INTRODUCTION

BACKGROUND

The City of Ojai has received a grant from the California Department of Fish and Game (CDFG) to prepare a comprehensive assessment and restoration plan for the watersheds that drain through the city limits (CDFG Contract Number po250014). These watersheds include Stewart Canyon, Fox Canyon, and portions of San Antonio and Thacher Creeks. Thacher, Stewart Canyon, and Fox Canyon Creeks are all tributaries to San Antonio Creek, which is a major tributary to Ventura River.

One of the major problems with watershed management, within Ojai as well as in California in general, is the impacts to fish habitat. The Ventura River system has been ranked as the third most endangered river in the United States during a recent survey (American Rivers [website] 2000). The Ventura River and its tributaries (along with other coastal streams in Ventura County) have been designated as critical habitat for Southern California Steelhead Trout (*Oncorhynchus mykiss irideus* [a southern California Ecologically Significant Unit or ESU]), a federally listed endangered species. In the past, the river had a large Steelhead population, which spawned in the upper reaches of its tributaries, including the larger San Antonio Creek watershed in the foothills of the Ojai Valley. However, Steelhead populations have declined over the years, largely due to the impact of human activities. Some of those activities and their impacts include:

- Urban development leading to increases in impervious surfaces and associated runoff;
- Modifications to the creek channel and banks for flood control and construction of creek crossings that form barriers to upstream passage;
- Increased sediment and other polluted runoff from urban development leading to degraded water quality; and
- Surface and groundwater withdrawals that have significantly decreased historical perennial surface flows in the creeks of the Ojai Valley.

The predominant known problems, in regards to Steelhead habitat within the streams of the City of Ojai, include the following:

- **Fish Passage** is limited on San Antonio Creek at the Soule Park Golf Course and further upstream in Soule Park (*Soule Park is on Thacher Creek to the east*) by road crossings. Stewart and Fox Canyons also have major fish barriers at flood control structures located within city limits.
- **Water Quality** is adversely impacted by urban runoff and stagnation related to the intermittent nature of flows in the watersheds.
- **Spawning and Rearing Habitat** is diminished as pools are filled and riffles choked with fine sediment from upland erosion.
- **Deficient Stream** flow is a problem endemic to many southern California streams due to climate, but the situation is made worse by urbanization, loss of open space, and water withdrawals (both surface and groundwater).

The City is acting at the request of several concerned groups and individuals who desire to improve the quality of the riparian systems traversing the City. These groups have already undertaken and completed a number of small stream improvement projects, but now desire to enlarge their efforts in a more comprehensive and systematic way.

David Magney Environmental Consulting (DMEC), Hawks & Associates, and Concerned Resource & Environmental Workers (C.R.E.W.) have been contracted by the City to conduct the Ojai Basin streams characterization and assessment, and to make recommendations on how stream habitats within the City could be protected or restored.

PROJECT OBJECTIVES

A primary purpose of the proposed assessment and restoration plan is to identify specific problems of the Ojai creeks relevant to Steelhead Trout, and develop a plan to restore fish habitat and to address the land use issues that adversely affect that habitat and the ecological health of the watersheds.

The objectives of this assessment and restoration plan are to:

- Conduct a baseline assessment of the City of Ojai urban watershed;
- Identify and prioritize limiting factors to increasing Southern Steelhead populations;
- Determine and analyze the root causes of these limitations; and
- Develop specific recommendations for restoration actions.

Some of the most significant issues that are addressed in this report to achieve the above objectives include the following:

- Historical conditions and significant developments influencing the watershed over time;
- Watershed hydrology, including the range of flows and temporal distribution;
- Physical characteristics of the stream channels (e.g. gravel size, canopy, pools, riffles, runs);
- Riparian vegetation characteristics (e.g. habitat classification, dominant species, structural diversity, canopy density, invasive exotic species);
- Location and severity of fish passage barriers;
- Water quality, sources and types of pollution, sediment, and turbidity;
- Basic physical parameters of streams and water (e.g. temperature, dissolved oxygen, *p*H, salinity);
- Watershed physical characteristics;
- Current and future land use practices that are detrimental or beneficial to riparian ecosystems;
- Land ownership along the riparian corridors and stakeholders in habitat restoration;
- Functional fish habitat limiting factor analysis;
- Restoration to improve watershed conditions; and
- Implementation of activities that deserve highest priority.

SOUTHERN STEELHEAD

Steelhead Trout are an important and valued resource to California's citizens and are an important component of the vast biodiversity of the State. Like many of California's Southern Steelhead resources, Steelhead are declining, which is only one aspect of the present statewide decline in biodiversity, caused by California's burgeoning human population and the ever-increasing demand on natural resources.

The following five subsections discuss Southern Steelhead in regard to their (1) general status and distribution, (2) life history, (3) habitat requirements, (4) stock characteristics, and (5) existence within the Ventura River system as summarized from the CDFG's *Steelhead Restoration and Management Plan for California* (CDFG 1996).

Status and Distribution

Rough estimates place the total statewide population at 250,000 adults, less than half the population of 30 years ago. The decline of Southern Steelhead appears to be part of a more prevalent coast-wide Steelhead decline. The major factor causing the decline in California is freshwater habitat loss and degradation, which is a result of three primary factors: inadequate stream flows, blocked access to historic spawning and rearing areas due to dams, and human activities that discharge sediment, pollution, and debris into watercourses.

Southern Steelhead Trout (occurring south of San Francisco Bay) were formerly found in coastal drainages as far south as the Santo Domingo River in northern Baja California and were present in many streams and rivers of southern California. Today, San Mateo Creek on the Orange/San Diego County line is the southernmost stream containing a known spawning population, with Malibu Creek in Los Angeles County being the main southernmost Steelhead Trout stream south of the Santa Clara River. Southern Steelhead are the most jeopardized of all California Steelhead populations. Population numbers have declined drastically in nearly all streams where they exist, and runs have been extirpated from many others. Of 122 streams south of San Francisco known to have a Steelhead population, 20% of the streams had populations with significant decline from historical levels; 47% had populations with reduced production from historical levels; and 33% no longer supported populations (Titus et al. 1994). Major adverse impacts to Southern Steelhead are from urbanization and water impoundment and diversion.

There is little information regarding historical run size of Steelhead in the Santa Clara River system, although Hubbs (1946) reported that there were "large and consistent runs into Ventura and Santa Clara Rivers." Moore (1980a) estimated the historical run size in the Santa Clara River system to be around 9,000 fish by comparing it with the Ventura River system. During the course of a two-year study beginning in 1982, Puckett and Villa (1985) documