life cycle. If shellfish are included, this percentage increases to 95 percent. Within Southern California, coastal wetlands serve as nurseries for commercially important fish and shellfish species, including anchovy, bass, and California halibut. Wetland-dependant fish species caught by recreational fishers include cabezon, rockfish, and sculpin. Juvenile fish will use the shallow waters of a wetland as a refuge from larger fish that cannot enter such shallow areas. In addition, wetland areas provide economically important tourist destinations for those travelers wishing to bird-watch or enjoy nature. Wetlands are desirable areas for birdwatchers, as wetlands provide important stopovers for migrating birds along the Pacific Flyway. As tourism is a cornerstone of Southern California's economy, ensuring diverse opportunities for visitors is vital to ensuring sustainability of the region's tourism industry.

Notable Wetlands Projects within the Santa Ana Watershed

Although the Santa Ana Watershed is home to numerous effective wetland projects, this section will focus on a few illustrative examples of wetlands projects. These projects were chosen as representative examples of the different types of wetland projects within the Watershed to highlight the innovative ways in which agencies and organizations are implementing wetland proejcts to acheive multiple benefits. For more information on wetland projects, please consult Table 3-9, which includes a much more complete list of wetland projects within the Watershed by geographic area.

Prado Wetlands

Within Orange County Water District's 2,150-acre land holdings behind Prado Dam lies one of the world's largest constructed wetlands. Operating since 1992 and totaling 465 acres, the system consists of fifty shallow ponds used for water quality improvements. The primary purpose of the wetlands is to remove nitrogen from the River. Above Prado Dam, 50 percent of the base flow water is diverted into the wetlands. The wetlands system reduces nitrate concentrations from 10 milligrams per liter (borderline for drinking water quality) to less

Prado Wetlands
Photo courtesy of SAWPA

than one milligram per liter during summer months. It is the Orange County Water Districts's goal to treat 100% of Santa Ana River flows.

The Prado Wetlands have been hailed as a success from a habitat conservation standpoint. Within the wetlands, federally endangered least Bell's vireo populations have increased dramatically and are used as a much publicized success story of endangered species recovery. Within the Prado Basin, the population rose from 19 pairs in 1986 to 123 pairs in 1993. By the end of 1996, the count stood at 195 nesting pairs and this number rose to 224 by 1999. This stunning recovery is due to the provision of high-quality habitat for the bird species, a project in place to control populations of the predatory cowbird, and other restoration efforts on the part of agencies such as the U.S. Fish and Wildlife Service and Orange County Water District, including the removal of invasive plant species.

In 1997, the wetlands were reconstructed to increase the capacity of the wetlands to handle the increased base flow that is expected with population increases. Since the River is dominated by effluent and urban runoff, population increases raise the amount of effluent produced and therefore increase river flows. Future plans for the wetlands may include expansion of constructed wetlands and the City of Ontario's implementation of a Wildlife and Raptor Conservation Area adjacent to the Prado Wetlands.

Hemet/San Jacinto Multi-purpose Constructed Wetlands

The Hemet/San Jacinto Multipurpose Constructed Wetlands, a cooperative effort between the Eastern Municipal Water District and the Bureau of Reclamation, diverts over one million gallon daily from the Hemet/San Jacinto Regional Water Reclamation Facility. The constructed wetlands are approximately 50 acres in size and support a multitude of activities including recreation, bird watching, and research. The project was constructed in stages: first, the Wetlands Research Facility consisting

Riverside-Corona Resource Conservation District Constructed Stream
Photo courtesy of The Riverside-Corona Resource Conservation District

of a wetland plant nursery and research cells; then, the large demonstration wetlands; and, lastly, the Wetlands Water Education Facility. Multiple groups continue to do research at the site and have produced a number of scientific papers. Nearly 120 species of birds have been identified in the wetlands area. In fact, this wetland area boasts 10-15 percent of the entire world population of tri-colored blackbirds, and was crucial in preventing the listing of this species. The multipurpose wetlands are managed to reduce nitrates, create habitat, and provide educational opportunities. Outflow from the wetlands is used for irrigation at nearby farms, a duck club, and at the San Jacinto Wildlife Area.

Riverside-Corona Resource Conservation District Constructed Stream

The Riverside-Corona Resource Conservation District has constructed a native fish stream and associated riparian area and rearing tank facility. The native fish stream is a 300-foot recreated stream habitat with four swirling pools lined with boulder, cobble, and gravel bottoms along its length. Native streamside vegetation and trees add to the local, native riparian ambiance and shade the larger pools to reduce daytime water temperature and reduce algae growth. Four pools average in size from 15 to 20 feet in length and up to five feet in depth, comprising 50 percent of the streams one-quarter acre surface area. Native fish that currently populate the stream are the Santa Ana sucker, arroyo chub, and the speckled dace. The sucker has been recently introduced and is a threatened species that needs flowing water with a gravely substrate for feeding and reproduction. The dace uses both the pools and the stream sections, and the chub prefers the more tranquil water of the pools. All fish species require high water quality and algae on the rocks for feeding.

Future Wetland Projects within Santa Ana Watershed

SAWPA and its member agencies are committed to assist with the planning and implementation of native and treatment wetlands within the Santa Ana Watershed. Approximately 20 wetland projects were identified during scoping meetings or in response to SAWPA's request for wetlands projects watershed-wide. This list is not intended to be exhaustive, but as a snapshot of wetland projects submitted prior to release of this Plan. (Refer to Figure 3-6, Wetlands Projects Map and Table 3-9, Projects and Opportunities). Additional potential constrcuted wetland sites, as identified by OCSD, include Talbert Marsh and the Santa Ana River ocean outlet.

The following projects were identified in the IWRP and are included here as a sample of the types of wetalnds projects undergoing planning wihtin the watershed.

Hidden Valley Wildlife Area—The Hidden Valley Wildlife Area (HVWA), located in Riverside, California, consists of over 1500 acres of parkland. Through the cooperative efforts of several agencies and citizen groups the Hidden Valley Wetlands Enhancement Project (WEP) has become an environmental asset that promises to provide the community with years of recreation, education, research, and water quality improvements.

The project is a unique example of inter-agency cooperation meeting the collective goals of the community. HVWA now supports multiple benefits:

- Restoration of high quality riparian habitat (supporting native and transient migratory wildlife)
- Reliable water supply for wetlands ecosystem

- Local groundwater recharge
- An interpretive center for environmental education
- Trails for recreation and equestrian activities
- Mitigation of non-native vegetation, wildlife protection, all with the coordination of local agency resources

Irvine Ranch Water District Natural Treatment System—This IRWD project would serve as an alternative for handling dry weather runoff intended to provide new community resources, riparian habitat, and water quality benefits throughout the watershed. Low-flow natural and urban runoff, as well as smaller storm flows, will be diverted into man-made wetlands throughout the San Diego Creek Watershed where contaminants will be removed and prevented from reaching the Upper Newport Bay.

Upper San Jacinto Watershed Nutrient Control—This potential LESJWA program could provide improvements to the upper portions of the San Jacinto Watershed through construction of wetlands, levees, flood control structures, debris basins, and retention basins. Nutrient control in the upper watershed would improve water quality throughout the watershed, including Lake Elsinore at the bottom of the San Jacinto Watershed. The proposed wetlands could be described as flow-through wetlands that would provide both habitat enhancement and nutrient removal to the San Jacinto River.

Implementation

1. When siting treatment wetlands, project proponents should take care not to destroy valuable native riparian habitat.
2. Native and treatment wetland projects should be designed to serve as multi-benefit projects in addition to improving water quality, including increased habitat value, improved aesthetics, and expanded recreational opportunities, hiking trails, educational components and opportunities for observation (where feasible).
3. Desirable wetland projects are those that address as many improvements as are obtainable (e.g., wetland habitat, water quality, treatment, aesthetics, etc.)
4. Wetland projects should be designed to be durable and either resistant to potential flood damage or quickly recoverable after flooding.
5. Wetland projects should be designed to minimize the production of vector species.
6. Wetland projects should be designed to be low maintenance.

2. Removal of Invasive Species

> "We hope that Arundo is something that you'll have to go to a botanic garden to show your children."
>
> —*Jeff Beehler, Santa Ana Watershed Project Authority, August 14, 2002*

Biology of *Arundo donax*

Of the many nonnative species that have invaded the riparian forests of Southern California, *Arundo donax* (giant reed) is particularly problematic due to its ability to rapidly invade and colonize new areas and outcompete native species. Although *Arundo* is thought to have originated in freshwaters of eastern Asia, extensive cultivation has occurred throughout Asia, southern Europe, North Africa, and the Middle East for thousands of years. *Arundo* is a hydrophilic (water-loving) plant that grows within the riparian zone of lakes, streams, rivers,

and in other moist soils. It requires moist soils and large amounts of water to sustain its high growth rates of up to 2 inches per day, using more than 528 gallons of water per year for each meter of standing *Arundo*. This water uptake rate roughly equates to three times the amount of water used by native Southern California riparian vegetation.

This monotypic stand of *Arundo donax* provides poor quality habitat for native wildlife species.
Photo courtesy of SAWPA.

Distribution and Removal Efforts of *Arundo donax* in Santa Ana Watershed

Arundo infestation within the Santa Ana Watershed is extensive (see Figure 3-1) and removal efforts began in 1988. The numerous parties making up Team *Arundo* within the Watershed are clearing *Arundo* from many areas, including the upper tributaries of the Watershed. Table 3-1 lists *Arundo* distribution and historical specific removal efforts within the Watershed, as described by Neill and Giessow (2001). Appendix A provides further information. By providing necessary funding, the SCIWP *Arundo* Removal Program will greatly accelerate *Arundo* removal efforts within the Watershed.

This *Arundo* infestation at Hidden Valley Wildlife Area has been targeted for removal by the County of Riverside Park and Open Space District.
Photo courtesy of SAWPA.

SCIWP *Arundo* Removal Program

Operating within the Santa Ana Watershed and facilitated by the Santa Ana Watershed Project Authority, Team *Arundo* is recognized throughout the State of California as a leader in *Arundo* removal efforts. A number of agencies and organizations compose Team *Arundo*, including the Santa Ana Watershed Association of Resource Conservation Districts (SAWA), the Riverside County Parks and Open Space District, the Riverside County Flood Control District, the Orange County Water District, the Orange County Public Facilities and Resources Department, the Monsanto Company, the Orange County Conservation Corps, and California Conservation Corps. Historically, the Nature Conservancy has also participated in Team *Arundo*. The foresight and leadership of these groups have proven instrumental in elevating the need for *Arundo* removal to an issue of statewide importance. Team *Arundo* efforts have included securing funding, acquiring permits, and development various methodologies for removal. During the summer of 2002, Team *Arundo* produced an *Arundo* Removal Protocol, compiled with input from Team *Arundo* members, that documents *Arundo*

Table 3-1 Distribution of *Arundo donax* and Past Removal Efforts within the Santa Ana Watershed

Watershed Zone	Location	Arundo Abundance / Acres Removed	Removal Agency / Organization	Removal Timeframe
Cajon Wash	Lost Lake and below Highway 38	Abundant to scattered	Inland Empire West Resource Conservation District (RCD)	1999-2000
San Bernardino Area	Downstream areas of Waterman Canyon, Hot Springs Creek, and East Twin Creek	Continuous stands, except along City Creek, where Arundo is absent in National Forest to Highland Boulevard, below which scattered clumps are present.	N/A	N/A
San Timoteo Canyon	Near Highway 60 below the City of Beaumont	11 miles of riparian corridor cleared near Alessandro Road, plus most of Live Oak Canyon cleared through Yucaipa	East Valley RCD	1996-2000
Riverside Area	Various	1 mile cleared Near Van Buren Bridge. 7 acres removed at Fairmount Park, 16 acres removed at Alessandro, 10 acres removed at Castle View, 25 acres removed at Woodcrest, 5 acres removed at La Sierra Creek, 16 acres removed at Golden Star Creek	Riverside County Parks and Riverside-Corona RCD	1993-2001
San Jacinto River	San Jancinto Valley below Saboba Reservation	Arundo absent from Idyllwild and Nationall Forest land.	San Jacinto Basin RCD and Washburn Grove Management	1998-2001
Temescal Canyon	Downstream from Lake Elsinore and Lake Corona.	220 acress removed. Arundo absent from Walker Canyon. Arundo becomes present below Lake Corona and near El Cerrito. Quarter mile reach cleared near El Cerrito	Riverside-Corona RCD, Glenn Lukos and Associates and Canyon Landscaping	1997-1998
Prado Basin	Along River Road Bridge	30 acres removed above River Road Bridge	Riverside-Corona RCD	1993-2002
Santa Ana Canyon	Near Featherly Regional Park	60 acres removed on north side of Featherly Park. Arundo remains in central part of flood channel	Orange County staff and Orange County Conservation Corps	1989-2000
Carbon Canyon	Along Carbon Creek	2 acres removed along Carbon Creek. No Arundo within Telegraph Canyon in Chino Hills State Park	Chino Hills State Park staff and Chino Fire Dept.	2000
Santiago Creek	Silverado Canyon area	2 miles private property cleared along Silverado Creek. Arundo present in Modjeska Canyon	Silverado Canyon residents and County staff	1997-1998
Aliso Creek	Whiting Ranch Park	2 sections of Aliso Creek cleared in Whiting Ranch Park	Orange County employees	Late 1990s
Arroyo Trabuco	Holy Jim Canyon and O'Neill Regional Park	Upper two miles in O'Neill Park cleared. Much Arundo in Holy Jim Canyon.	County staff	2000-2001
San Juan Creek	Caspers Regional Park, San Juan Capistrano	Hot Springs area cleared. Area between La Novia Ave. and I-5 cleared but not maintained, and Arundo has reinvaded.	Orange County staff and prison crews	1995, 1997-1998

SOURCE: Neill and Giessow, 2001 and Riverside-Corona RCD, 2002, personal communication

removal as practiced in the Santa Ana Watershed. The protocol is included in this document as Appendix C and is available on-line at www.sawpa.org/Arundo/index.htm.

Through Southern California Integrated Watershed Program funding, the Riverside County Regional Park and Open Space District will remove *Arundo* from the Santa Ana River between the Mission Inn Boulevard Bridge and the Hidden Valley Wildlife Area during the first two years. The Santa Ana Watershed Association of Resource Conservation Districts (SAWA) will remove *Arundo* from the San Jacinto River, Redlands Zanja, Mill Creek (East Valley), Santa Ana River Phase I area, East Twin Creek, Temescal, Santiago Creek, and Warm Creek during the first year. SAWA will remove *Arundo* from Highland, San Timoteo Creek, Juniper Flats, Mockingbird Canyon, Bedford Canyon, and the Santa Ana River Phase II area during the second year. During the third year, SAWA will remove *Arundo* from Mill Creek (Inland Empire West), Mystic Lake, and Santa Ana River Mainstem Reaches 3 and 4. Additionally, SAWA plans to remove further *Arundo* from Mystic Lake and the Santa Ana River during the fourth year and from the San Jacinto River and the Santa Ana River during the fifth year. The Orange County Public Facilities & Resources Department may remove *Arundo* from the Santa Ana River canyon in the Yorba Linda area during the first three years, from Weir Canyon Road to the Orange County line. The Orange County Conservation Corps may remove *Arundo* from Featherly Park in Orange County during the second year of the program. Another agency, likely the Orange County Water District or SAWA, will remove *Arundo* from other upper Watershed areas and isolated tributaries in San Bernardino and Riverside Counties. In addition, the Riverside County Flood Control District will remove *Arundo* through the Arundo Removal Program.

Other Invasive Species

In addition to *Arundo*, team members may remove other invasive species while undertaking *Arundo* removal activities. These species include, but are not limited to, tree of heaven (*Ailanthus altissima*), tamarisk or saltcedar (*Tamarix* sp.), artichoke thistle (*Cynara cardunculus*), castor bean (*Ricinus communis*), tree or wild tobacco (*Nicotiana glauca*), and perennial pepperweed or tall whitetop (*Lepidium latifolium*). These species disrupt natural ecosystems by competing with native flora for limited resources and generally providing poor quality habitat for native fauna.

Like most invasive species, tree of heaven is known to establish in disturbed areas such as roadsides, highway medians, and vacant lots in urban areas. Tree of heaven spreads via seed dispersal, and once established can grow 40 to 60 feet. These shade-tolerant trees produce toxins that prevent the establishment of other plant species. Tree of heaven is very difficult to remove. Salt cedar also reproduces via seed dispersal and, like tree of heaven, is a prolific seed producer. Like *Arundo*, salt cedar presents a significant fire hazard and consumes much more water than native vegetation. One unique characteristic of salt cedar is that the plant is known to increase soil salinity by absorbing salt from the surrounding soil, then concentrating salt in the area around the tree. Increased concentrations of salt often preclude establishment of other species near salt cedar. Artichoke thistle is an herb that invades grasslands, particularly disturbed areas such as areas associated with overgrazing. Artichoke thistle, which also reproduces via wind-dispersed seeds, is closely related to the commercially cultivated globe artichoke. Castor bean, a woody herb that may reach 15 feet outdoors, is grown as an ornamental in gardens, sometimes as a houseplant. Castor bean is highly toxic to

humans and other animal species. The bean itself has the highest concentration of toxins and likely to be fatal if ingested and the outer shell is broken or chewed open, particularly if ingested by a child. However, castor bean is also the source of castor oil, a traditional remedy for gastro-intestinal ailments and absent of toxins. Tree tobacco is also toxic to humans, although not as toxic as castor bean. This plant, known for its elongate yellow flowers, can grow up to 10 feet. Tree tobacco is closely related to domestic tobacco cultivated throughout the southeastern United States for use in cigarettes, but its leaves release toxins when burned.

Consequences of *Arundo donax* Invasion

> "More than 95 percent of the historic riparian habitat in the southern part of the state has been lost to agriculture, development, flood control, and other human-caused impacts. The greatest threat today to the remaining riparian corridors is the invasion of exotic plant species, primarily giant reed (*Arundo donax*).
>
> —*Excerpt from the* Environmental Assessment for the Santa Ana Watershed Program *by Dick Zembal and Susan Hoffman (2000)*

Given that less than 5 percent of historic riparian habitat in Southern California remains today, the invasion of exotic plant species dramatically threatens remaining habitat. As a result of past and present introductions, its ability to colonize new areas relatively easily, and its ability to outcompete native species, *Arundo* has infested nearly every drainage system in the southwestern United States.

Arundo competes with native species, such as willows (*Salix* sp.), mulefat (*Baccharis* sp.), and cottonwoods (*Populus* sp.) that provide nesting habitat for threatened or endangered species such as least Bell's vireo (*Vireo bellii pusillus*), southwestern willow flycatcher (*Empidonax traillii*), and countless other native species. *Arundo* inhibits seedling recruitment of native riparian species, outcompetes established native species, and uses large amounts of water that would otherwise be available to native plants and surrounding areas.

Ecosystem Dynamics

Disturbance within the River floodplain has favored the fast-growing *Arundo* over native riparian vegetation. *Arundo*-infested acreage increases each year in response to annual flood events, fires, and other ecological perturbations. *Arundo* readily invades native riparian communities at any stage of succession, in addition to invading after floods and fires. Because of these characteristics, once *Arundo* becomes established in a riparian area, it alters the ecosystem by redirecting the succession of the community towards pure stands of *Arundo*.

Arundo fueled fire near Hidden Valley Wildlife Area cleared an estimated 200 acres of Arundo.
Photo courtesy of Riverside Co. Park and Open Space District.

Risk of Fire

Arundo is highly combustible, increasing fire frequency and intensity. For example, a single fire in April 2002 swept through approximately

200 acres of riverbed near Martha McLean Anza Narrows Park in Riverside County. Although the cause of the fire is unknown, the flames were fueled by extensive stands of *Arundo*. Unfortunately, removal of *Arundo* by wildfires is not permanent and does not constitute a "silver lining" to these fires. One and half months after the Riverside fire, the burned *Arundo* had resprouted to about 3 feet.

Flooding Issues

By virtue of its great biomass, rapid growth, and dense, interconnected root masses, *Arundo* poses a substantial flood management problem. Floodwaters strip portions of the standing crop of *Arundo* and root masses from the substrate and these mats combine with trash and other debris to form substantial debris dams. In contrast, native riparian species tend to bend rather than break during high flows, greatly reducing the amount of vegetative debris washed downstream. Heavy rains wash debris dams of *Arundo* downriver, pushing mats of dense roots and stalks against bridge abutments. These mats can damage the abutments, clog river channels, and re-direct river flows, thereby flooding adjacent lands.

For example, Riverside County's River Road Bridge near Norco was damaged twice within three years, causing almost $1 million in damage. The Riverside County Board of Supervisors subsequently authorized $8 million to construct a new River Road Bridge. Furthermore, as these large quantities of *Arundo* move downstream, they eventually find their way to the ocean, and subsequently wash up on local beaches. The annual cleanup of this debris costs the public millions of dollars each year.

Arundo damaged the River Road Bridge in Riverside County, causing over $1 million in damage.
Photo courtesy of SAWPA.

Decreases in Water Quality and Quantity

Arundo absorbs a great deal of water through its roots, effectively removing much water from the available supply. Ideally, as *Arundo* is removed, native plants that require less water will replace it. As previously mentioned, it is estimated that native vegetation uses one-third of the water used by *Arundo*. For example, the removal of every 1,000 acres of *Arundo* and subsequent recovery of native vegetation will yield a water savings of approximately 3,800 acre-feet per year. This is enough to supply almost 20,000 urban residents with water annually.

Extensive stands of *Arundo* along rivers lack the dense foliage canopy and habitat complexity of native riparian forests. As a result, near-shore stream habitats lack the shade offered by the native vegetation's canopy, and water temperatures are several degrees higher than under natural conditions. Higher water temperatures have a direct negative impact on native stream fishes, such as the Arroyo chub (*Gilia orcutti*) and the threatened Santa Ana sucker (*Catostomus santaanae*). Higher temperatures not only increase algal growth and lower oxygen concentration within the water, they can also lead to increased algal

photosynthetic activity that has been found to increase pH levels within the shallower sections of the River. Increases in pH can facilitate the chemical conversion of ammonium (NH_4^+) salts to the toxic nonionized ammonia form (NH_3), resulting in reduced water quality for both aquatic organisms and downstream users.

This Hydro-axe is a common machine used to remove *Arundo*.
Photo courtesy of SAWPA.

Benefits of Removal of *Arundo donax*

Because this exotic plant alters ecosystem dynamics and interrupts and redirects succession, the removal of *Arundo* from the Watershed offers numerous direct and indirect benefits to landowners, land managers, public agencies, and other Watershed residents. These benefits include reduction in risk of flooding and fire, improvements in water quality, increases in water conservation, and restoration of habitat for native species, including several threatened and endangered species.

Riparian vegetation serves as critical habitat for many State- and federally listed threatened and endangered species, such as the least Bell's vireo. Suitable habitat for listed species within the Watershed has been reduced over time by as much as 95 percent and *Arundo* has replaced over 50 percent of the remaining habitat. Preventing the spread of *Arundo* will preclude the further deterioration of habitat for many of the sensitive, threatened, and endangered riparian species. As areas of *Arundo* are removed and converted back to native riparian habitat, rare species will be able to expand their populations throughout the Santa Ana River Watershed. Replacing these stands of exotics with native riparian vegetation will, in time, result in sufficient overhanging foliage to provide the necessary cooler water temperatures, bank cover, and improved water quality needed to protect populations of native fish species and other aquatic organisms.

In addition, *Arundo* removal would result in more in-stream water for both residents of the Watershed and the native aquatic organisms. Given that the costs associated with providing imported water to residents will only increase over time, the savings to the water suppliers, and ultimately to the Watershed residents, would be substantial.

Methods of *Arundo* Removal

Removal of *Arundo* can be accomplished by a variety of methods. Each method differs in cost, time, and can be specific to certain areas or types of infested habitat. Removal methods include mechanical removal, chemical control, and biological control, in addition to a comprehensive integrated weed management approach. Prevention of further invasion or reinfestation should also be considered in conjunction with removal methods.

Combination of Mechanical Removal and Foliar Spraying

One common method of removal used by Team *Arundo* members involves a combination of mechanical removal and foliar spray. Crews will chip or cut *Arundo* stalks, then return two to four weeks later when the plants are between 2 and 4

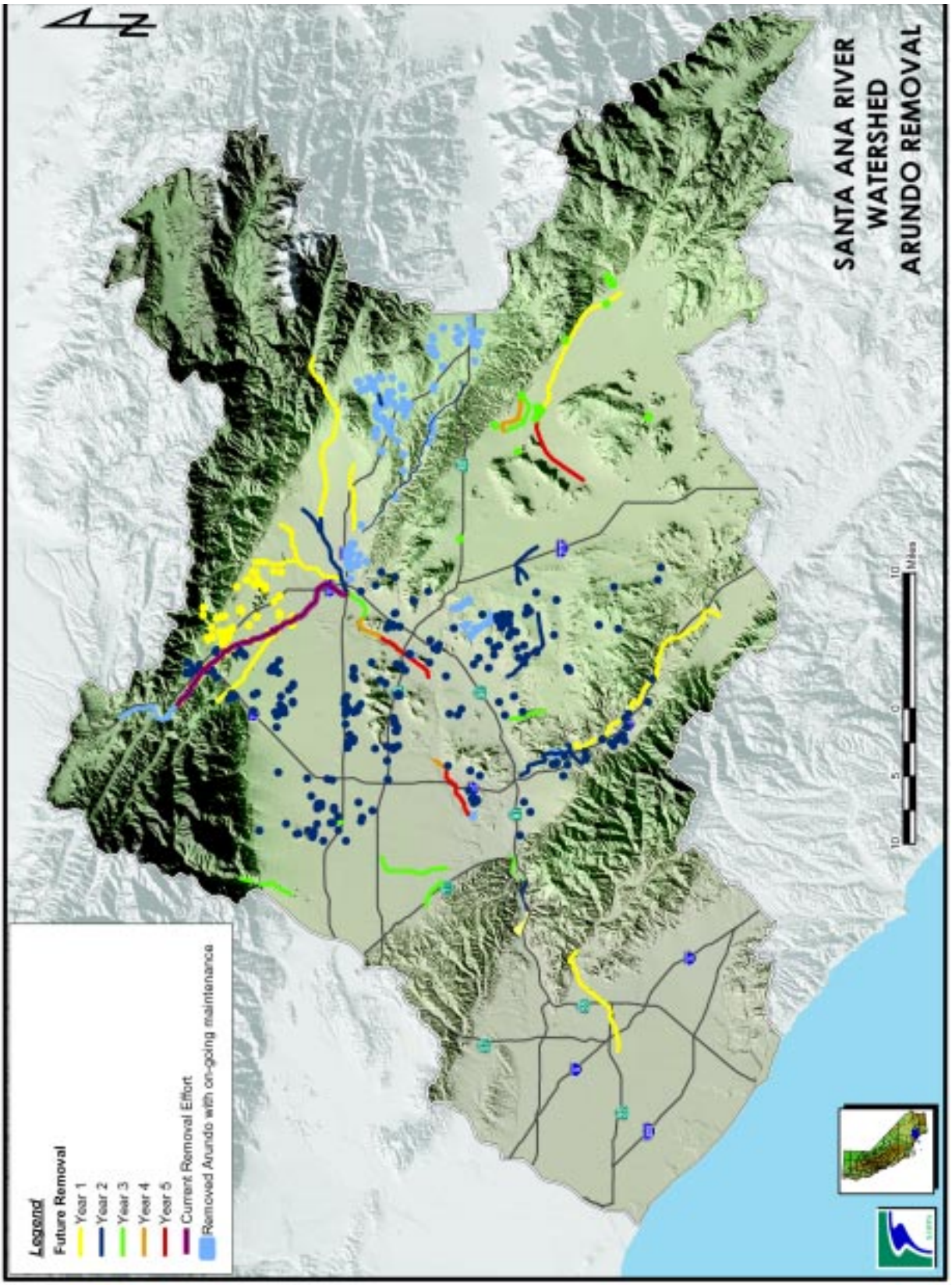


Figure 3-1 Arundo Removal within the Watershed

feet tall to apply a foliar spray solution of a glyphosate-based herbicide. The primary advantages of this method is that the amount of herbicide used on the fresh growth is greatly reduced from that used on the 30 to 40-foot-tall *Arundo* stalks (as with full foliar spraying), and that herbicide coverage is better when the stalks are shorter and of a uniform size. One drawback associated with this method is that cutting the stalks induces the plant to re-enter the growth stage, thereby causing it to translocate less of the herbicide to the roots and rhizomes. However, as with most removal methods, supplemental treatments are generally required in *Arundo* removal, and total root kill is almost never achieved with a single application of herbicide when the plants are already established.

Integrated Weed Management

The Integrated Weed Management (IWM) approach most closely describes Team *Arundo*'s overall methodology. IWM is defined in the federal Noxious Weed Act as, "a system for the planning and implementation of a program, using an interdisciplinary approach, to select a method for containing or controlling undesirable plant species or groups of species using all available methods, including education, prevention, physical or mechanical methods, biological control agents, herbicide methods, and general land management practices." The goal of IWM is to minimize the impact of control actions on the nontarget environment and public health while maximizing the effectiveness of practical control methods. Team *Arundo* members combine mechanical control and chemical control, and strives to incorporate elements from IWM such as landowner and nursery education. Landowner education is important to discourage landowners from planting new *Arundo* in their yard and to encourage them to eradicate current stands, while nursery education is important because it is still legal to sell *Arundo* within the State of California. Both SAWPA and SAWA have produced educational brochures for homeowners about the impacts of *Arundo* and SAWPA has produced a PowerPoint presentation targeting nurseries to discourage the sale of *Arundo*.

IWM includes "cultural methods" of exotic species invasion prevention, which involve the modification of human behavior both within and around the area of infestation. Recreational, economic, and urban land uses that contribute to the introduction and proliferation of invasive species are discouraged by this method. Within the Santa Ana Watershed, behavioral modifications include altered planting practices that encourage the use of native plant species for landscaping, rather than *Arundo* or other exotic species. Other native or less invasive species can be substituted for bank stabilization and aesthetic purposes.

Arundo disposal

Cut *Arundo* may be removed from treatment areas through burning, chipping, or vehicular transportation. The removal of the cut cane is important due to the untreated cane's ability to re-root and colonize new areas either at the site or downstream (if washdown occurs). Although burning is the most cost effective method to dispose of the dead cane, Team *Arundo* members seldom burn cane due to environmental considerations and requirements for AQMD permits. Cutting, chopping, and chipping is the most common method of disposal, with Team *Arundo* members using this method to dispose of 80 to 100 percent of the cut biomass. If chipped and left on site, pieces of cane should be chipped to about ¼ inch to 1 inch to prevent resprouting.

Chipping of *Arundo* after removal is necessary to prevent resprouting.
Photo courtesy of Inland Empire West Resource Conservation District.

One company in California spent five years on research and development to determine the commercial viability of *Arundo* as an alternative to wood pulp. This company has produced the first commercial run of bleached *Arundo* pulp and has shown an interest in taking Arundo from removal projects. Producing 300 tons of pulp per month would require about 8,000 tons per month of green Arundo chips (equivalent to 400 semi-truck loads). Disposal of chipped *Arundo* though recycling for paper is desirable as it provides fiber for a sustainable tree- and chlorine-free product and minimizes potential impacts associated with stockpiling *Arundo*. However, certain issues must be considered, such as preventing the accidental spread of *Arundo* during transport and the sustainability of the industry once all of the *Arundo* has been removed.

> "It takes 250,000 acres of trees to provide the same amount of pulp provided by 25,000 acres of *Arundo*."
>
> —*Fred Martin, Samoa Pacific, Cellulose, LLC*

Permitting for *Arundo* removal

Applicable permits and regulatory compliance are measures identified in Table 3-2. While implementing the *Arundo* Removal Program, specific impact avoidance measures described in each permit must be followed. Obtaining current permits and adhering to the permit requirements are the individual responsibility of each Team *Arundo* member. According to federal law, herbicide applicators must comply with the label requirements and instructions for each herbicide used. Appendix C of the Arundo Removal Protocol contains the labels and material safety data sheets (MSDS) for herbicides commonly used for *Arundo* removal within the Santa Ana Watershed. The MSDS provides information to supplement label requirements, such as toxicity and ecological data.

Invasive Species to Watch

Perennial Pepperweed—The Next *Arundo*?

Although extensive removal efforts within the Santa Ana Watershed have not focused on perennial pepperweed (*Lepidium latifolium*), this plant has been identified as a potential threat to the Watershed. Perennial pepperweed, also called tall whitetop due to its thick clusters of white flowers, reproduces by sprouting new shoots off existing roots. However, the plant also produces up to 6 billion seeds per acre, which are spread by forces of nature such as wind and water over great distances and allow the plant to colonize new areas. Although not nearly as pervasive (yet), pepperweed has been referred to as "the next *Arundo*." Like other invasive species, pepperweed harms native flora and fauna by outcompeting native species, forming a monoculture that is inhospitable to native and special status wildlife species such as the least Bell's vireo.

Table 3-2. Permitting and Regulatory Compliance Required for *Arundo* Removal within the State of California

Law or Regulation	Regulating Agency	Applicable Document	Type of Permit Required
Federal Insecticide, Rodenticide, and Fungicide Act (FIFRA)*	US Environmental Protection Agency	Herbicide product label and MSDS sheet	No permit needed; herbicide applicators must comply with herbicide labels
National Pollution Discharge Elimination SystemNPDES*	State Water Resources Control Board	Water Quality Order No. 2001-12-DWQ: Statewide NPDES Permit for Discharges of Aquatic Pesticides to Surface Waters of the United States	This General Permit applies to entire State of California. However, General Permit users must file a Notice of Intent to Comply with the Terms of the NPDES General Permit
California Food and Agricultural Code *	California Department of Pesticide Regulation	Qualified Applicator's License and/or Qualified Applicator's Certificate	Statewide, a permit is needed only for restricted use materials (glyphosate is not a restricted use material. However, confirm with local County Agricultural Commissioners as local regulations can vary).
California Environmental Quality Act (CEQA)	Governor's Office of Planning and Research, State Clearinghouse	Categorical Exemption	Individual; SCIWP Arundo removal occurs under Categorical Exemption filed by SAWPA
California Fish and Game Code Section 1603	California Department of Fish and Game	Lake or Streambed Alteration Agreement	Individual (agencies removing Arundo must negotiate this permit)
Federal Clean Water Act, Section 401	California Regional Water Quality Control Board	Clean Water Act Section 401 Water Quality Certification	Individual (agencies removing Arundo must negotiate this permit)
Federal Clean Water Act, Section 404	US Army Corps of Engineers	Regional General Permit No. 41 for Removal of Invasive, Exotic Plants	General Permit No. 41 covers Southern California (Los Angeles District)

*Applies only to Arundo removal involving herbicide application

Perennial pepperweed, shown here while flowering, has been called "the next *Arundo*"
Photo courtesy of Jesse Giessow, Santa Margarita and San Luis Rey Watersheds Weed Management Area

According to an informal field survey performed during June 2001, pepperweed is dominant in open riparian areas near Chino Creek at Euclid and on the north side of Prado Basin. Isolated patches are present near Van Buren Bridge in the City of Riverside. Small populations are present below Prado Dam and at Rancho Jurupa Park. The plant is also present near Temecula in the Santa Margarita watershed. Pepperweed is a hardy plant; it's invaded all western states except Arizona. Pepperweed has been found to invade after removal of other invasive species, such as *Arundo*. Given that the purpose of invasive species removal is to encourage reestablishment of native vegetation and to avoid a monoculture of invasive species, the invasion

of new invasives following removal of other species should be strongly monitored and management measures should be taken to avoid such a situation.

Implementation

The following implementation measures are offered to acheive invaisve species removal goals. Remoaval of invasive species is vital to habitat restoration and improvement of ecosystem function. Given the rising cost of land acquisition in Southern Californira, restoration of habitat is less expensive than and equally important to acquiring further habitat. Removal of invasive species is an excellent way to increase ecosystem function.

1. Continue seeking funding for further removal of *Arundo* and other invasive species and long term monitoring of previous removal efforts.
2. As groups remove *Arundo* within the watershed, post-removal monitoring should include identification, documentation, and removal of perennial pepperweed for a minimum of three years. This recommendation is crucial for the Hidden Valley area to prevent spread of pepperweed to the Riverside County Parks land above Van Buren Bridge. Control of the species below Prado Dam is crucial to prevent spread to the Orange County River Channel.
3. Facilitate other groups beyond Team Arundo to perform removal and maintenance.
4. Facilitate efforts by agencies and groups who maintain the river.

3. Increasing Connectivity of Regional Trail System

> "The common link connecting all of the projects that we've discussed today is the Santa Ana River Trail. This trail is the golden thread running throughout planning efforts within the watershed."
>
> —*Jonathan Jones, City of Corona, Santa Ana Scoping Meeting, July 26, 2002*

As explained in Section 2C, Open Space and Recreation, several segments of the Santa Ana River Trail totaling approximately 40 miles have been constructed, out of 110 miles of total trail length. Conceptual plans are basically complete for the remaining 70 miles (as well as a number of feeder trails and connections) and full funding has been secured for some segments. Refer to Figure 3-2 for a map of the current status of the Santa Ana River Trail, including planned segments. One goal of the Santa Ana Integrated Watershed Plan is to assist in securing funds for those trail segments that have not yet received funding. Trail status is most easily discussed by county, as follows.

Orange County—The backbone of the Santa Ana River Trail is basically complete through Orange County, from the mouth of the Santa Ana River to the Orange County line. However, parts of the trail are in need of aesthetic improvements, as the trail runs along a dry concrete channel for much of the Orange County portion. At the mouth of the River, the trail connects very smoothly to the Pacific Coast Trail, which runs along the beach from Sunset Beach to Balboa Beach. In Orange County, the trail allows access to Arrowhead Pond, a large sporting event and concert venue, home to the Mighty Ducks of Anaheim Hockey Team, and Edison Field, home to the Anaheim Angels Baseball

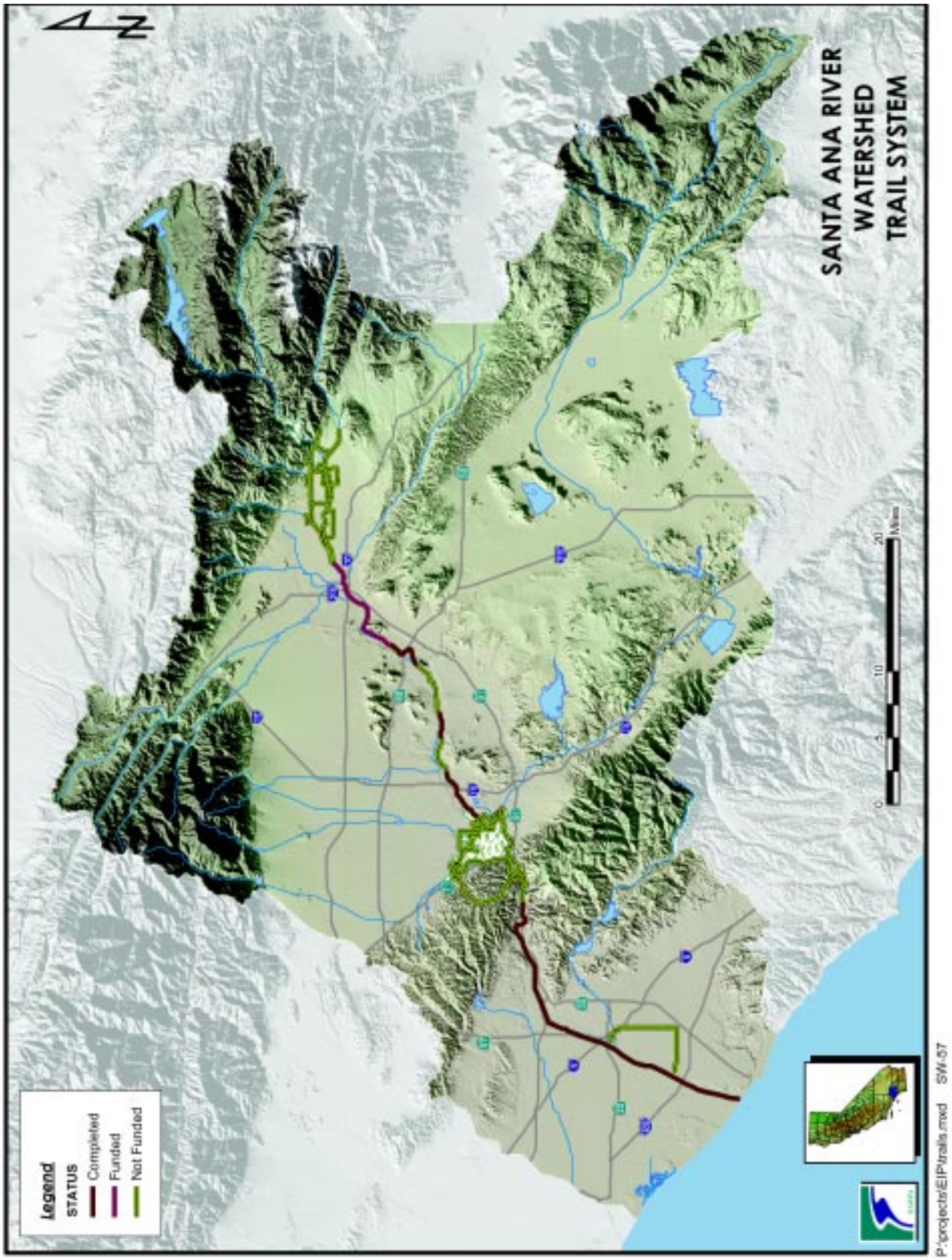


FIGURE 3-2 Santa Ana Watershed Trail System

Team. The proximity of the Trail to these event centers provides a unique opportunity for trail usage; event attendees could make use of the trail to avoid traffic and parking fees.

The following statements are based on the original 1990 Santa Ana River Trail Plan and modified according to recent input.

The goal of the Santa Ana River Trail and Parkway project is to develop a continuous multi-use regional trail system and parkway along the Santa Ana River corridor. In support of the overall goal, planning and implementation activities will accomplish the following objectives:

1. Provide for a continuous, safe trail linkage system.
2. Provide trail linkage to feeder trail systems.
3. Provide multi-use, barrier-free trail opportunities within the trail system.
4. Provide environmental education opportunities within the trail system.
5. Provide protection of the natural resources for the Santa Aria River corridor through operation and management guidelines.
6. Provide new park facilities and upgrade interfaces with existing parks as needed at appropriate intervals along the river corridor
7. Provide interesting venues for interaction with the community and commercial interests along the river corridor.

The trail in Orange County is dual use for much of the route, with an unpaved hiking/equestrian trail running next to the Class I bikeway (a Class I bikeway provides a completely separated right-of-way for the exclusive use of bicycles and pedestrians with cross-flow of motorized traffic minimized). However, the unpaved portion is not contiguous and does not run all the way to the Pacific Ocean. Although there are a few equestrian features, such as unpaved paddocks that serve as "rest areas" for horses, regional equestrians see the need for more equestrian staging areas. Also, equestrian trails are viewed as ephemeral, highlighting the need to ensure permanent easements for equestrians to access the Riverbed.

Tri-County Area—The tri-county area, at the intersection of Orange, Riverside, and San Bernardino Counties, includes one of the largest challenges for completion of the trail. A major "missing link" in the trail is the area around Prado Dam and Prado Wetlands. A large loop around Prado Dam is planned, but funding has not yet been secured for this section, which will be primarily constructed through Riverside County. Planning of this trail segment must be coordinated with the U.S. Army Corps of Engineers in accordance with the agency's plans to raise Prado Dam, as raising the Dam will increase the area of the flood basin. In addition, trail planning through this area is difficult due to the large amount of restricted habitat and the high number of special status species in the vicinity of Prado Basin. Please refer to Figure 3-3 for a map of the conceptual trail loop around Prado Wetlands.

Riverside County—Completing the trail through Riverside County may prove to be more challenging than in Orange County or San Bernardino County. In Riverside County, the Santa Ana River runs through three cities after

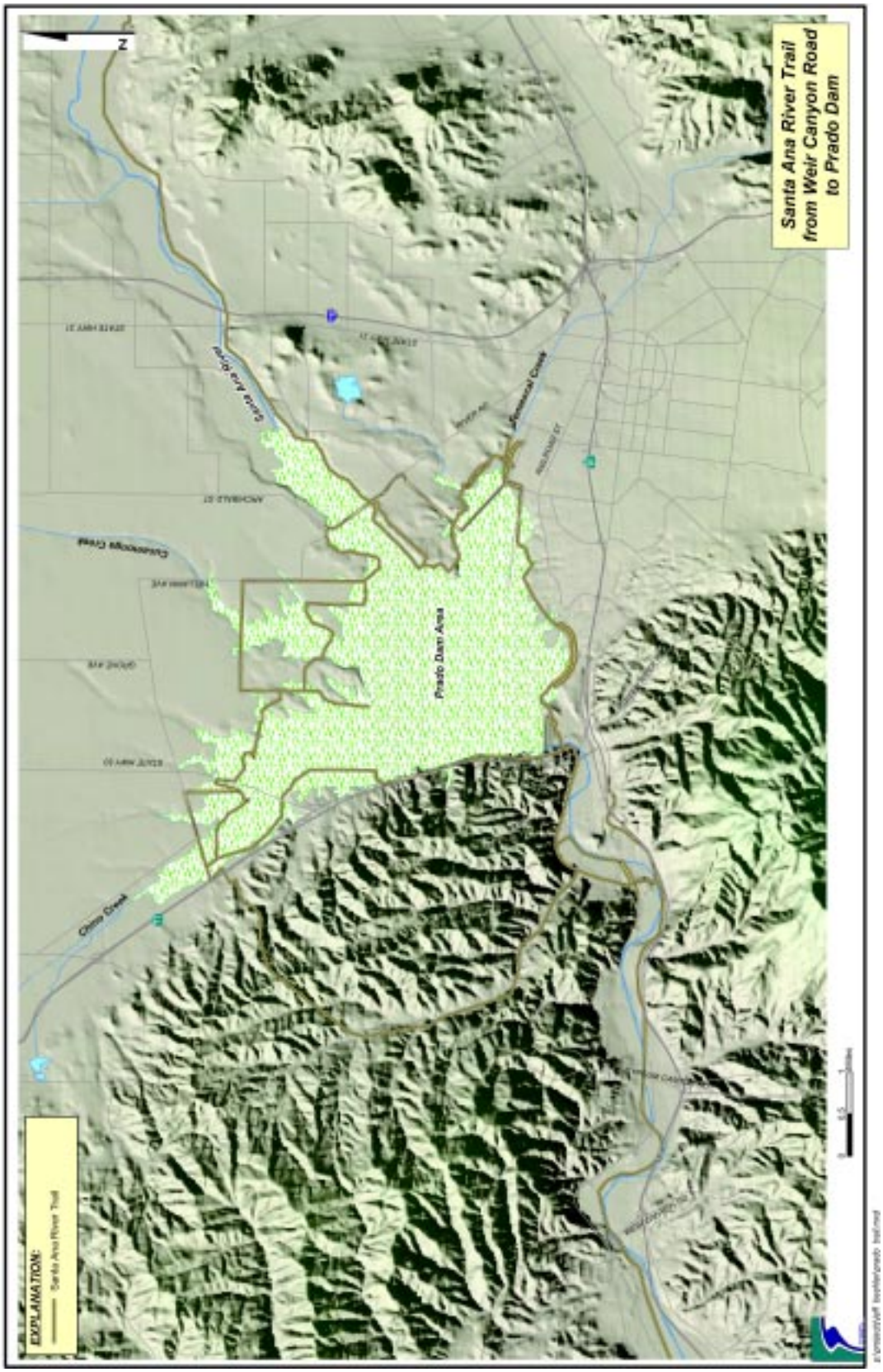


Figure 3-3 Santa Ana River Trail from Weir Canyon Road to Prado Dam

crossing the Orange/Riverside County Line. The trail is in long-term development plans as it passes through the City of Corona and the City of Norco, and the trail is nearing completion through the City of Riverside.

The most comprehensive trail plan to date is the 1990 "Santa Ana River Corridor Trail System," which predicted that the longer the trail took to implement, the more difficult implementation would be. This statement has proven prophetic in the case of routing the trail from Prado Basin through the City of Corona. A residential neighborhood has been built over the original 1990 plan trail route, and rerouting the trail around the neighborhood would place it in sensitive habitat. An alternative route along Rincon Street looks implausible. Although the road is planned for widening, there is inadequate right-of-way for a bike lane and the road passes through dense riparian habitat under regulatory protection.

Completing the trail through the City of Norco will also prove challenging in many areas, as potential trail sites travel through residential neighborhoods with little to no right of way for a bike path. Two segments along the City of Norco need completion: from Pedley Avenue to Hamner Avenue is likely to be completed before the Hamner Avenue to River Road segment, as the Army Corps of Engineers has recently completed a bank stabilization project and has paved part of the trail.

The City of Riverside boasts a contiguous stretch of trail, starting just west of the Van Buren Bridge at Tyler Street and traveling east for approximately 7.5 miles, ending at Market Street in the City of Riverside. This is a pleasant stretch of trail, passing through Anza Narrows and Mount Rubidoux Parks, ending near Evans Lake in Fairmont Park. Although the trail is not complete through the City of Riverside, the City has completed planning the unfinished segments and is seeking funding to complete the trail.

San Bernardino County—Currently, there is no official Santa Ana River Trail and Parkway in San Bernardino County. Eighteen miles of the planned trail fall under the jurisdiction of San Bernardino County, from the Riverside/San Bernardino County Line to the boundary of U.S. Forest Service land in the foothills of the San Bernardino Mountains. As the Pacific Crest Trail runs through U.S. Forest Service Land, the U.S. Forest Service has jurisdiction over connecting the Santa Ana River Trail to the Pacific Crest Trail. This connection would provide 35 miles of trail, but may never be paved as a Class I bikeway. Approximately 11.3 miles of the San Bernardino County portion of the trail have been planned in three phases, with the remaining 7 miles still in conceptual stages. Phase I (3.3 miles) has received some funding, but more funding is needed before engineering design can begin. The County has secured funding to complete construction of Phase II, which should begin in Fall 2002. The County has also secured funding for Phase III and engineering design should begin Fall 2002. Much of the future trail in San Bernardino County will be built on existing flood control levees that will require little to no grading and clearing of vegetation. San Bernardino County trail planners have applied to various grant programs to fund the rest of the trail.

Another trail area in San Bernardino County is the California Field Office Rail-Trail Projects Rancho Cucamonga Pacific Electric Trail. The cities of Montclair, Upland, Rancho Cucamonga, Fontana and Rialto have agreed to work together with SANBAG, the San Bernardino Association of Governments to develop a 20-mile trail along the alignment of the old Pacific Electric line from Los Angeles. The route connects with many

schools, shopping districts, and residential areas, and would stretch from Claremont to Rialto. Area trail planners should investigate linkages to connect this trail to the Santa Ana Rvier Trail.

Implementation

Trail Completion

1. Construct those sections of the Santa Ana River Trail for which funding has been secured (namely, Phase I in San Bernardino County).
2. Secure funding for completion of those sections that have been planned: Phases II, III, and IV in San Bernardino County and Phase I: Part 2, Phase IIIB: Part 2, Phase IV, and Phase V in Riverside County (refer to Table 3-3, Status of the Santa Ana River Trail, by County and Segment).
3. Complete other vital links such as Temescal Wash/San Jacinto Wash to San Jacinto Mountains and connections to the new San Timoteo State Park
4. Best utilize up to $10.0 million in funding provided by Proposition 40 to complete the trail.
5. Employ better communication and integrated review to assist city and county planners in assessing trail impacts when considering proposed projects. Trail users are concerned about pieces of potential trail connections disappearing permanently once development is approved without provision for trails. Therefore, there is a need to coordinate trail planning efforts with other project efforts to avoid conflicting land uses. For example, each county's Parks and Recreation/Trail Planning Department should coordinate with other County and City partners regarding potential projects (e.g., planning and public works projects).
6. Integrate individual cities' trail planning efforts to ensure connectivity and to ensure that the Santa Ana River Trail's usefulness reaches its full potential.
7. Institute a trail overseer role. For example, SAWPA could assist the watershed community in developing a trail overseer role, so that when proposed projects undergo environmental review through the CEQA process, not only will the lead agency/City/County look at trail impacts, but the trail overseer could also do the same.

Amenities

The American Association of Highway and Transportation Officials (AASHTO) and the California Department of Transportation (Caltrans) have developed national standards for bikeways. Caltrans advises that all standards in the Caltrans Highway Design Manual, Chapter 1000: Bikeway Planning and Design be followed, including mandatory and advisory standards. The following are additional recommendations for the Santa Ana River Trail, identified and recommended by watershed participants either in writing or at scoping meetings. These recommendations are intended to complement Chapter 1000 of the Caltrans Highway Design Manual and none of these recommendations shall be interpreted to supersede or conflict with Caltrans standards.

8. Ensure consistent trail mileage. Orange County's mileage system begins with the Pacific Ocean as Mile Zero, and this mileage system should be carried out along the length of the Trail, with the connection to the Pacific Crest Trail approximating Mile 110. A mileage system is important safety issue because it allows users to know their location,

distance traveled, and distance left to travel. In addition, those training for marathons and other fitness events that require specific mileage goals during training may use the trail.

9. Trail should include the availability of water fountains for user refreshment and safety.

10. Trail should include restroom access, such as maintained port-a-potties.

This paddock serves as a "rest area" for horses using the trail
Photo courtesy of EIP Associates.

11. Trail should include frequent shade trees to provide relief from the sun and heat of inland Orange, Riverside, and San Bernardino Counties. Native species should be used for these shade trees.

Example of dual trail: unpaved horse/hiking trail alongside paved Class I bikeway.
Photo courtesy of EIP Associates.

12. Trail should include staging areas for equestrian use and paddocks to serve as rest areas for horses.

This interpretive sign alerts Orange County trail users to an osprey nesting platform along the Santa Ana River
Photo courtesy of EIP Associates.

13. Trail should include bike racks to allow riders to secure bicycles when using trailside amenities.

14. Trail should include ample disposal facilities for garbage, including garbage cans, recycling bins, and elevated "bicycle-friendly" garbage cans that are convenient for bikers to utilize.

15. Trail should include access to air hoses for bikes that need to inflate their tires.

16. Trail should include interpretive signage for environmental and wildlife education.

17. Trail should include some bike 'n' hike primitive campgrounds for those interested in biking or riding from coast to crest (these campgrounds should be accessible by foot, not requiring a car). Once challenge in implementing these campgrounds will be security issues, including personal safety and emergency vehicle access.

Other Implementation

18. Continue outreach and contact with law enforcement to pursue trail access and safety.

19. To draw attention to the trail, its planners should host annual 2-day Bike n' Ride events with camping on the first night. This event could be timed such that participants could join in at various points along the trail.

4. Multi-objective Conservation Planning and Projects

Key actions to restoring ecological function within the Santa Ana Watershed include habitat acquisition, enhancement, and restoration. Agencies and organizations within the watershed engaged in conservation activities should balance priorities and funding allocation between habitat acquisition and habitat restoration.

Table 3-3. Status of Santa Ana River Trail, by County and Segment

County	Phase	Location	Miles	Status
Orange County	Orange County	Mouth of River to Orange County Line	26	Trail complete through Orange County
Riverside County	Tri-County Area	Orange County Line to Green River Road	1	Trail segment incomplete
	Long-term trail/ bike path	Green River Golf Course to Pedley Avenue in Norco	7	Trail segment conceptual
	Phase V	Pedley Avenue to western edge of Hidden Valley Wildlife Area	1	Trail segment conceptual
	Phase IV	Western edge of Hidden Valley Wildlife Area to Tyler Street	1.5	Planning complete
	Phase IIIB, part 2	Offshoot of main trail along Van Buren to Jurupa Ave. Includes Hole Lake crossing	0.25-0.5	Planning and environmental clearance complete
	Phase I, part 1, to Phase IIIB part 1	Tyler Street to Market Street	7.5	Trail segment complete
	Phase I, part 2	Market Street to Riverside/SB Co. Line	1	Funding secured
San Bernardino County	Phase I	Riverside/SB Co. Line to La Cadena Drive	3.3	Plans complete (but need revision)Some funding acquired Seeking future funding
	Phase II	La Cadena Drive to Waterman Avenue	3.5	Planning complete Engineering designs complete, Funding acquired, Construction starts Fall 2002
	Phase III	Waterman Avenue to Alabama Street	4.5	Plan complete Most funding acquired Engineering design starts Fall 2002
	Remaining trail under SB Co. Jurisdiction	From Alabama Street to US Forest Service Land	11	Trail segment conceptual
	US Forest Service Land	Beyond 7 Oaks Dam	35	Some unpaved mountain bike trail, some conceptual
		Total Miles	*110*	

Recommendation #2: Protect and Restore Habitat Resources

2-A. Restore natural wetland habitats in flood plains of the River and its tributaries.

- Look for opportunities in natural undeveloped areas to add wetlands that will increase complex natural habitats in juxtaposition to the stream system.
- Connect wetlands to the stream corridor through the addition of channels and vegetation.

2-B. Protect and restore remaining native species and habitats.

- Recreate meanders and backwaters where possible within the River and its tributaries to enhance native fish habitat.
- Create drop structures and other oxygenation devices that do not inhibit fish passage.
- Reestablish riffle substrates.
- Develop instream structures to promote pool and flow complexes.

2-C. Identify public and private agencies and organizations to maintain acquired lands and funding sources.

2-D. Acquire key parcels of land for conservation.

- Establish conservation goals and target selection criteria.
- Identify key potential parcels based on selection criteria.
- Negotiate conservation easements as an alternative to outright purchase of lands.

2-E. Promote the identification, establishment, and protection of wildlife corridors.

2-F. Connect upland vegetation and habitats through edge habitats and corridors.

- Locate isolated habitat patches and establish corridors suitable to increase the habitat diversity available to all species.
- Plant native trees, shrubs, and forbs to establish wildlife-friendly pathways along roads and channels.

2-G. Remove and control exotic species.

- Continue active programs for removal of established invasive species.
- Identify and control recently established invasive species to prevent further spread.
- Prevent introduction of future invasive species.

Habitat Acquisition

Several areas within the watershed offer excellent opportunities for habitat acquisition, enhancement, and restoration. Watershed planning participants recognize that habitat acquisition is equally important as habitat restoration. As the watershed continues to urbanize, land values are expected to rise, increasing the difficulty of land acquisition with each passing year. Refer to Figure 3-4 for a map of potential resource conservation areas within the watershed, as determined by representatives from community-based organizations, cities, counties, State Parks, and the California Coastal Commission.

Ideally, the parcels of land targeted for preservation will help to connect open space, link

existing recreational trails, increase public access to water, provide habitat, protect wildlife corridors, positively contribute to groundwater recharge, and prevent development in environmentally sensitive areas. Alternatives to land acquisition include the negotiation of conservation easements whereby the lead agency or organization for the land acquisition project does not gain *fee simple* property rights (full ownership). Through these types of agreements, private property owners retain ownership of their land, but surrender some of their property rights, such as the right to develop the property, in exchange for federal income and estate tax advantages. Implementation of conservation easements is generally much less expensive than purchasing a property outright. Refer to sample Conservation Easement Deed issued by California Department of Fish and Game, Appendix G.

Habitat Restoration and Enhancement

Restoration strategies include invasive species removal, debris removal, wetlands enhancement, beach renourishment, and revegetation projects. Potential restoration projects include culvert daylighting, as discussed in section 2G, Flood Control. In addition to restoring ecological function, appropriate implementation of these restoration activities can prevent listing of threatened or endangered species, as well as providing economic and other benefits to the region. Economic and public safety benefits of removing invasive species are discussed in Section 3A-2, Invasive Species Removal. Additionally, beach renourishment provides recreational and economic benefits to the region.

Beach Renourishment

Beach renourishment is an economically important restoration strategy that has become necessary within Southern California. Coastal streams and rivers provide 70 to 90 percent of California's beach sand, with the remaining 10 to 30 percent provided by gully, terrace, and bluff erosion. Flood control measures such as

ESSENTIAL RESOURCE CONSERVATION AREAS

Source: Watershed Stakeholders, SAWPA Scoping Meeting, August 14, 2002

1. Santa Ana River Mouth to Fairview Park
2. Bolsa Chica Wetlands
3. Upper Newport Bay
4. Lower Newport Bay
5. Santiago Creek
6. Temescal Canyon
7. Palomar- Santa Ana Mountains linkages
8. Featherly Park
9. Prado Basin
10. Coal Canyon
11. City of Chino- Sphere of Influence
12. Box Springs Mountains
13. San Timoteo Canyon
14. Carbon Canyon Creek
15. Connection from City of Whittier to Chino Hills State Park
16. Lytle Creek
17. Mystic Lake

LAND ACQUISITION TARGET SITE SELECTION

The following outlines steps for targeting specific sites for land acquisition. Source: EIP Associates, 2002

A. Identify clear and concise objectives for selecting target sites

1. What are the intended uses of these sites (e.g., recreation, trails, habitat conservation, groundwater recharge)?
2. Will this site conserve habitat for particular species or at the community level? Which species? What communities?
3. What is the available budget for acquiring and maintaining lands for conservation?

B. Develop criteria for selecting sites based on the stated objectives

1. Work with stakeholders and scientists to create a list of criteria that will be used to select target sites.
2. Some examples of possible criteria that may be used:

i. Habitat Conservation

- Reserve size: minimum dynamic area required for supporting natural processes, disturbance regimes, recovery from disturbance, and species ranges.
- Connectivity between target sites for allowing migrations and distribution of genetic material.
- Uniqueness of species or communities found within a site. Are rare, endemic, or threatened/endangered species found within the site?
- Anthropogenic threats to the potential sites. For example, is development encroaching on particular sites, suggesting that either the site will be eradicated if not protected *or* that the site is not viable as human pressures will overwhelm natural communities? We might look at the distance of sites from urban sprawl, sites that occur in the urban/wildland interface, etc.
- What are the specific demands of the species of concern? What types of sites are required to ensure their long-term conservation?

ii. Open Space/Recreation/Public Access

- Recreational potential of site, including the effect that it would have on conservation objectives Existing land use
- Connectivity of trail network
- Accessibility to river, tributaries, and ocean

iii. Groundwater Recharge/Water Quality

- Runoff estimate and groundwater recharge potential
- Soil characteristics (permeability/infiltration, erosion hazard, etc.)
- Effects of upstream/downstream point and non-point source pollutants

iv. Wetland Conservation/Enhancement

- Acreage and type of existing wetland features
- Sensitivity ratings of existing wetland features
- Potential for wetland restoration or enhancement

v. Political and Fiscal Feasibility

- How much would it cost to conserve a particular site in comparison with others?
- What are the political hurdles associated with each potential site?

What are the current land use designations for each site, and what value would each site have with other land uses?

- Are conservation easements a potential vehicle for conserving the site?

C. Develop model for optimizing the reserve design based on criteria and available data

1. Which data layers will be used and why?
2. What are the individual parameters for each criterion?
3. What are the assumptions inherent in the model?

D. Conduct analysis and generate maps of alternative target sites

1. Use GIS to evaluate sites based on the selected criteria.
2. Identify several alternative target sites to be presented to SAWPA and relevant stakeholders.

E. Work with stakeholders, scientists, and agencies to identify an optimal group of target sites based on both political feasibility and environmental effectiveness

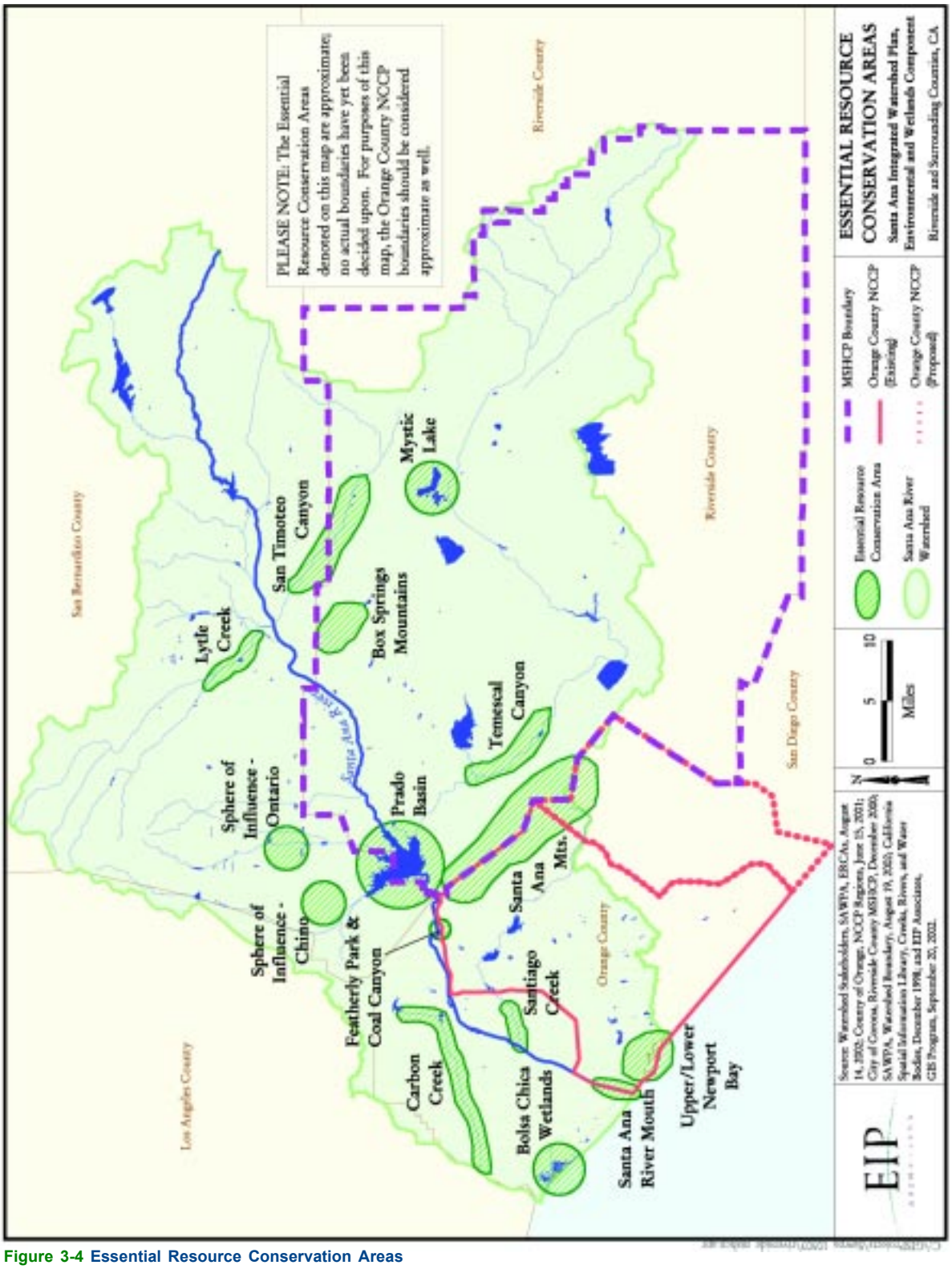


Figure 3-4 Essential Resource Conservation Areas

Huntington Beach, a world-famous surf spot, is an important recreational area for Southern California residents.
Photo courtesy of EIP Associates.

dams, debris basins, and river channelization may reduce the amount of sand reaching the coast, while harbor structures may obstruct along shore sand movement. According to Flick (1993), the most drastic sand deficit in Southern California exists along Orange County's coastline, where the natural sediment supply has decreased up to 85 percent. It is estimated that Prado Dam alone reduces sand and gravel flow by approximately 67 percent each year. According to the U.S. Army Corps of Engineers and the U.S. Interagency Advisory Committee on Water Data, historic sedimentation rates behind Prado Dam have averaged well over 1,000,000 cubic yards per year[1].

Preventing the Listing of Species

With respect to wildlife, it is imperative to focus time, energy, and funding on those native species that are not yet listed as threatened or endangered, such as the speckled dace, a native fish species. Once a species is placed on State or federal lists, engaging in actions that help the species may actually become more difficult due to regulatory requirements. Activities that are beneficial in the long term can often cause short-term disturbances that impede the permitting process when working with threatened and endangered species. Recovery efforts that focus on only one species should be avoided in favor of multiple benefit projects.

[1] Average sedimentation rate from 1941 to 1979 was 1,130,000 cubic yards per year. From 1979 to 1988, this rate was estimated to rise to at least 1,380,000. Although upstream construction of the Seven Oaks Dam, completed in 1999, may have reduced the sedimentation rate behind Prado Dam, total sedimentation rates behind Santa Ana River dams would not have decreased as a result of the Seven Oaks Dam.

Strategies for *thinking ahead* to create a conservation strategy that ensures the long-term viability of the watershed's native flora, fauna, and aquatic communities will prevent degradation of the watershed's delicate ecosystem. By overlaying significant resource data such as the Riverside County land acquisition priority map with other watershed studies, better decisions will be made with regard to habitat restoration and enhancement efforts. Planning and discussion amongst key watershed participants will ensure that the best possible targets for restoration land acquisition will be selected.

A related strategy proposed in this plan, which could help to prevent sensitive or threatened species from becoming endangered, would be the creation of an Aquatic Resources Committee (ARC), expanding the role of the Santa Ana Sucker Discussion Group, to include other native fish, for example. While participation in ARC would be voluntary, the objective would be to encourage the active involvement of state and federal resource agencies, cities, counties, other local jurisdictions, and the private sector, in coordinating and developing programs and specific projects focused on preventing future listing of native fish such as the arroyo chub and the speckled dace. Refer to Appendix G, Aquatic Resources Assessment, for more detail.

5. Education

"In the end, we will conserve only what we love, we will love only what we understand, we will understand only what we are taught."

—Baba Dioum, Senegalese Conservationist

"We have an opportunity to help people understand the remarkable amount of resources within the Santa Ana Watershed and the work that is being done to protect and enhance these resources."

—Martha Davis, Inland Empire Utilities Agency
July 23, 2002

Environmental educational programs strive to provide proactive—rather than reactive—solutions to water quality and waste disposal problems. The ultimate goal of environmental educational programs is to provide information and a context for behavioral change. Educational messages must be powerful enough to inspire someone to break a habit such as over-fertilizing a lawn or taking 45-minute showers. The implementation of environmental education within the watershed may be accomplished through a combination of three strategies: public outreach, educational programs, and interpretive signage.

With respect to water resources, one of the most effective ways to reduce non-point source pollution is through public education. Throughout the watershed, point sources of water contamination have been reduced, and water quality improved, through use of better technology and through efforts of the regulators as well as the regulated community. Non-point sources of water contamination are areas discharges to soil, groundwater, and surface waters, such as inappropriate application of waste and fertilizers and atmospheric deposition of contaminants to the soil and water bodies.

While point sources can be traced back to a single source, such as the end of a pipe, non-point sources can rarely be traced back to individuals and will require regions behavioral changes to reduce contamination.

The importance of education is easy to overlook within the watershed, as no specific organization has jurisdiction over education, unlike trails, wetlands, and habitat projects. Beyond standard classroom curriculum, educational programs do not have specific agency oversight as mandated by law, although many water agencies do have water education programs in place. Educational programs are decentralized throughout the region, carried out by individual water agencies or nonprofit organizations. Whereas many groups are educating people about water conservation or habitat improvement within the watershed, few groups if any specifically educate about the Santa Ana Watershed. The watershed concept is not yet widely understood—many people are not sure what a watershed is, or which one they live in. Agencies, organizations, and individuals within the watershed recognize the need for additional educational opportunities within the Santa Ana Watershed.

Huell Howser, shown here with Joe Grindstaff, SAWPA General Manager, produced an educational video about the Santa Ana Watershed.
Photo courtesy of SAWPA.

Educational Program Types	Notable Santa Ana Watershed Examples
Nature centers and interpretive exhibits	Expansion of Santiago Oaks Regional Park's educational facilities to include a Watershed and Nature Education Center with high-tech innovative exhibits (in progress)
Tours	The Orange County Water District (OCWD) offers tours of the Prado Wetlands led by a naturalist. To sign up for a tour, go to http://www.ocwd.com/_html/tour.htm. Eastern Municipal Water District (EMWD) offers tours of the Hemet/San Jacinto Constructed Wetlands, and Elsinore Valley Municipal Water District (EVMWD) offers student tours.
Brochures/flyers	"The Good, the Bad, and the Invasive," Santa Ana Watershed Association of RCD's invasive plant educational brochure
Events/meetings	Annual Coastal Clean-up, held each September and hosted by a number of organizations including inland cleanups sponsored by Trails 4 All
Curriculum development	California Coastal Commission compilation of K-12 curriculum specific to Upper Newport Bay with hands-on restoration activities (in progress) . EVMWD offers classroom presentations, books, and student/teacher workbooks. Riverside Corona RCD and OCWD are developing curriculum on invasive speices and the importance of wetlands. Western Municipal Water District (WMWD) offers the Water Conservation Garden Activity Book: a teacher's guide to activities and lesson plans relating to water conservation.
Homeowner guides and workshops	San Bernardino Municipal Water District's web site www.sbvmwd.com, hosts "The Easy Guide To Lawn Watering--Save Water & Cost," including a table that explains the total number of minutes to water your lawn each week. EVMWD offers a landscape workshop series, homeowner water audits, and conservation booklets and materials. WMWD recently published a brochure titled "Guide to Landscape Water Conservation in western Riverside County." The Riverside Lands Conservancey offers a useful and informative booklet titled "Stream Care- Every Person's Guide to Healing Waterways.
Videos	Huell Howser's video on the Santa Ana Watershed, Elsinore Valley Municipal Water District (EVMWD) Videos, and SAWA Video, "Arundo's Fatal Grip" with Congressman Calvert (available for purchase for $17.00)
Job training/scholarships	Orange County Conservation Corps- employs southern California youth to implement environmental projects, including recycling more than 1.6 million pounds of recyclable materials and completion of over 215 projects to maintain parks, beaches, rivers, and trails.
Internships	UC Irvine School of Social Ecology (http://www.seweb.uci.edu/) offers paid internships for university credit.

Table 3-4 Education Program Types and Examples

On Saturday, April 27, 2002, SAWPA and EIP Associates hosted a booth at the annual Environmental Expo at Cal State San Bernardino. The primary focus was to solicit input from Santa Ana Watershed residents and other stakeholders such as organizations and agencies involved with resource conservation or recreation. Two different surveys were produced for the event: a Household Survey, aimed at watershed residents, and an Organization and Agency Survey. SAWPA and EIP staff spent great deal of time educating watershed residents and stakeholders about watershed issues and the development of the Environment and Wetlands portion of the Santa Ana Integrated Watershed Plan

While not enough household surveys were completed to yield any statistically significant results, survey tabulation from the Expo and Santa Ana River Symposium did generate some interesting information. For example, completed surveys reflected the fact that many people do not know what a watershed is. The Expo attracted watershed residents that have at least some interest in and knowledge of environmental issues. Therefore, the sample population was biased in that they were more likely to know what a watershed is than a random population sampling. However, survey respondents reacted to the fill-in-the-blank question "What is a watershed?" in one of four ways. 32% of respondents answered the question incorrectly, 25% left the question blank, 14% answered with "I don't know" or similar expression, while only 29% of respondents answered the question correctly. It should also be noted the survey station (where most people filled out their survey) furnished a conspicuously posted watershed definition.

Recommendation #3: Engage the Community through Education and Recreation

3-A. Improve recreational opportunities for the region, including access to streams, lakes, and beaches through dedication of easements and land acquisition.

3-B. Increase water conservation and decrease imported water use through public education and provision of water saving devices.

3-C. Involve the public through outreach and education coordinated with the agencies and schools in the watershed.

3-D. Increase available open space throughout the region, including balancing open space availability among various communities by increasing parkland acreage in densely urbanized areas.

Santa Ana River Symposium, April 2002.
Photo courtesy of EIP.

A. Public Outreach

Many watershed residents do not understand that the storm drain system is completely separate from the sewer system in the watershed: there is no treatment system or filter between a storm drain on the street and the Pacific Ocean. Used motor oil or a cigarette butt thrown out of

a car window—be it in Corona, Big Bear, or Costa Mesa—will ultimately end up on the beach. Unclean stormwater runoff flowing into the Pacific Ocean causes swimmers and surfers to become sick and may result in beach closures. Public education will make clear the linkages between the condition of the watershed and the health and well-being of the population, wildlife, and ocean. Public service campaigns address nonpoint source pollution, as well as the reduction of trash, animal waste, organic matter, and other pollutants that wash into storm drains and then into the rivers and ocean. Public involvement programs should also encourage residents to become involved in the cleanup of the rivers and build upon existing programs, such as the use of volunteers in monitoring river water quality.

Santa Ana River, April 2002
Photo courtesy of EIP Associates

Table 3-5. Existing Educational Programs

Program Name	Website
The California Regional Environmental Educational Center--Regions 9a and 10	www.creec.org
Global Learning and Observations to Benefit the Environment	www.globe.gov
The Global Rivers Environmental Education Network	www.earthforce.org/green/
The North American Association of Environmental Educators	www.naaee.org/
The US EPA's Water Office Kid's Page	www.epa.gov/kids/
Earth 911	www.earth911.org/usa/master.asp
Water Education for Teachers	www.projectwet.org/
Local resource conservation districts and local water districts, such as as the Santa Ana Watershed Association of Resource Conservation Districts and water districts such as EMWD, WMWD, IEUA, SBVMWD, OCWD, and EVMWD. WMWD funds the Water Education Advisory Council which brings together representatives from local water districts to collaborate on water education programs.	www.sawarcd.com, www.evmwd.com, www.ieua.org, www.emwd.org, www.ocwd.com, www.wmwd.com, www.sbvmwd.com

In addition to those issues most directly related to the condition of the watershed, outreach programs should also address broader environmental issues, including sustainability. At the simplest level, sustainability is the ability to meet current needs without compromising the ability of future generations to meet their own needs. This goal encompasses a range of concepts, such as recycling, energy and water conservation, use of appropriate building materials, minimizing use of hazardous materials, appropriate transportation planning, and the purchase of environmentally friendly products and packaging.

Furthermore, public outreach programs should strive to inform watershed residents of political awareness issues and ballot initiatives, such as park and water bonds that provide funding for habitat acquisition and restoration, trail planning, and water quality improvements. For example, the SAWPA quarterly newsletter provides information on upcoming bond issues and includes descriptions of projects funded with previous bond money.

B. Educational Programs

Educating children is equally important as continuing education for adults. Incorporating more environmental and water resource education into school curriculum, including as many field trips and hands-on programs as feasible, is the most effective way to ensure that

the watershed's next generation will be commendable environmental stewards. Education programs for children should be built upon the extensive network of existing resources such as those presented in Table 3-5.

Education programs for adults should include development of backyard habitat for wildlife, gardening techniques that minimize pesticide and herbicide use, natural methods of pest control, composting, organic gardening, planning and construction of stormwater drainage systems that promote groundwater infiltration, and low-water gardening and landscaping using improved irrigation and mulches. For example, Western Municipal Water Distrct and Elsinore Valley Municipal Water District offer annual landscape workshops for homeowners, which include instruction in landscape design, drip irrigation, and sprinkler design. The Riverside-Corona RCD has contracted with the Riverside County Flood Control District since 1996 to provide Santa Ana Homeowner Garden Workshops, Adult Education Program.

Kerwin Russell of the Riverside-Corona Resource Conservation District is shown here leading a SAWA field trip.
Photo courtesy of EIP Associates.

Scoping Meeting Two, July 26, 2002
Photo courtesy of EIP Associates

The watershed is home to several higher education institutions, such as California State University, San Bernardino; University of California, Riverside; University of California, Irvine; California State University, Fullerton; University of Redlands; The Claremont Colleges; California State Polytechnic University, Pomona; and Loma Linda University. These institutions have opportunities to conduct research and teaching related to the condition of the watershed. Given the interrelationships between the physical and natural environment, this includes a variety of fields, including hydrology, biology, environmental planning, ecology, urban planning, architecture, civil engineering, transportation planning, atmospheric sciences, geography, education, sociology, chemical engineering, and public health.

For example, Cal State San Bernardino is home to the Water Resources Institute (WRI). WRI offers a number of services for the watershed. These comprise public conference and speakers series, such as the annual "Sharing the Waters" conference held each fall; a water resources archive that includes Inland Empire well data dating back over 80 years, aerial photos dating to the 1930s, maps, USGS and other government publications dating back nearly 100 years, and oral histories; a website that houses large

amounts of water-related data and fun facts about water (http://wri.csusb.edu/); and dispute resolution services for water and other public agencies. Educational resources available through WRI consist of water-related research on technical or public policy issues; academic programs, including a BS degree in Environmental Geology and an Master's Degree of Public Administration with a Water Resources Management Specialization; and K–12 curriculum development related to water resources, the environment, and conservation. In addition, the University hosts an annual Inland Empire Environmental Expo each spring, with attendance upwards of 10,000 people.

Eastern Municipal Water District (EMWD), Elsinore Valley Municipal Water District (EVMWD), Riverside-Corona Resource Conservation District, and Western Municipal Water District (WMWD) have designed the "Teaching Southern California's Water Story" course through Fresno Pacific University and Cal State San Bernardino's College of Extended Learning. The fast-paced, independent study course allows students to earn professional credit while exploring several Southern California water sites. The course was designed to assist teachers in enhancing their water lessons and ties into the History and Social Science Frameworks for California public schools.

WMWD also offers a number of regional programs via the Water Education Advisory Council. The Council, funded by WMWD, provides

- Theater program performances;
- Science fair contests;
- Mini-grant program for teachers implementing new and innovative water education programs;
- H_2O Explorer Badge program; and
- Book/materials distribution.

Through the Water Education Advisory Council, EVMWD offers Project Wet, a groundwater model demonstration program that teaches students about the use of groundwater as a resource, the water cycle, and the water cycle's role in groundwater replenishment. The program also highlights hydrogeology, nonpoint source pollution, identification of the water table, watershed protection, and water recycling. Grades 4 through 6 are targeted; however, the lesson can be tailored for both lower and higher grade levels. EVMWD has been using the groundwater model for classroom presentations for ten years.

Storm drain stencils are an excellent example of public outreach through signage. The Riverside Corona RCD has stencilled over 1,336 storm drains since 1996 with a similar message.
Photo courtesy of Heal the Bay

EMWD's Education Program is a free resource for teachers and students in over 100 schools within the watershed. The mission of EMWD's Education Program is to foster understanding of water and wastewater issues and to promote wise water use among the future leaders of the Santa Ana Watershed community. They go about fulfilling this mission through a facilities tour program (1,624 student reached in 2001/02 school year); water awareness theater assemblies (27,939 students reached); classroom presentations (2,051 students reached); water education materials (19,454 students reached);

career days (13,375 students reached); science fair assistance (67 students reached); a water awareness poster contest (3,300 students participated in 2001/02); and teacher in-services (1,035 students reached). In the 2001/02 school year, 68,845 students were reached with a water and/or wastewater message.

EMWD also offers an extensive hands-on wetlands education program to school groups and other community groups at its Hemet/San Jacinto Multipurpose Constructed Wetlands. A professional groundwater model is a tool that is taken to classrooms for presentations and is also demonstrated with each group touring EMWD's Wetland Water Education Facility. Watershed and groundwater issues are key components of EMWD's overall education program.

Dan Bogan of the Riverside County Park and Open Space District explaining the massive root structure of *Arundo donax*
Photo courtesy of EIP Associates.

Western Municipal Water District offers several excellent programs to educate watershed residents and students about water conservation and landscaping. WMWD's "Landscapes Southern California Style[sm]" program is a water conservation demonstration garden, an interpretive project that includes over 250 species of water-wise plants on one acre. The garden receives over 10,000 visitors each year and seminars are conducted for the general public addressing such topics as appropriate plant selection, efficient irrigation methods, and natural pest control. In addition, WMWD provides about 50 different free brochures on water to the public. WMWD has also been a leader in the field of water education support for area schools since 1982, offering free materials including student workbooks, teachers' guides, videos, speakers, field trips, theater programs, grants for teachers, scholarships for students studying water related curriculum, and book donations to school libraries.

C. Interpretive Opportunities

When people visit open space, parks, community gardens, historic sites, cultural resources, riverfront walks, bike paths, wetlands, or habitat preserves, opportunities to learn about what they see and experience should be available. This requires interpretive programs that translate information for a variety of audiences. The information presented could be scientific, environmental, cultural, or even artistic in nature. Within the watershed, interpretive programs include hands-on programs at nature centers and museums, docent-led nature walks, summer day-camps for families, tours of water resources or flood management facilities, bird-watching or wildlife viewing events, living history exhibits at cultural sites, or signage and informational materials at accessible locations in parks, along trails, or at wetlands or habitat preserves.

The Metropolitan Water District (MWD) offers extensive educational programs throughout Southern California. MWD's Diamond Valley Lake has a museum and offers tours and field trips to the Santa Rosa Nature Preserve in Murrieta.

Orange County River Park
Photo courtesy of The Newport Beach Chapter Surfrider Foundation

Further interpretive opportunities include the Watershed and Waterway Signage Program, in which the Santa Ana Watershed Project Authority and its member agencies would work with Caltrans to implement a signage program for the watershed.

For example, watershed signage would include signs saying, "You are entering the Santa Ana Watershed" at, among others, the following locations:

- I-5 near La Mirada
- I-5 in unincorporated Orange County
- I-10 in Pomona
- I-10 in Beaumont
- I-15 near Lake Elsinore
- I-215 in northern San Bernardino County
- SR-71 near Pomona
- SR-91 near Cypress
- SR-60 near Pomona
- SR-55 near Newport Beach
- SR-57 near Brea

In addition, roads and highways over waterways should have signs indicating the waterway crossed (e.g., Santa Ana River, Santiago Creek). These locations would include, among others, the following:

- SR-91, I-405, I-15, SR-60, I-10, I-215, and I-5 as they cross the Santa Ana River
- I-15 as it crosses Lytle Creek
- I-215 as it crosses the San Jacinto River
- SR-71 as it passes along the Prado Wetlands

The Watershed and Waterway Signage Program would enlighten Santa Ana Watershed residents as to which watershed they reside in and familiarize them with the names of local waterways. With the help of Caltrans and the California Resources Agency, this program could be implemented Statewide to create a network of watershed signage. California residents and visitors would not only grasp the concept that "wherever you are, you're in a watershed," but would become familiar with the names of the watersheds they live in and travel through, thus creating these important connections to the land and water.

5. Partnerships

Recommendation #4: Plan for the Future

4-A. Facilitate partnerships among groups with similar goals and support community based sub-watershed groups.

4-B. Work with the State Resources Agency through the California Watershed Management Forums and other standard Regional Agencies to achieve State and regional goals.

4-C. Use the best scientific data available and regional collaboration to make complex resource management decisions.

4-D. Promote effective watershed monitoring, data management, and project evaluation programs.

4-E. Identify and pursue future sources of funding to complete watershed projects. Funding source identification should include provisions for operation and maintenance of projects in addition to capital expenditures.

4-F. Utilize this Santa Ana Integrated Watershed Plan, Environmental and Wetlands Component as a living document, including regular updates to maintain current watershed-wide planning and coordination.

Why Partner?

Communication is an essential element within any watershed, especially among groups with the authority to manage natural resources. As watershed planning has catapulted to an issue of international significance throughout the past few decades, awareness of watershed ecology and hydrology has illuminated the need for managers within each watershed to work together to manage resources. Watersheds are made up of multiple interests; no one group or individual can manage all of a watershed's resources by themselves. Watershed partnering means bringing together different combinations of citizen groups at difference scales and helping them to work together to value and enhance the resources within the watersheds.

Due to its large size, the Santa Ana Watershed provides the opportunity to coordinate the management of 1.7 million acres within one ecological unit. Assembling seemingly conflicting interests at same table to resolve issues of concern has proven very successful within the Santa Ana Watershed, and has resulted in unique and effective partnerships. The large scale of Santa Ana Watershed is both a challenge and a significant opportunity. There are many groups to bring together, but when everyone is working together, there is a much greater ability to achieve landscape-level resource management goals. Whereas watershed planning may be easier within smaller watersheds, the difficulty of

Team Arundo

Riverside County Parks and Open Space District

Orange County Public Facilities and Resources Department

Santa Ana Watershed Project Authority (SAWPA)

Santa Ana Watershed Association of Resource Conservation Districts (SAWA)

- Riverside-Corona Resource Conservation District
- Inland Empire West Resource Conservation District
- East Valley Resource Conservation District
- San Jacinto Basin Resource Conservation District
- Elsinore-Murrieta Resource Conservation District

Riverside County Flood Control and Water Conservation District

Orange County Water District

California Conservation Corps

Orange County Conservation Corps

California Exotic Pest Plant Council

Monsanto Corporation

Santa Ana River Trail Parnters

Counties:	*Agencies:*
Riverside	Orange County Water District
Orange	U.S. Forest Service, San Bernardino National Forest
San Bernardino	Santa Ana Watershed Project Authority
Cities:	
Colton	
Highland	*Organizations:*
Loma Linda	Orange County Equestrian Coalition
Redlands	Loma Linda University Community Outreach
Riverside	U.S. Army Corps of Engineers
Anaheim	California Department of Parks and Recreation
Orange	Trails 4 All
Santa Ana	San Bernardino Riders
Villa Park	Mike Carona Foundation
Corona	National Park Service, Rivers and Trails Conservation Assistance
Huntington Beach	Orange County Sheriff's Office
Norco	
Rialto	*Consultant Groups:*
San Bernardino	Dangermond Group
	EDAW
	Withers and Sandgren

planning within larger watersheds is balanced by the ability to affect large-scale regional resource management and the opportunity to pool resources on a regional scale.

Examples of Notable Partnerships within the Watershed

The Santa Ana River Watershed Group (SARWG)

SARWG is a collaborative effort of public and private sector agencies and interests focused on water quality management concerns in the Santa Ana River Watershed area. Principal Conveners include San Bernardino, Riverside and Orange Counties, the Santa Ana Watershed Project Authority and the Orange County Sanitation District. Among the members are dairy owners, environmental representatives, the major counties spanning the watershed area (Riverside, San Bernardino and Orange), and other stakeholders—nearly 50 groups in all. A tri-county memorandum of understanding has enabled SARWG to discuss and think about regional issues together with so many diverse stakeholder groups.

Orange Coast River Park Partners

- Friends of Harbors, Beaches, and Parks
- City of Costa Mesa
- City of Huntington Beach
- City of Newport Beach
- City of Laguna Beach
- County of Orange
- California Coastal Conservancy
- Surfrider Foundation, Newport Beach Chapter
- California Department of Fish and Game
- U.S. Army Corps of Engineers
- U.S. Fish and Wildlife Service
- Huntington Beach Wetlands Conservancy
- The Irvine Company

Team *Arundo*

Operating within the Santa Ana Watershed, Team *Arundo* is recognized throughout the State of California as a leader in *Arundo* removal efforts. Team *Arundo* members have undertaken a number of ambitious invasive species removal and restoration projects throughout the watershed. In addition to the partners listed below, the Nature Conservancy was historically a part of Team *Arundo*. The foresight and leadership of these groups have proven instrumental in elevating the need for *Arundo* removal to an issue of statewide importance.

Santa Ana River Trail

The Santa Ana River Trail is discussed at length in Sections 2C and 3A-3, and the following provides a list of major partners in the trail effort, many of whom have been involved for three or four decades.

Chino Basin Partners

- Inland Empire Utilities Agency
- Santa Ana River Watershed Group (SARWG)
- Milk Producer's Council
- Synagro
- Orange County Water District
- Chino Basin Watermaster
- All of the Chino Basin Cities
- Santa Ana Watershed Project Authority
- U.S. Department of Agriculture/Natural Resources Conservation Service
- U.S. Department of Energy and the California EnergyCommission
- Santa Ana Watershed Association of Resource Conservation Districts
- San Bernardino County
- Orange County Flood Control
- Orange County Sanitation District

Orange Coast River Park

With a paid membership of over 500 persons and organizations, the Friends of Harbors, Beaches, and Parks was established to promote the protection, enhancement, and expansion of Orange County regional parks, open space preserves, recreational trails, and coastal recreational facilities. Shortly after establishment in 1997 the group set its highest priority project as the Orange Coast River Park, which would create a 1,400-acre park at the mouth of the Santa Ana River. This park would be "assembled from a patchwork quilt of neighboring lands owned and individually managed by three cities; the County of Orange; several regional, State, and federal agencies; and private entities" (Orange Coast River Park Proposal 2001).

Chino Basin Program

Chino Basin is one of the largest groundwater basins in southern California, and is faced with significant organics management and water quality challenges. Through the collaboration of community leaders including the Milk Producers Council, Inland Empire Utilities Agency, Chino Basin Watermaster and many others, the Basin has developed an award winning organics management and groundwater protection strategy that offers an

Santa Ana Sucker Discussion Group

SUPPORTING PARTICIPANTS:

City of Riverside

City of San Bernardino

County of Orange PFRD

Orange County Sanitation District

Orange County Water District

Riverside County Flood Control and Water Conservation District

San Bernardino County Flood Control District

SAWPA

OTHER PARTICIPANTS:

U.S. Fish and Wildlife Service

California Department of Fish and Game

Santa Ana Regional Water Quality Control Board

Riverside-Corona RCD

City of Corona

integrated (multiple benefit) watershed plan for treating, recycling and reusing organic materials. This strategy will deliver significant water and air quality improvements for the region, enhance the reliability of local water supplies, generate clean renewable energy and recycled organic materials, provide significant local economic benefits and contribute to enhanced wildlife habitats within the Chino Basin. Innovative projects under construction include state-of-the-art anaerobic digesters and composting facilities, as well as California's first platinum "LEED" rated water and energy efficient office building that will serve as the new headquarters for the Inland Empire Utilities Agency.

Santa Ana Sucker Discussion Group

The Santa Ana Sucker Discussion group, which meets regularly at SAWPA headquarters, has recently completed a draft Conservation Program for the federally threatened fish. The program, which has been submitted to the U.S. Fish and Wildlife Service, enumerates activities that may be undertaken by organizations within the Watershed to minimize effects on the sucker. Conservation Program partners (which do not include all discussion group members) contribute financially to the program on an annual basis, which helps support much needed research and conservation measures for the sucker.

Lake Elsinore and San Jacinto Watersheds Authority (LESJWA)

The joint powers agency referred to is the Lake Elsinore and San Jacinto Watersheds Authority (LESJWA), which was created under a Joint Powers Agreement on March 8, 2000. A water resource improvement program has been established for the 700-square-mile San Jacinto and Lake Elsinore watersheds. These improvements address the following objectives:

- Provide nonpoint pollution control
- Develop flood control projects
- Protect wildlife habitat
- Protect and enhance recreational resources

LESJWA meets monthly and is governed by a Board of Directors comprised of one representative from each of the member agencies. The Board is also supported by a Technical Advisory Committee and a Public Relations Committee, which meets regularly.

LESJWA has entered into agreements with the Regional Water Quality Control Board for the purpose of conducting nutrient, pathogen, and toxic TMDL monitoring programs. Studies included are a Canyon Lake Pathogen TMDL and Internal Loading and Nutrient Cycling in Lake Elsinore. A TMDL Workgroup currently meets on a monthly basis to enlist the participation of stakeholders in solving the various TMDL issues.

LESJWA Partners
City of Canyon Lake
Elsinore Valley Municipal Water District
City of Lake Elsinore
County of Riverside
Santa Ana Watershed Project Authority

San Jacinto River Watershed Council

The Council is a multi-agency non profit collaborative group of watershed stakeholders. Their purpose is "to ensure that the current and potential uses of the San Jacinto River Watershed's resources are sustained, restored, and where possible, enhanced, while promoting the long-term social and economic vitality of the

region. The council will be serving in an advisary role in the development of the San Jacinto Watershed Management Plan.

Southern California Wetlands Recovery Project

The Southern California Wetlands Recovery Project is a partnership of public agencies working cooperatively to acquire, restore, and enhance coastal wetlands and watersheds between Point Conception and the international border with Mexico. Using a non-regulatory approach and an ecosystem perspective, the Wetlands Project will work together to identify wetland acquisition and restoration priorities, prepare plans for these priority sites, pool funds to undertake these projects, implement priority plans, and oversee post-project maintenance and monitoring. The goal of the Southern California Wetlands Recovery Project is to accelerate the pace, the extent, and the effectiveness of coastal wetland restoration in Southern California through developing and implementing a regional prioritization plan for the acquisition, restoration, and enhancement of Southern California's coastal wetlands and watersheds. Ultimately, the Wetlands Project's efforts will result in a long-term increase in the quantity and quality of the region's wetlands.

Implementation

1. The Santa Ana Watershed community should continue to create new partnerships and projects that improve the ecological health of the natural systems of the Watershed. SAWPA and other interested agencies, organizations, and individuals could help facilitate this process.
2. SAWPA should continue to facilitate Watershed discussions to educate and inform Watershed leaders in the community about funding opportunities and partnerships that would be beneficial to initiating and completing projects identified through this Plan and beyond.
3. SAWPA should continue to work with the counties and appropriate cities to expand Watershed cooperation.
4. County and city planners should participate in Watershed project discussions so that the process of implementing the projects identified in this Plan is carried forward.
5. SAWPA should continue to develop and sponsor watershed and subwatershed groups and task forces.
6. Watershed participants should invest resources to ensure that watershed interests such as connectivity, trails, open space, biological diversity, water quality and supply, wetlands, are supported and included in the County of San Bernardino General Plan Update.
7. As projects are proposed through collaborative funding opportunities, watershed partners should utilize the MSHCP in making decisions regarding land acquisition areas within Riverside County.
8. Watershed stakeholders should continue to engage in watershed-wide (interjurisdictional) collaboration regarding connectivity, trails, and other watershed needs so that landscape linkages, public/private partnerships, acquisition, in-holdings, and public coastal access goals are realized in the County of Orange General Plan Update and related planning efforts.

7. Funding

Watershed participants agree that one of the greatest obstacles to implementing good projects in the region is the lack of funding. While

Potential Watershed Project Funding Sources

Funding Program	Research/Education	Recreational Conservation	Water Resources and Water Quality	Wildlife Habitat	Watershed	Wetlands/Riparian Resources	Fisheries	Economic Development/ Redevelopment	Recreation	Pollution Control	Flood Control	Eligible Entities
Bring Back the Natives Grant Program		■				■	■					Local governments, states, and local nonprofit organizations
Brownfields Assessment Demonstration Pilots								■				States (U.S. territories), political subdivisions (including cities, towns, counties), and federally recognized Indian tribes.
Brownfields Cleanup Revolving Loan Fund Pilots								■				Entities must have been awarded a brownfields assessment demonstration pilot, or be a political subdivision with jurisdiction over sites that have either (1) been the subject of a targeted brownfields site assessment or (2) been selected to be the subject of an EPA assessment.
Brownfields Job Training and Development Demonstration Pilots								■				Colleges, universities, nonprofits, training centers, community-based job training organizations, states, cities, towns, counties, U.S. territories and federally recognized Indian tribes.
California Riparian Habitat Conservation Program		■		■		■						Resource Conservation Districts; federal, state, and local governments; nonprofit organizations; other special districts
California Waterfowl Habitat Program		■		■		■						Private landowners.
Capitalization Grants for Clean Water State Revolving Funds			■		■							States and Puerto Rico
Capitalization Grants for Drinking Water State Revolving Fund			■					■		■		States and Puerto Rico
Clean Vessel Act Grant Program			■									All states, as well as Puerto Rico, the Virgin Islands, Guam, the Commonwealth of the Northern Mariana Islands, America Samoa, and Washington, DC
Coastal Non-point Source Program			■					■		■		Municipalities, local agencies, educational institutions, nonprofit organizations
Coastal Program		■		■		■	■					Projects on either public or private land in coastal watersheds
Coastal Resources Grant Program		■				■		■	■			Coastal counties and cities with approved local coastal programs
Coastal Services Center Cooperative Agreements		■										State and local governments, public nonprofit institutions/organizations, other public institutions/organizations
Coastal Wetlands Planning, Protection and Restoration Act Program		■		■		■	■					All states bordering on the Atlantic, Gulf (except Louisiana), and Pacific coasts and the Great Lakes
Coastal Zone Management Administration/ Implementation Awards						■						Coastal states, including Great Lakes states, Puerto Rico, Virgin Islands, Guam, American Samoa, the Trust territories of the Pacific, and the Commonwealth of the Northern Mariana Islands.
Community-Based Restoration Program		■		■		■						State, territorial, local, or tribal governments; regional governmental bodies; public or private agencies or organizations; universities and colleges; private profit and nonprofit organizations
Conservation Reserve Program			■	■	■							Individuals, partnerships, associations, Indian tribal venture corporations, estates, trusts, other business enterprises or legal entities, a state, state political subdivisions, state or local agencies owning or operating land might be eligible to participate
Cooperative Forestry Assistance Programs				■	■							Owners of non-federal lands; rural communities; urban/municipal governments; nonprofit organizations; and state, local, and private agencies acting through State Foresters or equivalent
Environmental Education Grants Program	■											Local, tribal, or state education agencies, colleges and universities, nonprofit organizations, state environmental agencies, and noncommercial education broadcasting agencies
Environmental Quality Incentives Program		■										Non-federal landowners (including American Indian tribes) engaged in livestock operations or agricultural production
Fisheries Development and Utilization Research and Development Grants and Cooperative Agreements Program	■				■		■					Any U.S. citizen or national, corporations, partnerships, associations, Indian tribes, state and local governments, and other non-federal entities.
Fisheries Restoration Grants Program		■		■			■		■			State and local agencies, non-profit organizations, and individuals
Five-Star Restoration Program	■	■		■	■	■						Any public or private entity that engages in community-based restoration
Flood Mitigation Assistance Program		■				■					■	State agencies, participating NFIP communities, or qualified local organizations
Flood Protection Corridor Program		■				■					■	Public agencies, nonprofit organizations, Department of Water Resources
Forestry Incentives Program			■	■	■							Individuals, groups, Indian tribes or other native groups, associations, and corporations whose stocks are not publicly traded
Groundwater Recharge Feasibility Study Grants			■									Public agencies and incorporated mutual water companies
Habitat Conservation Fund	■	■		■		■	■					Local agencies, including counties, cities, or special management districts.
Inland Wetland Conservation Program		■		■		■						Private Landowners

Table 3-6 Potential Watershed Project Funding Sources

Potential Watershed Project Funding Sources

Funding Program	Research/Education	Restoration/Conservation	Water Resources/ Water Quality	Wildlife/ Habitat	Watershed	Wetlands/ Estuaries	Fisheries	Economic Development/ Redevelopment	Recreation	Pollution Control	Flood Control	Eligible Entities
Land and Water Conservation Fund Grants to States									■			States, American Samoa, U.S. Virgin Islands, Puerto Rico, Guam, Northern Mariana Islands and the District of Columbia
National Coastal Wetlands Conservation Grant Program		■		■		■						Designated state, territorial or commonwealth resource agencies of coastal states, including states that border the Atlantic or Pacific Oceans, the Gulf of Mexico, and the Great Lakes.
National Estuary Program			■	■		■						State, interstate, and regional water pollution control agencies and entities; state coastal zone management agencies; interstate agencies; other public/ private nonprofit organizations and institutions; and individuals are eligible.
National Sea Grant College Program	■				■			■				State and local governments, nonprofit and for-profit organizations, academic organizations, federally recognized Indian tribes, and individuals
Nonpoint Source Implementation Grants (319 Programs)	■	■	■		■							Formula grants are awarded to a lead agency in each state and territory.
Non-point Source Programs			■					■		■		Local agencies, nonprofit organizations formed by landowners to prepare and implement local nonpoint source plans
North American Wetlands Conservation Act Grants		■		■		■						Public or private, profit or nonprofit entities or individuals establishing public-private sector partnerships
Partners for Fish and Wildlife Program		■		■	■	■	■					Private landowners
Permanent Wetland Easement Program		■		■		■						Private Landowners
Pesticide Environmental Stewardship Grants										■		Open only to PESP Partners and Supporters
Public Works and Development Facilities Program			■					■				States, political subdivisions of a state, Indian tribes, special-purpose state/local government units, or public or private nonprofit organizations
Riparian/Riverine Habitats Program		■				■			■			Cities, counties, districts, local agencies formed for park purposes, other districts, and federally recognized California Indian tribes
Science to Achieve Results			■									U.S. states, territories, and possessions, including the District of Columbia; public and private universities and colleges, hospitals, laboratories, state and local government departments, other public or private nonprofit institutions, and individuals who have demonstrated unusually high scientific ability.
Southern California Wetlands Recovery Project		■		■		■						Public or private groups
Sustainable Agriculture Research and Education	■											Land-grant colleges or universities, other universities, state agricultural experiment stations, State cooperative extension services, nonprofit organizations, individuals with demonstrable expertise, and federal or state governmental entities
Sustainable Development Challenge Grants								■				Nonprofit organizations and community groups, federally recognized Indian tribes, state and local governments
Urban Stream Restoration Program		■				■					■	Local agencies, nonprofit organizations, local community conservation corps
Water Conservation Feasibility Study Grants												Public agencies and incorporated mutual water companies
Water Quality Cooperative Agreements			■					■		■		State water pollution control agencies, interstate agencies, local public agencies, Indian tribes, nonprofit institutions, organizations, and individuals
Water Quality Planning Grant Program		■	■							■		Local agencies, special districts
Water Quality Special Research Grants Program	■		■		■							State/local governments and academic/nonprofit institutions located in the United States are eligible for EPA, National Science Foundation, and USDA funding. Profit-making firms and federal agencies are eligible for USDA funding.
Water Recycling Program	■		■									Local municipalities
Watershed Assistance Grants	■	■	■							■		Nonprofits, tribes, and local governments.
Watershed Protection and Flood Prevention Program					■							Local or state agency, county, municipality, town or township, soil and water conservation district, flood prevention/flood control district, Indian tribe or tribal organization
Watershed Protection Program			■					■			■	Municipalities, local agencies, nonprofit organizations
Wetlands Program Development Grants	■				■	■						States, Local Governments, Indian Tribes
Wetlands Reserve Program						■						individual, partnership, association, corporation, estate, trust, business, or other legal entity, a state (when applicable), a political subdivision of a state, or any agency thereof owning private land
Wildlife Conservation and Appreciation Program				■			■					State fish and wildlife agencies are eligible for funding. Private organizations and individuals must work with their state agency
Wildlife Habitat Incentives Program				■								Private landowners.

Table 3-6 Potential Watershed Project Funding Sources

significant seed money and partnerships are currently in place for a number of watershed projects such as the Santa Ana River Trail completion, there are many more projects, both large and small, which require funding. This document highlights many of the projects that would result in improvements within the Watershed. It also identifies funding needs for these projects. If funding can be secured for these projects through increased awareness of the needs of this community, then the fundamental goal of this watershed plan will have been accomplished.

In an effort to facilitate greater understanding of potential funding sources available to project proponents, Table 3-6 was compiled. This table was derived from the U.S. Environmental Protection Agency, Catalog of Federal Funding Sources for Watershed Protection, Second Edition, and from the Los Angeles Regional Water Quality Control Boards website, Summary Document on Grant Funding Sources. For expanded information on the programs in Table 3-6, please refer to Appendix J. The table identifies different areas of interest or topics of program funding. These include: Research/ Education; Restoration/Conservation; Water Resource/Water Quality; Wildlife/Habitat; Watershed; Wetlands/Estuaries; Fisheries; Economic Development/ Redevelopment; Recreation; Pollution control; Flood control. The column labeled "Eligible entities" describes the types of organizations or individuals eligible for the program.

8. Monitoring and Assessment

Outcome indicators are a useful way to measure change within an area. In this case, outcome indicators are used as part of the Santa Ana Integrated Watershed Plan, Environmental and Wetlands Component plan to measure changes in the Santa Ana Watershed as a result of the efforts of SAWPA, SAWPA's member agencies, other governmental agencies, and citizens' groups. These changes can be the result of projects identified within the plan and other opportunities implemented throughout the watershed. The first step in categorizing outcome indicators is to distinguish indicators of outcome from those that measure the quantity of work activity done. The number of publicity flyers distributed or the number of water quality readings taken is an indicator of work activity. The knowledge levels of those targeted by the publicity flyers and the nitrogen levels determined from the water quality readings are indicators of outcome. It is extremely important to distinguish between different types of indicators in order to set a realistic, achievable timeframe to reach benchmarks. The U.S. Environmental Protection Agency describes four categories of outcome indicators. These are presented in Table 3-7.

To illustrate, distributing flyers to educate homeowners on fertilizer application is a work activity. The percentage of homeowners that reduced their fertilizer application after flyer distribution is a first order outcome indicator. The second order outcome indicator is the amount of fertilizer running off of private homes (a hard indicator to measure). Improvements in water quality in a neighborhood pond from reduced fertilizer load, such as lowered nitrogen levels, are a third-order outcome. Finally, improvement in the health of fish that are no longer threatened by eutrophication is a fourth-order outcome.

Benchmarks

Quantitative goals should accompany outcome indicators; however, some goals for improvement will take many years to reach, or

Table 3-7. Measurable Goals and Indicators

Outcome Indicator	Measures?	How Measured?	Examples	Comments
First-Order Outcome Indicators	Behavioral changes by households, businesses, and governments	Baseline data is determined by surveys.	Homeowner applying less fertilizer to yard	Measuring these outcomes will be a major way to track progress in implementing the watershed plan.
Second-Order Outcome Indicators	Reductions in pollutant discharges within the watershed	"End of pipe"	Reduction in fertilizer runoff from homes	Second-order indicators are difficult to measure.
Third-Order Outcome Indicators	Changes in water quality	Water quality monitoring	Reduction in nitrates of local pond downstream from home	Pollutant discharge reduction should cause increases in water quality, such as lowered nitrogen levels.
Fourth-Order Outcome Indicators	Changes to living resources	Population monitoring, human health surveys, toxicology studies in fish	Improvements in the health of local pond wildlife; AND extent to which the pond can support human uses such as fishing or swimming	These are long term indicators and may be based on many factors.

may never be reached due to unforeseen impediments. Therefore, it is important to celebrate successes by setting benchmarks, such as the attainment of 50 percent of the goals. Reaching both overall goals and benchmark goals provides opportunities for additional publicity to the Santa Ana Watershed efforts and recognizes the amount of hard work performed.

Santa Ana Watershed Data Management System (SAWDMS)

The Santa Ana Watershed Data Management System (SAWDMS) will be available for stakeholders to use for a variety of purposes. This watershed-wide database management system would include standardization of data from numerous stakeholders in the watershed, would enable Internet access to the data by appropriate entities, and would be used as a tool to improve water quality in the watershed.

The data collected would integrate surface and groundwater data to assist numerous water quality and water management programs.

Arundo Removal

With respect to the above classification of measurable goals, it is not feasible at this time to develop a monitoring matrix for all elements of the Santa Ana Integrated Watershed Plan, Environmental and Wetlands Component. However, the classification of measurable goals for the removal of *Arundo donax* would be as shown in Table 3-8.

Examples of Measurable Goals and Indicators

The following are examples of further types of measurable goals and indicators that would be identified after completion Environmental and Wetlands Component of the Santa Ana Integrated Watershed Plan:

1. Protect and Restore Habitat Resources

Remove Invasive Exotic Species

- Acres of land from which exotics have been removed

Table 3-8. Examples of Outcome Indicators for *Arundo* Removal	
Outcome Indicator	***Example***
First-Order Outcome Indicators	Number of acres of *Arundo* cut
Second-Order Outcome Indicators	Rduction in amount of water consumed by *Arundo*
Third-Order Outcome Indicators	Improvements in water quality and increases in water quantity
Fourth-Order Outcome Indicators	Recovery of least Bell's vireo population, as measured by number of breeding pairs

- Percentage of this land that has remained invasive-free after 5 years, 10 years, etc.
- Amount of new riparian habitat created

2. Improve Water Quality and Avoid Future Reductions to Ecosystem Function

Improve Water Quality

- Number of impaired water bodies within watershed (waterbodies removed from the State Water Resources Control Board's 303(d) List of Impaired Waterbodies)
- Use of water quality indicators such as dissolved oxygen, salinity, turbidity, and temperature.
- Percentage of groundwater basins that meets drinking water standards

Increase water conservation/Decrease imported water use/Reduce salinity

- Watershed wide use of recycled water (measured by millions of gallons per day)
- Per capita daily water use (measured by gallons per day)
- Amount of water imported to the Watershed (measured by acre-feet per year)
- Use of local water sources and storage of local water (measured by acre-feet per year)
- Water "banked" in groundwater basins (measured by acre-feet per year)
- Reduction and elimination of sources of salt in the Watershed

3. Engage the Community through Education and Recreational Opportunities

Improve Outdoor Recreational Opportunities

- Miles of biking and hiking trails within the Watershed
- Number of mega-connected trails (e.g. over 5 miles long)
- Number of publicly provided camping sites
- Number of equestrian staging areas

Increase Open Space

- Acres of land under protection on various levels within the watershed (e.g., private, city, county, state, and conservation easements)
- Acres of land covered in permeable vs. nonpermeable surfaces
- Public space acreage per 1,000 people (from SCAG data)
- Acreage of open space that provide multi-purpose benefits

Promote Watershed Education / Community Outreach

- Percentage of watershed residents that can accurately answer the questions, "What is a watershed?" and "What watershed do you live in?"
- Incorporation of water conservation curriculum into Orange County, Riverside County, and San Bernardino County Schools

- Participation of watershed residents in annual Coastal Clean-up (sponsored by the Center for Marine Conservation)

4. Plan for the Future

Identify Future Sources of Funding

- Number of grant applications made for watershed projects from

  a. Local funding sources

  b. State funding sources

  c. Federal funding sources

- Number of grants won for watershed projects from

  a. Local funding sources

  b. State funding sources

  c. Federal funding sources

- Operational and maintenance funding budgeted (measured per millions of dollars invested)

- Number of broad programmatic funding sources identified

Santa Ana River Watershed Citizens Monitoring Project

The Santa Ana River Watershed Citizens Monitoring Program is funded through the U.S.EPA and the SWRCB, and administered through the Santa Ana RWQCB. The program is run by the Orange County Coastkeeper, with assistance from the Riverside Corona RCD and the East Valley RCD. Watershed citizens engage in monitoring activities to identify sources of nonpoint source contaminants. Public outreach and education is an integral part of the project, which trains volunteers to collect water quality data that is later reported to the RWQCB.

B. Opportunities

Watershed Projects

The following projects, shown in Table 3-9, have been proposed by watershed stakeholders including cities, counties, agencies, organizations, and individuals. These are projects that may be in need of partnering or funding. While some projects are further along than others, all of these projects would enhance the ecological function of systems within the Watershed. Types of projects include wetlands, education, trails, habitat, and invasive species removal. Many of these are multi-objective conservation projects serving two or more ecological purposes. Refer to Figure 3-5, for a map of potential wetland projects and Figure 3-6 for a map of other projects and opportunities within the Watershed. In Figure 3-6, the map legend identifies project categories. In addition, Appendix A, Scoping Meeting Notes and Appendix B, Watershed Project Database and Summary include more detail on projects if this information was available at the release of the Plan.

> "Self-maintaining systems have certain attributes of a size, amount and shape to respond to forces of change, and to persist. At least four critical functions must be maintained and be able to support wildlife despite disturbance if the ecosystem is to be self-supporting. The health of a stream and its ability to withstand disturbance can be assessed by (1) habitat amount, (2) conduit of necessary elements, (3) connectivity between patches of habitat, and (4) transition between edges of habitats."
>
> *—Jim Steele, EIP Associates*

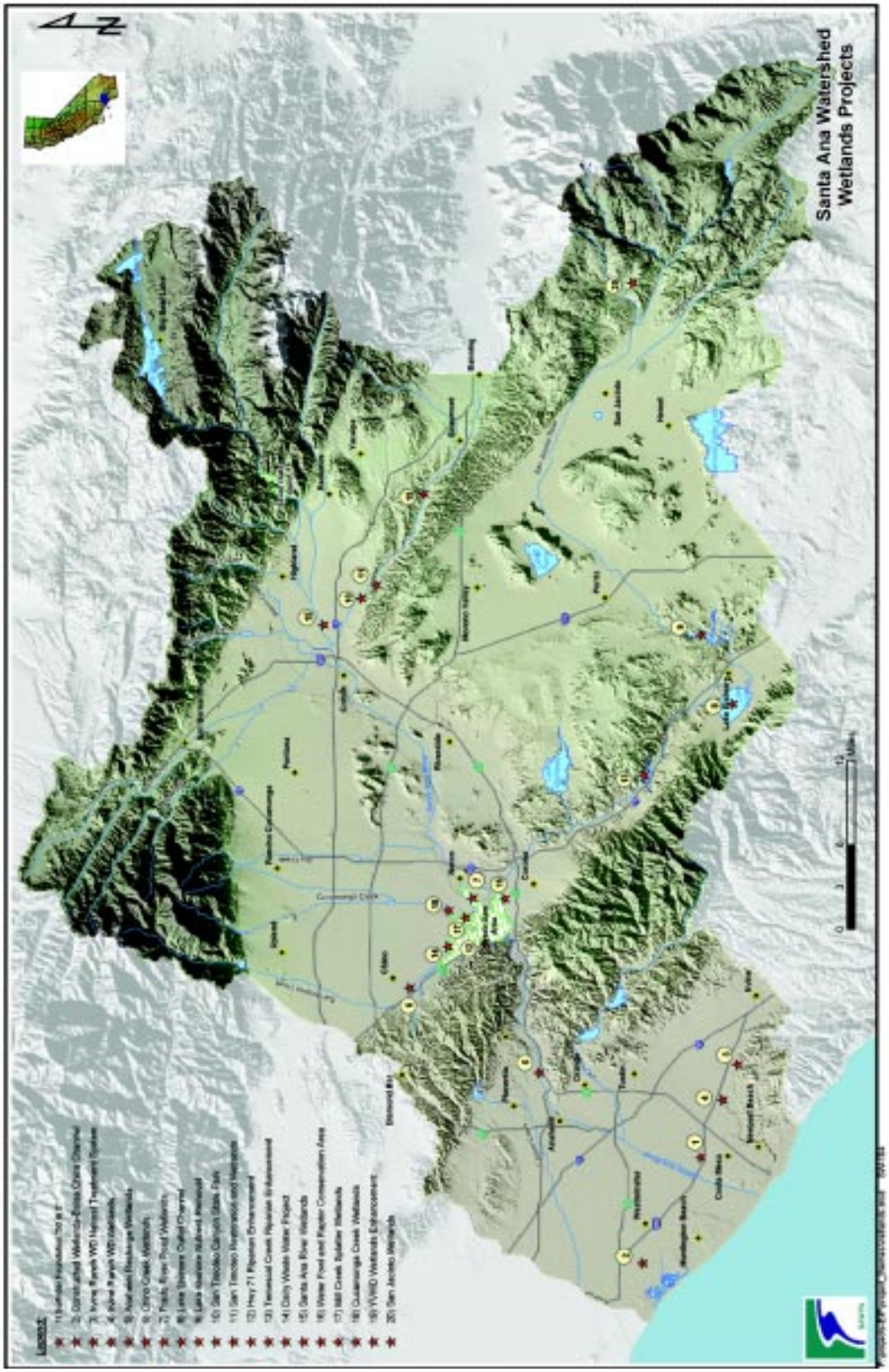


Figure 3-5 Potential Wetland Projects within the Watershed

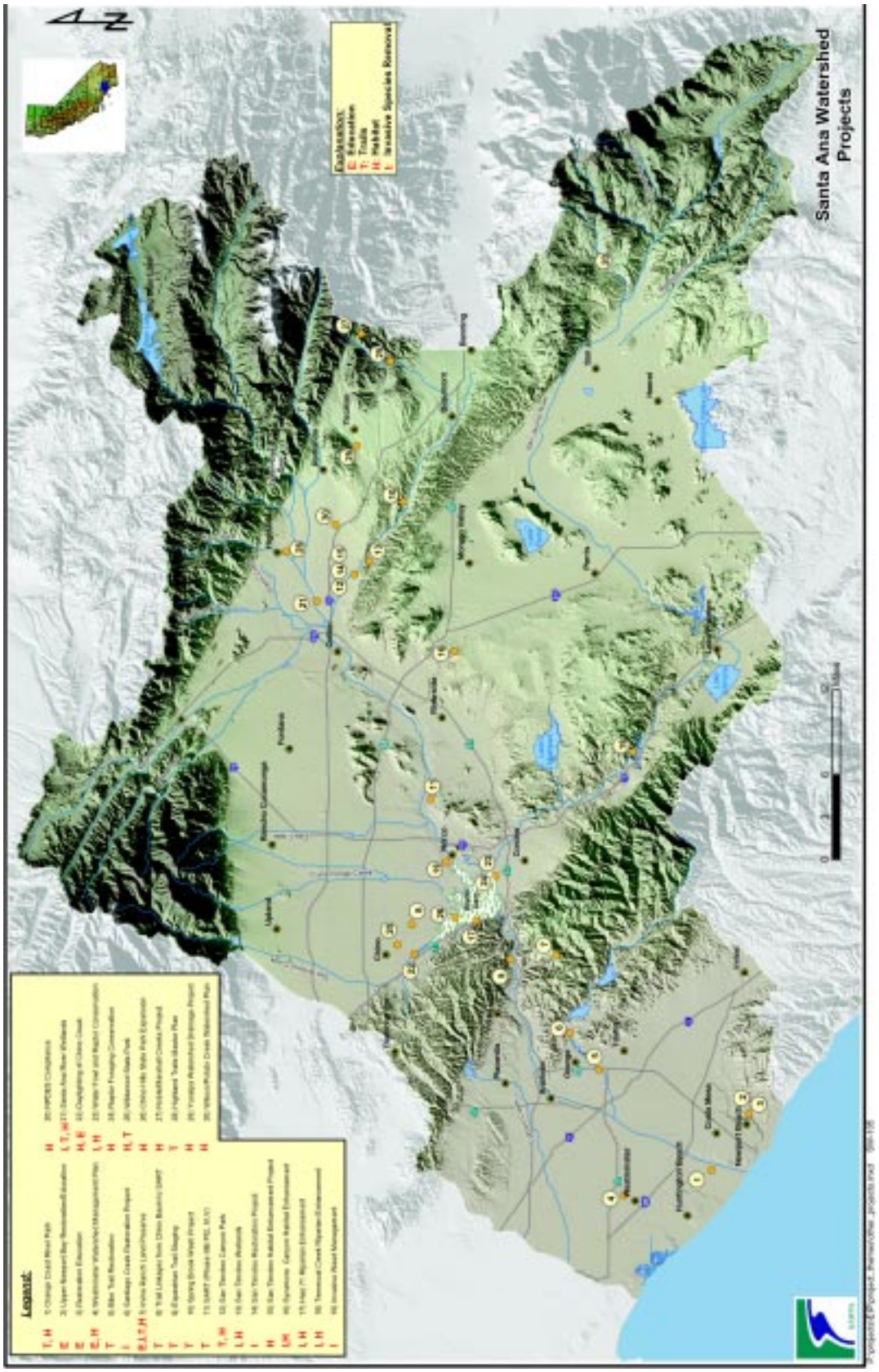


Figure 3-6 Other Projects and Opportunities within the Watershed

Table 3-9 Watershed Projects and Opportunities

Project Name	Agency/ Organization	Contact	Project Cost (in millions of dollars)	Project Description	Ecological purposes met: enhance/ restore ecological functions	improve habitat	water conservation drought protection	flood control	recreation	education	improve water quality	provide other benefits	Other funding sources	Project partners	Project status
SANTA ANA RIVER MOUTH/COASTAL ORANGE COUNTY PROJECTS															
Orange Coast River Park	Friends of Harbors, Beaches and Parks	Louise Greeley	none provided	1000-1400 acre park at the lower end of the Santa Ana River. Will provide trails, shared support facilities, and a wildlife habitat and park management program.	■	■			■			■	none provided	none provided	concept
Surfrider Foundation "50 in 5" Water Quality Improvement Project	Surfrider Foundation	Nancy Gardner	2.47	Diversion of water from Santa Ana River (Greenville-Banning Channel) into a series of bioremediation ponds which will cleanse the water of pollutants before it is released back into the river. Victoria Pond, which provides bird habitat, will be enlarged.	■	■	■				■		City of Costa Mesa, City of Newport Beach	none provided	concept
Constructed Wetlands- Bolsa Chica Channel	County of Orange-Public Facilities and Resources Department	Mary Anne Skorpanich	1.63	Urban runoff from the Bolsa Chica Channel would be routed through a wetlands system to be constructed on adjacent property at the Seal Beach Naval Weapons Station. The project will consist of a detention system to hold and pretreat flows and a vegetated area that will serve to polish water quality through plant uptake and ultraviolet exposure. A debris boom installed immediately upstream of the project would provide trash removal benefits.	■	■	■				■		Additional Prop 13 and CWA 319(h) grant programs	City of Huntington Beach, City of Seal Beach, US Navy, Orange County Coastkeeper	feasibility study
Upper Newport Bay Restoration Education	California Coastal Commission	Kristina Finstad	none provided	Involve local schools, community groups, and agencies in restoration and monitoring to enhance wetland, upland, and riparian habitat to benefit the UNB ecosystem. This project would build a boardwalk to limit uncontrolled access to sensitive habitat (currently used heavily by walkers, joggers, bikers, and horseback riders)	■	■				■		■	none provided	none provided	ready to begin implementation
Restoration Education	California Coastal Commission	Kristina Finstad	0.382	Compilation of K-12 curriculum specific to Upper Newport Bay with hands-on restoration activities. The community-based restoration program (ROOTS) will serve the vital purpose of restoring critical species' habitat through the work of community volunteers.		■				■			Cal Learn and Serve, Project Learning Tree	CDFG, Orange Co. Harbors, Beaches, and Parks, Newport Bay Naturalist and Friends	ready to begin implementation
Westminster Watershed Management Plan	County of Orange-Public Facilities and Resources Department	Mary Anne Skorpanich	2.00	Develop an integrated, highly collaborative Watershed Management Plan to maintain, restore, and enhance a healthy Westminster Watershed. Watershed stakeholders will examine existing conditions, identify opportunities and constraints, evaluate alternative projects and management measures, and recommend solutions. The plan would benefit the TMDL process as well as resulting in reduced flooding, protection for sensitive species, enhanced terrestrial and aquatic habitat, and improved quality of life through education, restoration, and aesthetics.						■		■	none provided	none provided	concept

Table 3-9 Watershed Projects and Opportunities

Project Name	Agency/ Organization	Contact	Project Cost (in millions of dollars)	Project Description	Ecological purposes met: enhance/ restore ecological function	improve habitat	water conservation drought protection	flood control	recreation	education	improve water quality	provide other benefits	Other funding sources	Project partners	Project status
OTHER ORANGE COUNTY PROJECTS															
Irvine Ranch Water District Natural Treatment System	Irvine Ranch Water District	John Hills	30.00	Alternative for handling dry weather runoff intended to provide new community resources, riparian habitats and water quality benefits throughout the watershed. Low-flow natural and urban runoff, as well as smaller storm flows, will be diverted into man-made wetlands throughout the San Diego Creek Watershed where contaminants will be removed and prevented from reaching the Upper Newport Bay.	■	■	■				■		Prop 13 state funds and Section 319 state funds, and other public funding sources	County of Orange, Caltrans, City of Irvine	CEQA complete-project ready to implement
Natural Treatment System- East Garden Grove Wintersberg Channel	City of Huntington Beach	Geraldine Lucas	3.47	Diversion of up to 4 MGD of urban runoff into a 20-acre constructed vegetative filter area to remove contaminants. Following treatment, the water would be used to rehabilitate Talbert Lake and to recharge the groundwater aquifer in the vicinity of Huntington Beach Central Park. Also includes habitat restoration and public education and outreach.	■	■					■		Prop 13 and Wetland Recovery Program	OC-PFRD, Orange County Coastkeeper, City of Seal Beach, and Bolsa Chica Conservancy	in process
Anaheim Recharge Wetlands	none provided	none provided	1.50	This project would install landscaping and other miscellaneous improvements around existing recharge basins. The Feasibility Report is currently being prepared.		■					■		none provided	none provided	CEQA in prep
Bike Trail and Restoration	City of Orange	Pamela Galera	none provided	Restoration of concrete-lined right of way and potential bike path implementation on sections of Santiago Creek in the City of Orange.	■	■		■	■		■		none provided	none provided	ready to begin implementation
Lower Santiago Creek Restoration Project	Santa Ana Parks, Recreation, and Community Services Agency	Patrick Mitchell	2.00	Community-based restoration: debris removal (e.g., concrete, asphalt, cars), invasive species removal and control, and revegetation with native species for habitat value and bank stabilization.		■				■	■		none provided	none provided	ongoing
Santiago Creek Restoration Project	East Valley Resource Conservation District	David Hansbergen/ Jennifer Ares	0.50	Removal of non-native species from tributary to Santa Ana River. Revegetation of sensitive areas along Santiago Creek to prevent erosion following removal of non-native species.	■	■	■					■	Santa Ana Watershed Association of RCD's	NRCS, OCWD, SAWA (Shelli Lamb)	ongoing
Orange County Public Facilities and Resources Department 1,200-Acre Arundo Removal	Orange County PFRD	none provided	none provided	This project would remove Arundo form the Santa Ana River bottom and restore riparian habitat. The project is located in the Santa Ana River canyon in the Yorba Linda area. The limits are from Weir Canyon Road to the Orange County line.	■	■	■	■		■	■	■	none provided	Orange County Water District	planning

Table 3-9 Watershed Projects and Opportunities

Project Name	Agency/ Organization	Contact	Project Cost (in millions of dollars)	Project Description	Ecological purposes met: enhance/ restore ecological functions	improve habitat	water conservation drought protection	flood control	recreation	education	improved water quality	provide other benefit	Other funding sources	Project partners	Project status
Orange County Conservation Corps Arundo Removal at Featherly Park	Orange County Conservation Corps	Rick Stroup	none provided	This project is designed to remove Arundo from a park adjacent to the Santa Ana River and restore riparian habitat. The project is located at Featherly Park in Orange County.	■	■	■	■	■	■	■	■	none provided	Orange County Water District	ongoing
Irvine Ranch Land Reserve	Irvine Company	Steve Letterly	not applicable	Land reserve totaling 50,000 acres, including public access and trails. $30 million commitment from Irvine Company for reserve management, to be carried out by The Nature Conservancy.		■			■			■	Private funding	TNC, Nature Reserve of Orange County, and others	ongoing
Watershed and Nature Education Center-Santiago Creek	County of Orange-Public Facilities and Resources Department	Chip Monaco	0.55	Expand Santiago Oaks Regional Park's educational facilities to include a watershed and nature education center with high-tech innovative exhibits. The Watershed and Nature Education Center will attempt to achieve three goals: Create an opportunity to change behavior with respect to behaviors affecting water conservation and water quality, provide interactive learning opportunities, expand current educational opportunities to teachers, students, and other groups countywide.		■	■		■	■	■	■	none provided	OCWD/Blue Planet Foundation, OCSD, MWD of Orange County, Serrano Water District, Centex Homes/SWRCB-B)	concept
Remote Telemetry Irrigation Control (RTIC) Water Conservation System	County of Orange-Public Facilities and Resources Department	Sonia Nasser	0.62	Water conservation through installation of evapotranspiration (ET) controllers to reduce over-irrigation. ET controllers adjust water applied to irrigation systems based on temperature, precipitation, wind speed, relative humidity, and solar radiation.			■				■	■	none provided	none provided	Concept
Orange County Water Use Efficiency Best Management Practice	Municipal Water District of Orange County	Joseph M. Berg	35.00	Evaluation of water use, installation of 250,000 ultra low flush toilets and 30,000 irrigation controllers.			■				■	■	OCSD, CALFED grants and loans, USBR grants, retail water agency contributions	MWD of So. Cal., OCSD, OCWD	In process
CHINO/PRADO BASIN PROJECTS															
Chino Creek Wetlands	Orange County Water District	John C. Kennedy	1.50	100 acres of constructed wetlands along Chino Creek just above Prado Dam. The wetlands would ensure that drinking water supplies in the Orange County Basin do not exceed the maximum contaminant load of 10 mg/L for TIN and nitrates.	■		■				■		None	US Army Corps of Engineers	CEQA Complete

Table 3-9 Watershed Projects and Opportunities

Project Name	Agency/ Organization	Contact	Project Cost (in millions of dollars)	Project Description	Ecological purposes met: enhance/ restore ecological function	Ecological purposes met: improve habitat	Ecological purposes met: water conservation drought protection	Ecological purposes met: flood control	Ecological purposes met: recreation	Ecological purposes met: education	Ecological purposes met: improve water quality	Ecological purposes met: provide other benefits	Other funding sources	Project partners	Project status
Prado River Road Wetlands Expansion	Orange County Water District	John C. Kennedy	3.50	200 acres of constructed wetlands above the River Road Bridge to treat mainstem Santa Ana River flows. The wetlands would ensure that drinking water supplies in the Orange County Basin do not exceed the maximum contaminant load of 10 mg/L for TIN and nitrates.	■		■				■		None	None	CEQA Complete
Trail Linkages (extensions) from Chino Basin to Santa Ana River Trail	So. Cal. Agricultural Lands Foundation	Chuck Hale	TBD	Critical mass of open space is currently isolated from the mountains to ocean trail master plan. Acquisition and dedication of linkage land is essential for future urban populations.					■			■	none provided	none provided	concept
Equestrian-friendly trail staging and amenities	Equestrian Coalition of Orange County	Christene McGovern	TBD	Return of Featherly Park to multi-use park including equestrian-friendly trail staging and overnight use. Project also includes construction of equestrian stable at Prado Dam.					■				none provided	none provided	concept
Conservation and Education Programs	Inland Empire Utilities Agency	N/A	N/A	Provide conservation and education programs, including low-flow toilet distribution, high-efficiency clothes washer rebates, Water Education Water Awareness Committee, and Think Earth environmental education programs.						■			none provided	IEUA member agencies	ongoing
Wetlands Restoration	Inland Empire Utilities Agency	N/A	N/A	Collaborative effort with the City of Chino, OCWD, OCFC, ACOE, and other watershed partners to restore ecological function and wetlands tributary to the Prado Basin	■	■					■	■	none provided	IEUA member agencies	ongoing
Organics Management Program	Inland Empire Utilities Agency	N/A	N/A	Clean-up, treatment, and reuse of locally generated organics material (dairy manure, biosolids, and green material) through development of anaerobic digesters, enclosed composting facilities, advanced sewering of dairies, and stormwater systems, including restoration of natural treatment systems.							■	■	none provided	Milk Producers Council, California Energy Commission, USDA Natural Resources Conservation Service, Synagro	ongoing
Regional Plant #5 and #2 Coordinated Habitat and Stormwater Management Plan	Inland Empire Utilities Agency	N/A	N/A	Site plan for IEUA properties within Prado Basin to demonstrate best management practices for stormwater management, organics processing, habitat conservation, and water conservation.	■	■	■			■	■	■	none provided	none provided	none provided

Table 3-9 Watershed Projects and Opportunities

Project Name	Agency/ Organization	Contact	Project Cost (in millions of dollars)	Project Description	Ecological purposes met: enhance/ restore ecological function	improve habitat	water conservation/ drought protection	flood control	recreation	education	improve water quality	provide other benefits	Other funding sources	Project partners	Project status
RIVERSIDE COUNTY PROJECTS															
River Road Wetlands	none provided	none provided	6.00	This project would construct 300 acres of wetlands to provide natural treatment for Santa Ana River flows prior to using the water in Orange County. The Feasibility Report is complete and the CEQA documents to be prepared in 2002.									none provided	none provided	CEQA Complete
Highway 71 Riparian Enhancement	Riverside-Corona RCD	Shelli Lamb or Kerwin Russell	2.63	Increases open space and improves wetland and upland habitat in the Prado Basin on 100 acres of currently impacted habitat. The project includes removal of 100 acres of eucalyptus, planting of native riparian and upland plants, creation of open space and irrigation of installed plant material and monitoring of listed species.	■	■							none at this time	OCWD, US ACE, US FWS	planning
Dairy Waste Water Project	Inland Empire West RCD	Paul Hogan	TBD	Assist local dairies in the development of plans and specifications for the construction of waste water containment and settling ponds. Provide funding for construction.							■	■	none provided	none provided	planning
NPDES Compliance	Inland Empire West RCD	Paul Hogan	TBD	Technical and financial assistance to cities working toward compliance with NPDES goals. This project will become crucial to cities' ability to access needed funds to upgrade or retrofit catch basins and perform other related work.							■		none provided	none provided	concept
Mockingbird Canyon Floodplain Acquisition	Western Municipal Water District		none provided	This project would prevent (via purchase) encroachment of development into a riparian area upstream of the city of Riverside. The area could conceivably be used as a source of environmental mitigation banking, as well as being a site for potential stream restoration and wildlife corridor enhancement.	■	■						■	none provided	none provided	planning
Temescal Creek Riparian Enhancement	Riverside-Corona RCD	Shelli Lamb or Kerwin Russell	1.25	Targets 50 acres of riparian habitat restoration and small ponds for nutrient polishing, fresh water marsh and effluent water use for wetland creation, with installation of native plants and wetland vegetation.	■	■	■				■		none at this time	3M Corporation, CDFG, City of Corona	ongoing/ planning
Lake Elsinore Nutrient Removal (Wetlands)	Lake Elsinore/San Jacinto Watersheds Authority (LESJWA)	Mark Norton	12.00	Project includes purchasing land, constructing a back basin wetlands, and implementing other nutrient control measures for Lake Elsinore in order to provide a natural method to reduce the lake's high nutrient level and provide an improved wildlife habitat. The existing 356-acre wetlands in the back basin could be reconfigured to provide advanced treatment to recycled water added to the lake and circulated lake water.		■			■		■		none provided	none provided	planning

Table 3-9 Watershed Projects and Opportunities

Project Name	Agency/ Organization	Contact	Project Cost (in millions of dollars)	Project Description	Ecological purposes met: enhance/ restore ecological functions	improve habitat	water conservation drought protection	flood control	recreation	education	improve water quality	provide other benefits	Other funding sources	Project partners	Project status
Nutrient Removal Elsinore Valley Municipal Water District Regional Reclamation Treatment Facilities	Lake Elsinore/San Jacinto Watersheds Authority (LESJWA)	Mark Norton	6.6	This project would increase nitrogen and phosphorous removal capacities at EMWD's Water Reclamation Plants to obtain water quality objectives and nutrient levels sufficient to discharge into Lake Elsinore to improve water quality and stabilize lake levels.		■			■		■		none provided	Eastern Municipal Water District	planning
Nutrient Removal Eastern Municipal Water District Water Reclamation Plants	Lake Elsinore/San Jacinto Watersheds Authority (LESJWA)	Mark Norton	10	This project would increase nitrogen and phosphorous removal capacities at EMWD's Water Reclamation Plants to obtain water quality objectives and nutrient levels sufficient to discharge into Lake Elsinore to improve water quality and stabilize lake levels.		■			■		■		none provided	Eastern Municipal Water District	planning
Non-native plant material removal	Lake Elsinore/San Jacinto Watersheds Authority (LESJWA)	Mark Norton	2.4	This LESJWA project would remove non-native plant materials in the back basin of Lake Elsinore that are taking over the natural habitat. This project would enhance and protect the wildlife habitat.	■	■	■	■		■	■	■	none provided	Western Municipal Water District	none provided
Installation of Aeration System/ Hypolimnetic Oxygenation System	City of Canyon Lake, County of Riverside	Dell Powers	0.50	Structural water quality improvement: Installation of an oxygenation system to improve drinking water of Canyon Lake and water quality for recreational uses.					■		■		LESJWA, City of Canyon Lake, EVMWD	Elsinore Valley Municipal Water District	planning
Riverside County Arundo Removal	Western Municipal Water District	none provided	none provided	This program would remove a large part of the Arundo in the middle portion of the riverbanks that are held or controlled by WMWD. This program has been operating using mitigation funds and is in need of expansion to meet further removal goals.	■	■	■	■		■	■	■	none provided	none provided	ongoing
Santa Ana River Bikeway/Trail- Phase IIIB-Part 2, Phase IV, Phase V (Riverside Co.)	County of Riverside (1) Reg. Park & Open Space District (2) Transportation Department	(1) Mark Brewer (2) Sena B. Wijesinha	1.50	Implementation of approved alignment for the Santa Ana River Trail in Riverside County. Phase IIIB-2 involves installation of a bridge across Hole Lake to complete a missing link to the Santa Ana River Trail. Phase IV extends the Trail for an additional 2 miles westerly from Tyler Street.					■			■	none provided	none provided	CEQA complete

Table 3-9 Watershed Projects and Opportunities

Project Name	Agency/ Organization	Contact	Project Cost (in millions of dollars)	Project Description	Ecological purposes met: enhance/ restore ecological functions	enhance habitat	water conservation and protection	flood control	recreation	education	improve water quality	provide other benefits	Other funding sources	Project partners	Project status
Sycamore Canyon Habitat Enhancement	Riverside-Corona RCD	Shelli Lamb or Kerwin Russell	0.3	Project encompasses 22 acres of riparian habitat in 1,500-acre Sycamore Canyon Wilderness Area. Approximately 5 acres of riparian habitat will be restored in conjunction with completed arundo removal and supplemental water during the dry season for 5 years.	■	■	■						currently none	City of Riverside Parks Department, WMWD, CDFG	planning
Vail Canyon Non-native Vegetation Removal Project	Rancho California Water District	Andrew Webster	0.30	Three year program consisting of non-native invasive vegetation removal and trash removal within Vail Canyon. Project will remove potential for groundwater contamination caused by abandoned cars and appliances and invasive species removal will increase the availability of local water.	■	■	■				■		RCWD General Fund	none provided	none provided
Santa Ana River Restoration Project	Riverside County Regional Park and Open Space District	Ron Baxter	40.00	Arundo removal and restoration of river bottom by native species (willow, cottonwood, sycamore, mulefat, etc.). Project will improve ecological function by restoring native wildlife habitat and increasing available water.	■	■	■				■	■	none provided	none provided	ongoing
Spring Brook Wash Project	Endangered Habitats League	Jane Block	0.03	Assess conservation needs of multi-use corridor extending from the closed county landfill at Pigeon Pass to Fairmont Park, and determine the most biologically feasible connection for wildlife and trail users from the Box Springs Mountains to the Santa Ana River and the Coast-to-Mountains trail system.	■	■			■		■	■	Private residential developer	To be submitted	planning
San Timoteo Canyon State Park	Riverside Land Conservancy	Pete Dangermond	40.00	Creation of a new State park centered around San Timoteo Creek Watershed that will increase water quality in San Timoteo Canyon and subsequently the Bunker Hill Basins. The park will provide a number of linkages with other habitat areas in the county, as well as reestablishing , creating, restoring, and protecting wetlands in the floodplains of the canyon and its major tributaries from Loma Linda to I-10.	■	■					■	■	US EPA, WCB, Cal. State Parks, US ACE, County Habitat Funds	State Parks, Wildlife Conservation Board, City of Loma Linda	planning
San Timoteo Creek Watershed Restoration and Wetlands Creation Project	Riverside Land Conservancy	Anne Mohnike and Peter Dangermond	11.00	Invasive species removal, land acquisition, restoration	■	■	■						Federal Grant and Prop 12	EPA, City of Redlands	ongoing
San Timoteo Restoration Project	East Valley Resource Conservation District	David Hansberger/Jennifer Ares	0.50	Removal of invasive weeds beyond Arundo donax, including castor bean, perennial pepperweed, German ivy, and tree of heaven.	■	■	■					■	Santa Ana Watershed Association of RCD's	NRCS, OCWD, SAWA (Shelli Lamb)	ongoing

Table 3-9 Watershed Projects and Opportunities

Project Name	Agency/ Organization	Contact	Project Cost (in millions of dollars)	Project Description	Ecological purposes met: habitat creation/ restoration	Ecological purposes met: erosion control	Ecological purposes met: water conservation	Ecological purposes met: groundwater recharge	Ecological purposes met: flood control	Ecological purposes met: recreation	Ecological purposes met: education	Ecological purposes met: improve water quality	Ecological purposes met: improve air quality	Other funding sources	Project partners	Project status
San Timoteo Habitat Enhancement Project	East Valley Resource Conservation District	David Haneberger/ Jennifer Ares	0.05	Restoration of tributary to natural state by removing trash debris within the creek bed. The project will involve coordination with appropriate agencies to conduct a series of clean-up dates. For public outreach, local volunteer agencies and residents will be encouraged to participate in clean-up dates.	■	■	■			■			■	Santa Ana Watershed Association of RCD's	NRCS, OCWD, SAWA (Shelli Lamb)	ongoing
Hemet San Jacinto Wildlife Area Environmental Enhancement and Recycled Water Storage Initiative	Eastern Municipal Water District	Mike Garner	N/A	Environmental enhancement, use of recycled water for restoration of historic wetlands, recycled water conservation, groundwater management, agricultural water supply, and maintenance of compatible uses around the SJWA.	■	■	■					■	■	CDFG	CDFG	ongoing
San Jacinto Flow through Wetlands	LESJWA	Mark Norton	3.00	This LESJWA project would create a flow-through wetlands that would provide both habitat enhancement and nutrient removal to the San Jacinto River from Canyon Lake to Lakeshore Drive. The project would provide recreational opportunities through the creation of trails for biking, walking, or viewing habitat.		■				■		■		none provided	none provided	planning
San Jacinto River Stage 4 Project	Riverside County Flood Control and Water Conservation District	Zully Smith	none provided	Project is designed to increase the width of the San Jacinto River downstream of the existing Corps levees from about 500 feet to 1200 feet, creating additional habitat value, flood control, and water quality improvement.	■	■		■					■	none provided	none provided	planning
Invasive Weed Management Program	Inland Empire West RCD	Paul Hogan	TBD	Removal of invasive weeds, including but not limited to: Arundo donax, tamarisk sp., castor bean, and others.	■	■	■							Prop 13 and Prop 14 grants	RC RCD, EVRCD, OCWD	ongoing
Sustainable Agricultural Demonstration Project	So. Cal. Agricultural Lands Foundation	Chuck Hale	TBD	Possible joint venture within IEUA Master Plan area. Environmentally sensitive agricultural heritage education demonstration.			■			■		■	■	none provided	none provided	concept
20-Year Land Use Open Space Plan	So. Cal. Agricultural Lands Foundation	Chuck Hale	TBD	Development of a strategic land plan for 20 years into the future: acquisitions, exchanges, consolidations, trail extensions. Agricultural sustainable use including practices that are environmentally sensitive to watershed.								■	■	none provided	none provided	concept

Table 3-9 Watershed Projects and Opportunities

Project Name	Agency/ Organization	Contact	Project Cost (in millions of dollars)	Project Description	Ecological purposes met: enhance/ restore ecological functions	improve habitat	water conservation drought preparedness	flood control	recreation	education	improve water quality	improve other aquatic resources	Other funding sources	Project partners	Project status
Landscape/ Agriculture Waste Management Evaluations	Riverside Corona RCD/ WMWD	Shelli Lamb or Kerwin Russell	0.22	Maximum of 15 water management evaluations on large water use sites. Evaluations would recommend design, management, and cultural practices to improve water conservation.			■						none provided	Bureau of Reclamation, Department of Water Resources, Orange County Water District	concept
SAN BERNARDINO COUNTY PROJECTS															
Chino Creek Park	Inland Empire Utilities Agency	Richard Atwater or Eliza Jane Whitman	TBD	Elimination of box culvert and restoration of natural stream and flood plain. Also devotes upland areas to an educational park.	■	■				■	■		none provided	none provided	concept
Chino Hills State Park Expansion	California State Parks	Geary Hund	none provided	Expansion of existing state park to provide habitat linkages to the Santa Ana River and Prado Basin. Landform restoration (road closing and recontouring, revegetation), construction of bridges over Aliso Creek.	■	■			■				none provided	none provided	planning
Wetlands and Habitat Conservation Area	City of Ontario	Jerry Blum	24.20	Wetlands construction and habitat acquisition. Plans include conjunctive uses such as a perimeter nature trail and walkway, interpretive learning center, observation areas for bird watching, and wetland nesting areas. Includes 85 acres of restoration and 145 acres of land acquisition.	■	■	■	■	■	■	■		City of Ontario, US Army Corps of Engineers	US ACE, USFWS, CDFG, San Bernardino Transportation and Flood Control District	CEQA complete
Raptor foraging conservation area	City of Chino	Bob Prasse	N/A	Mitigation for Chino Sphere of Influence annexation (5,400 acre conversion from agricultural land to urban land). Will provide 300 acre foraging area for raptors. The city is looking to pair this project with other conservation efforts.	■	■					■	■	none provided	none provided	planning
Cucamonga Creek Wetlands	Inland Empire Utilities Agency	Eliza Jane Whitman	5.00	This project would construct wetlands to provide natural treatment for Cucamonga Creek, located in IEUA.	■	■							none provided	none provided	planning
Santa Ana River Wetlands (Mission Zanja Creek Channel)	S.B. Co. Dept. of Public Works, Regional Trails Division	Jeff Weinstein	0.8	Creation of a wetlands on the Santa Ana River at the confluence of the Mission Zanja Creek Channel in the City of San Bernardino. The project will entail the removal of non-native vegetation and the planting of native species. Interpretive signage, boardwalk, and bike path will provide access and educational opportunities for trail users.	■	■				■	■	■	Wildlands Conservancy, State Parks, Prop 40	Wildlands Conservancy, San Bernardino County Flood Control District	planning

Table 3-9 Watershed Projects and Opportunities

Project Name	Agency/ Organization	Contact	Project Cost (in millions of dollars)	Project Description	Ecological purposes met: enhancing/ restoring ecological functions	improve habitat	water conservation drought protection	flood control	recreation	education	improve water quality	provide other benefits	Other funding sources	Project partners	Project status
Mill Creek Splatter S Wetlands	Orange County Water District	John C. Kennedy	0.50	Diversion of Mill Creek flows through the US Army Corps of Engineers Splatter S Wetlands System. The wetlands would naturally remove nitrates from surface water supplies traveling into the Prado Dam basin and would ensure that drinking water supplies in the Orange County Basin do not exceed the MCL of 10 mg/L for TIN and nitrates.			■				■		none provided	US Army Corps of Engineers	CEQA complete
City of Highland Trails Master Plan Implementation	City of Highland	Bruce Meikle	none provided	Major goal: ensure trail connections with the Santa Ana River Trail. Proposed trails follow existing dirt/maintenance roads owned or controlled by public agencies or utilities.					■			■	none provided	none provided	planning
San Timoteo Wetlands	none provided	none provided	6.00	This project is designed to increase water quality and quantity in San Timoteo Canyon, and subsequently the Bunker Hill Basins, through the re-establishment, creation, restoration and protection of wetlands in the floodplains of the canyon and its major tributaries from Loma Linda to Interstate 10.	■	■					■		none provided	none provided	none provided
Yucaipa Valley Water District Wetlands Enhancement	Yucaipa Valley Water District	Joe Zoba	5.00	This project would construct a 30 acre wetlands facility to polish recycled water prior to discharge to San Timoteo Creek. The project includes pipelines, hydraulic control structures, control systems, and a new 30 acre wetlands. Discharge from the new wetlands would support the existing riparian habitat downstream o the existing YVWD point of discharge to San Timoteo Creek.					■	■	■		none provided	none provided	planning
Wildwood State Park	Yucaipa Valley Conservancy	Frank Sisaona	none provided	Proposed park is headwaters for Live Oak Canyon and Noble Creeks, which flow to San Timoteo Creek and Santa Ana River. The area also serves as a wildlife corridor from the San	■	■	■		■			■	none provided	none provided	planning
Yucaipa Watershed Drainage Project	East Valley Resource Conservation District	David Hansberger	6.00	Construction of 3 detention basins for flood protection and erosion prevention (2 at the confluence of Wilson and Oak Glen Creeks and one basin in Wildwood Creek).			■	■				■	none provided	City of Yucaipa, Yucaipa Valley Water District	planning
Wilson and Potato Creek Watershed Plan	City of Yucaipa	Jennifer Shankland	4.00	Construct a series of spillover detention basins to provide flood control, groundwater recharge and habitat preservation as part of the Wilson Creek and Potato Creek Watershed Management Program. Natural improvements will be made to Wilson Creek in lieu of PCC lined channels.		■	■				■	■	EPA	San Bernardino County, Yucaipa Valley Water District, Yucaipa/ Calimesa Joint Unified School District	planning

Table 3-9 Watershed Projects and Opportunities

Project Name	Agency/ Organization	Contact	Project Cost (in millions of dollars)	Project Description	Ecological purposes met: enhance/ restore ecological function	improve habitat	water conservation/ drought protection	flood control	recreation	education	improve water quality	provide other benefits	Other funding sources	Project partners	Project status
Noble Creek/Marshall Creek Wetland Project	Beaumont-Cherry Valley Water District	Chuck Butcher	25.7 (total) for overall larger project	Project comes from Recycled Water Master Plan. The District has a stormwater recharge program currently under design which plans for the utilization of recycled water in constructed wetlands (for additional nutrient removal) and subsequent groundwater recharge to the Beaumont Storage Unit.							■		local funding and private funding	City of Beaumont	planning
San Jacinto Habitat Acquisition	Eastern Municipal Water District	none provided	none provided	This project would acquire mitigation property identified in a Habitat Conservation Plan, allowing EMWD to proceed with a major conjunctive use project featuring all of the major environmental objectives established in the CalFed program.	■	■						■	none provided	Eastern Municipal Water District	planning
Rancho California Water District Arundo Removal	Rancho California Water District	none provided	none provided	This project would remove Arundo from the Rancho California Water District service area, primarily within the Murrieta Creek area. The removal of invasive species would enhance the groundwater recharge capabilities of the creek and thereby allow greater recharge of the groundwater basin.	■	■	■	■		■	■	■	none provided	Eastern Municipal Water District	planning
San Jacinto State Park	California State Parks	Geary Hund	N/A	New State Park, consisting of 13,000 acres. The park is home to endangered species, and is meant to combat habitat fragmentation issues.		■			■			■	none provided	none provided	complete
WATERSHED-WIDE PROJECTS															
Native and Treatment Wetlands	none provided	none provided	56.50	This five-year program will develop and fund projects in Orange, Riverside, and San Bernardino counties in areas where improvements to water quality are the most critical. The creation and restoration of wetlands in the watershed is essential to improving water quality and reducing the impacts of non-point source pollution. Wetlands are used for natural water treatment and serve as a buffer to the river and its tributaries. They also provide environmental habitat and a cleaner more resilient system for surface waters. Treatment wetlands are constructed where larger flows of highly eutrophic waters are found to reduce nutrients and other pollutants and provide habitat. These areas may be surrounded by natural wetlands and provide habitat for many sensitive, endangered, and threatened species. Natural wetland restoration will also be provided in areas where land and function can be maintained.	■	■	■	■	■	■	■	■	Prop 40, Prop 50, Prop 13	USFWS, USACE, CDFG, RWQCB	program adoption

Project Name	Agency/ Organization	Contact	Project Cost (in millions of dollars)	Project Description	Ecological purposes met								Other funding sources	Project partners	Project status
					enhance/ restore ecological functions	improve habitat	water conservation/ drought protection	flood control	recreation	education	improve water quality	provide other benefits			
Santa Ana River Trail Parkway	none provided	none provided	52.00	This project would further develop the Santa Ana River Trail and Parkway along the Santa Ana River. The trail is completed in Orange County and parts of Riverside and San Bernardino Counties. More improvements, however, are needed to complete and upgrade the multiuse trail to connect the San Bernardino Mountains and the Pacific Crest Trail. This trail would connect important areas in the inland empire cities and counties, thus expanding regional access and availability to existing parks and riverfront areas, as well as providing alternative transportation and recreation opportunities.					■	■		■	Prop 40	Orange County, Riverside County, San Bernardino County, cities within watershed, and other groups	program adoption
East Valley Resource Conservation District Arundo Removal	East Valley Resource Conservation District	David Hansberger	none provided	Projects currently in process of first-time treatment would continue on all upper watershed tributaries, as well as mainstem Santa Ana River down to Riverside County Parks and Open Space District lands (and on to Orange County). The program would also provide education to private landowners through written materials, workshops, and hands-on assistance. Database maintenance would include areas of infestation, current projects, sensitive species, and native vegetation recovery.	■	■	■	■		■	■		none provided	San Bernardino Valley Municipal Water District	ongoing
Arundo Removal/ Restoration	SAWA	Sheili Lamb/ Kerwin Russell	56.00	This five to ten-year project seeks to remove the Arundo donax (giant cane) from the Santa Ana Watershed and restore some 10,000 acres of riparian habitat. Funding to date has provided almost $25,000,000 and will take at least five years to complete; however, more funding is needed for agencies to more aggressively remove the species and monitor removal for five or more years.	■	■	■	■		■	■		Proposition 13, local mitigation, etc.	SAWA, Riverside Co. Parks, RCFCD, OCWD, OC PFRD, Monsanto, OCCC, CCC	ongoing
Santa Ana Sucker Conservation	Santa Ana Sucker Discussion Group	none provided	TBD	Increas in variability of stream edges and bottom topography. Re-establishment of meanders, vertical banks, pools, and riffles. Placement of coarse materials (stone and gravel) in the river.	■	■							Local funding	Riverside, San Bernardino, OCPFRD, OCSD, OCWD, RCFCD, SBCFCD	ongoing
Annal Inner-Coastal Watershed Cleanup	Trails 4 All	Jim Meyer	N/A	Annual inland waterway cleanup in conjunction with international coastal cleaup day. The intention is to remove trash and debris from inland waterways before it has a chance to reach the coast. Over 2,000 volunteers in 2001. In 2002, over 34,000 pounds of debris were collected.		■			■	■	■		The Irvine Company, Y&R Industries, Boeing, & more	The Irvine Company, Y&R Industries, Boeing, & more	ongoing annual event

Table 3-9 Watershed Projects and Opportunities

Project Name	Agency/ Organization	Contact	Project Cost (in millions of dollars)	Project Description	Ecological purposes met								Other funding sources	Project partners	Project status
					enhance/ restore ecological functions	restore habitat	water conservation	energy production	flood control	recreation	education	improve water quality	provide other benefits			
Santa Ana Watershed Data Management System (SAWDMS)	SAWPA	Greg Duecker	1.00	Data standardization of data from numerous stakeholders in the watershed enabling Internet access to the data by appropriate entities usable as a tool to improve water quality in the watershed. Integrate surface and groundwater data to assist numerous water quality and water management programs.										Prop 13 SCIWP (partial)	SAWPA Member Agencies	planning
Watershed Planning, Modeling, and Stakeholder Programs	SAWPA	Mark Norton	6.00	This three-year program would provide a prototype model for California watersheds. Collecting information and developing plans, as well as coordinating stakeholder programs, is essential to these watershed planning efforts. Infrastructure development is needed to advance state-of-the-art data management and to model how various programs and projects affect the watershed. This program would develop these tools and provide information and outreach to both the public and other agencies. It would also serve as a permanent home for collaborative projects in the watershed, as well as an independent analysis of the effects of various solutions on the current and projected future conditions of the watershed.										none provided	SAWPA Member Agencies	planning
TOTAL COST, in millions of dollars:			472.10													
			TOTAL													

Table 3-9 Watershed Projects and Opportunities

Watershed Structure and Function Restoration Recommendations

The restoration recommendations are intended to allow jurisdictions, communities, and groups to advance, promote, and enable the concepts below.

Recommendation #1: Improve Water Quality and Preserve and Improve Ecosystem Function

1-A. Develop water treatment wetlands and channels to improve water quality in a sustainable manner and provide multiple benefits.

1-B. Protect, restore and widen riparian vegetation corridors to reduce impacts of stormwater runoff, provide habitat, and improve aesthetics.

- Reintroduce vegetated buffer strips wherever possible along stream banks to reduce the force of a flooding current against the bank, slow water overflowing channel banks, and allow sediment to deposit.
- Ensure that riparian vegetated buffer strips are as wide as possible, although a narrow strip is better than none at all.

1-C. Carefully plan human activities to reduce erosion.

1-D. Continue to utilize technologically advanced sustainable solutions to resource management dilemmas, such as water quality improvements.

1-E. Reduce or eliminate beach closures through water quality improvements and reduction of contaminant discharge into the Pacific Ocean.

Recommendation #2: Protect and Restore Habitat Resources

2-A. Restore natural wetland habitats in flood plains of the River and its tributaries.

- Look for opportunities in natural undeveloped areas to add wetlands that will increase complex natural habitats in juxtaposition to the stream system.
- Connect wetlands to the stream corridor through the addition of channels and vegetation.

2-B. Protect and restore remaining native species and habitats.

- Recreate meanders and backwaters where possible within the River and its tributaries to enhance native fish habitat.
- Create drop structures and other oxygenation devices that do not inhibit fish passage.
- Reestablish riffle substrates.
- Develop instream structures to promote pool and flow complexes.

2-C. Identify public and private agencies and organizations to maintain acquired lands and funding sources.

2-D. Acquire key parcels of land for conservation.

- Establish conservation goals and target selection criteria.
- Identify key potential parcels based on selection criteria.
- Negotiate conservation easements as an alternative to outright purchase of lands.

2-E. Promote the identification, establishment, and protection of wildlife corridors.

2-F. Connect upland vegetation and habitats through edge habitats and corridors.

- Locate isolated habitat patches and establish corridors suitable to increase the habitat diversity available to all species.
- Plant native trees, shrubs, and forbs to establish wildlife-friendly pathways along roads and channels.

2-G. Remove and control exotic species.

- Continue active programs for removal of established invasive species.
- Identify and control recently established invasive species to prevent further spread.
- Prevent introduction of future invasive species.

Recommendation #3: Engage the Community through Education and Recreation

3-A. Improve recreational opportunities for the region, including access to streams, lakes, and beaches through dedication of easements and land acquisition.

3-B. Increase water conservation and decrease imported water use through public education and provision of water saving devices.

3-C. Involve the public through outreach and education coordinated with the agencies and schools in the watershed.

3-D. Increase available open space throughout the region, including balancing open space availability among various communities by increasing parkland acreage in densely urbanized areas.

Recommendation #4: Plan for the Future

4-A. Facilitate partnerships among groups with similar goals and support community based sub-watershed groups.

4-B. Work with the State Resources Agency through the California Watershed Management Forums and other standard Regional Agencies to achieve State and regional goals.

4-C. Use the best scientific data available and regional collaboration to make complex resource management decisions.

4-D. Promote effective watershed monitoring, data management, and project evaluation programs.

4-E. Identify and pursue future sources of funding to complete watershed projects. Funding source identification should include provisions for operation and maintenance of projects in addition to capital expenditures.

4-F. Utilize this Santa Ana Integrated Watershed Plan, Environmental and Wetlands Component as a living document, including regular updates to maintain current watershed-wide planning and coordination.

C. Next Steps

Plan Life Continues Beyond Today

In as much as this Plan presents a snapshot of the innovative projects and summarizes the plans and projects of many agencies, it will quickly age. SAWPA has received excellent feedback from agencies, groups, and individuals in this process.

The dynamic nature of projects and plans in the Watershed necessitates their update and renewal on a relatively frequent basis. This Plan will be used by agencies in the Watershed to help integrate plans and to focus funding on projects that are most effective and ready to proceed. This information must remain current to be effective.

Additionally, revisions to this Plan's strategies aimed at restoring the ecological function of the Watershed will develop over time forming a culture for the Watershed community. Future revisions of this document will capture these developments, new projects that are created, and projects currently listed that develop and evolve.

The SAWPA Commission will adopt this plan as part of the Integrated Watershed Plan for the Santa Ana River Watershed and will use it to guide funding and development priorities.

As the need for update and the funding is available, SAWPA will initiate efforts to update and refine this Plan. Necessary elements for inclusion in Phase II of the Environmental and Wetlands Component are as follows:

- More information on the natural history of the watershed, including vegetation descriptions.
- An assesment of remaining significant habitat is needed. This assessment is essential for setting priorities. A more detailed description of natural resources, including vegetation, and a more comprehensive analysis of the ecological function of the Santa Ana River is needed.
- An expanded, more comprehensive assessment of ecological/open space/ recreational resources and their significance to the region, the state, and the nation would be useful in seeking further funding.
- Further information to explain what is special about the Santa Ana Watershed as a system, and what it contributes to California's and the nation's resources overall.
- Development of a multi-benefit, multi-agency strategy to help achieve agreed-upon watershed goals.
- Gap analysis for the watershed.
- Development of a coordinated, multi-benefits, multi-agency strategy to help achieve agreed upon watershed goals.

Given that everyone associated with the Santa Ana Watershed is inextricably linked from the mountains to the Pacific Ocean, additional partnering with State, federal, and regional agencies to further watershed planning efforts is vital. The actions of upstream users impact the quality of life of downstream users, and keeping this connection in mind is very important to improving both the overall ecological function of the watershed and the quality of life of its residents.

Prado Wetlands
Photo courtesy of SAWPA

Finally, further efforts to engage the planning community (i.e., community development and planning staff at Watershed cities and other agencies at every level of government as well as private sector planning) should include training, workshops, and other educational forums to facilitate free exchange of innovative ideas and information related to the implementation of watershed planning. Realization of the recommendations and projects in this document and future iterations of this document require planning staff engagement and dedication. The Santa Ana Watershed is making progress toward a healthier and more ecologically sustainable watershed through continued collaboration and leadership in the protection of its resources.

GLOSSARY

This glossary of useful terms was adapted from *Common Ground: From the Mountains to the Sea*, which was derived from the *Second Nature* report prepared by Tree People and from *Stormwater: Asset Not Liability* by Dallman and Piechota.

Base Flow of Streams

Water slowly percolates underground and then spreads laterally until it reaches the surface (not pumped up) becoming part of the natural flow in rivers and streams, its base flow. This seeping groundwater is what maintains the flow in a river due to the return flow of groundwater.

Bio-remediate

Bio-remediation uses biological processes to repair pollution damage. For example, a grass swale can bio-remediate much of the pollution caused by automobile use by holding heavy metals in the soil at harmless concentrations as well as by the action of soil bacteria, which gradually breaks down hydrocarbon waste such as crankcase oil.

Beneficial Uses

Historical, existing or potential uses of a body of water. The Regional Water Quality Control Boards designate uses for individual bodies of water, with the intent of preserving or restoring those uses. There are 24 beneficial uses designations in California, including wildlife habitat, industrial processes, agricultural supply, and groundwater recharge.

Class I Bikeway

Completely separated right-of-way designed to be shared with pedestrians. The standard pavement width of a Class I Bikeway is eight (8) feet. The typical right-of-way width is ten (10) feet. Class I Bikeways are considered ideal. They are usually located on publicly owned land such as parks, school sites, or road right-of-way.

Compost

Decayed vegetation from a variety of sources, such as green waste or biosolids. Can be used as ground cover or mulch, and as fertilizer.

Detention Basin

Temporary storage of stormwater or other flows to reduce the peak flow, but not the total volume of stormwater during a storm.

Debris Basin

Facility constructed to contain debris flows (water, rocks, mud, sediment vegetation and other debris) that occur during major storm events, particularly in areas that have been subject to wildfires.

Dry Weather Flow

The continuous flow in a storm drain system that occurs even during extended periods without rain.

Evapotranspiration

The loss of water from the soil both by evaporation and by transpiration from the plants growing thereon.

First-Flush Rain

In Southern California, many months can pass between one rainstorm and the next. During this time, pollution and grime build up on all of the city's outdoor surfaces, and in particular, on its streets. When the next rainstorm finally comes, it washes the accumulated grime and pollution off of the streets and into the storm drain system. This is the "first flush rain." As you might expect, it carries a very large amount of suspended and dissolved pollutants.

Flood Plain

The lands next to rivers and streams that flood naturally during large storm events. The flood plain's function is to store sediment and flood flows.

Grass Filter Strips

A grassy edge or swale that filters stormwater in the root layer before percolating the water into the soil below or discharging the water overland.

Graywater

Water drained from household sinks, washers, tubs, and showers—that is, all water not coming from toilets. This water carries relatively few suspended or dissolved solids. Consequently, it can often be used for such purposes as landscape irrigation.

Groundwater

The water that collects and is stored underground into basins defined by the underlying geology. The level of groundwater or "water table" varies according to the type of soil and underlying geologic formations, and from season to season. In rare instances, and on particular sites, the groundwater table comes up to the surface. This results in standing water on the surface of the ground. More often, the groundwater table is located many feet below the surface.

Groundwater Recharge

Surface water that filters into the ground and reaches underground reservoirs, providing replenishment and/or increased storage for groundwater basins. This occurs naturally during and after rainstorms, in creek beds with flowing water, or can be accomplished purposefully by directing stormwater into specially prepared recharge areas for infiltration.

Heat Island Effect

Many urban areas lack shade trees. In these areas the sun strikes pavement and rooftops, heating them to very high temperatures. These surfaces re-radiate heat into the air, raising air temperatures by five or more degrees. Urban areas that contain dense tree canopy avoid the heat island effect because trees absorb virtually all of the sun's energy without radiating heat back into the air.

Holding Pond

A depression where rainwater is directed and held temporarily. Holding ponds function to slow the rate at which water is discharged from a site to the rate more typical of undeveloped natural sites.

Humus Layer

The top layer of soil where there is the most organic activity, fibrous root material, and recycling detritus from the plants above.

Hundred-Year Storm

There is a 1 in 100 chance of a storm of this magnitude happening in any one year. Flood flow rates from hundred-year storms are recalculated over time due to changes in the landscape (e.g., increased urbanization).

Hydrology

The occurrence, distribution, movement, and properties of water above and below the earth's surface. The natural hydrology of an area may be significantly altered by catastrophic events (earthquakes, landslides) and by human development (agriculture, urbanization).

Impervious or Impermeable Surfaces

A surface that does not allow the passage of water and thus potentially facilitates the generation of runoff.

Infiltration

The process by which water moves downward through the earth's surface, replenishing soil moisture and groundwater basins. The ability of the soil to infiltrate water depends on many factors, including the nature of the surface cover, and soil characteristics such as texture and depth.

Infiltration Zone

An area particularly well suited and/or altered for directing stormwater back into the soil.

Mulch

Organic material placed on the ground, sometimes many inches thick, used as a ground cover to cool the soil, discourage weeks and erosion, aid in the infiltration of water, minimize the heat island effect of the city, and reduce the costs of green waste disposal.

Natural Flood Plain

Every river or stream naturally overflows its low flow or non-storm capacity channel during major storm event. Flood plains consist of those areas that would naturally flood during major storms. Their function is to disperse sediments and to infiltrate water underground.

Percolation

The act of water soaking into the ground. This term is used most frequently in conjunction with spreading grounds, where water is purposefully allowed to percolate through the soil to the groundwater.

Percolation Basin

An aboveground storage place, or retention basin, built so as to encourage the percolation of water contained therein underground.

Percolation Rate

The rate at which water filters into the soil. Some soil types, such as sand, have a very high percolation rate; other soils types, such as clay, have a very slow percolation rate.

Permeable Pavement

Permeable pavement is honeycombed with voids, or air pockets. These voids allow water to migrate down through the pavement into the soil below.

Pervious or Permeable Surfaces

Surfaces that allow water or other liquids to penetrate and potentially reach the ground (depending on the thickness of the surface, how porous it is, and the amount of water.

Porosity

A measure of the ability of water to pass through a material, which is dependent upon how much empty space occurs between the particles that make up the substance. For example, sand is much more porous than clay.

Potable Water

Water that is fit to drink.

Precipitation

Rain, hail, or snow that falls from the atmosphere.

Recharge Areas

Certain zones in the landscape can accept water back into the soil at higher than average rates. Such areas are often referred to as recharge areas.

Residential Density

The number of family units to be found on an average acre of land in a residential area is referred to as its density. These densities range from low (1–2 units per acre) to high (40 + units per acre).

Retention Basin or Infiltration Basin

Stores water with the purpose of reducing the volume of runoff by capturing precipitation and surface runoff for recharge to groundwater. These basins do not return captured runoff to stormwater channels.

Riparian Habitat

Habitat next to rivers or streams and dependent on the additional moisture in the river. Its function is to provide food and shelter for many creatures, to reduce the volume and velocity of runoff, and increase infiltration.

Riparian Retention and Treatment Area

A retention or recharge area where plants native to rivers or lakes are installed to consume and clean the water therein.

Rip-rap

A rock lining used to stabilize sloping stream banks.

River Corridor

Includes the river, the flood plain, and the riparian trees and plants that grow in the high groundwater and most soils along the way.

Runoff

Stormwater that flows off of one surface or site onto another.

Sheet Flow

Stormwater that flows in even sheets across a flat surface, such as a parking lot.

Spreading Grounds

A land area specifically designed to be flooded so that the water will percolate or soak into the ground, recharging the groundwater.

Stormwater

Refers to all rainwater that hits the surface of the ground. Stormwater either percolates back into the soil or flows on the surface to the nearest storm drain inlet, stream, or other wetland area.

Subsoil

The soil layer below the "topsoil" layer.

Subsurface

Below the surface of the ground.

Sustainability

The ability to meet current needs without compromising the ability of future generations to do the same.

Swale

A V-shaped depression in the land, usually lined with grass, designed as a channel for moving stormwater from one place to another.

Velocity of Flow

How quickly the stormwater flows over the surface or through the storm drain system to the ocean. Velocity is determined by the design of the conveyance system: how wide, how smooth or rough, and the slope of the conveyance.

Water Conservation

Means different things in different contexts. Usually, it means using less (consumer or farmer or landscape) due to hardware or management strategies. In the stormwater management context, it means storing water in retention basins or behind a dam for infiltration to the groundwater, making the water available as an addition to the drinking water supply.

Watershed

A region or area bound peripherally by a divide or ridge, all of which drains to a particular watercourse or body of water. Also defined as the drainage area of a river or stream system.

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APPENDICES

All appendices are available on CD-ROM (provided in the back pocket of this binder).

Appendix A: Scoping Meeting Notes, List of Participants

Prepared by SAWPA and EIP Associates

This appendix provides meeting notes and participant lists for each of the four scoping meetings held in July and August 2002 to gather input for the Plan.

Appendix B: Santa Ana River Trail Summary

Prepared for SAWPA by Dangermond and Associates

This document provides a summary of Santa Ana River Trail status and future completion needs.

Appendix C: *Arundo* Removal Protocol

Prepared for SAWPA by EIP Associates and Nelroy E. Jackson, Ph.D.

The *Arundo* Removal Protocol was prepared for the Southern California Integrated Watershed Program to provide groups removing *Arundo* within the watershed a comprehensive document including removal methods and permitting information.

Appendix D: *Arundo* Removal Program, Notice of Exemption

Prepared for SAWPA by EIP Associates

This Notice of Exemption for the *Arundo* Removal Program provides environmental documentation (CEQA) clearance for SCIWP-funded *Arundo* removal activities within the Santa Ana Watershed.

Appendix E: Wetlands Program, Notice of Exemption

Prepared for SAWPA by EIP Associates

This Notice of Exemption would provide environmental documentation clearance for a number of SCIWP-funded wetland and habitat projects.

Appendix F: Rare and Sensitive Species and Habitats Potentially Occurring within the Watershed

Prepared for SAWPA by EIP Associates

This list of rare and sensitive species and habitats potentially occurring within the Watershed was compiled by EIP Associates using the California Department of Fish and Game's California Natural Diversity Database.

Appendix G: Aquatic Resources Assessment

Prepared for SAWPA by EIP Associates

Please note that the tables in the document are to be printed on legal-sized paper.

This assessment of the Santa Ana River Watershed Plan has three purposes:

1. To provide background and perspective on the historical and current aquatic vertebrate resources of the watershed
2. To describe the primary factors affecting the viability of those resources
3. To describe the conservation strategy and actions proposed to ensure the continued viability of aquatic resources

The aquatic resources addressed in this assessment include fish, amphibians, and semi-aquatic reptiles that depend on the aquatic system and adjacent riparian and wetland habitats for all or part of their life history.

Appendix H: Sample Conservation Easement Deed

Source: Land Conservancy of San Luis Obispo County

This Sample Conservation Easement Deed is provided for informational use only, to illustrate some provisions commonly included in conservation easement deeds.

Appendix I: Education Curriculum Kit Used at Public Outreach Events

Prepared for SAWPA by EIP Associates

The Education and Curriculum Kit includes three items. Two items, the watershed maze and the game cards, are aimed at children. Please note that both of these items are to be printed on 11x17-inch paper. The *Arundo* educational brochure is aimed at homeowners and explains the need to prevent the spread of *Arundo*, providing alternative native planting ideas. This brochure is to be printed on legal-sized paper.

Appendix J: Funding Table

Prepared for SAWPA by EIP Associates

This appendix provides expanded information for the funding sources presented in Table 3-6, Section 3A-7, Funding. Expanded information includes contacts for various funding programs.

Appendix K: Comment Letters on Draft IWP, Environmental and Wetlands Component

Prepared for SAWPA by EIP Associates

This appendix provides a list of all commentors on the Draft IWP, Environmental and Wetlands Component, as well as copies of each written letter.

Appendix L: Public Outreach

Prepared for SAWPA by EIP Associates

This appendix provides information on SAWPA's public outreach events, including informal household survey results from the Environmental Expo.

Appendix M: California Environmental Dialogue, Economic and Environmental Benefits of Habitat Protection, Restoration, and Enhancement

Prepared for California Environmental Dialogue

This appendix provides information that explains how habitat protection, restoration, and enhancement lead to economic benefits relative to natural systems, recreational and leisure industry, and reduction of conflict caused by species extinction, among other concerns.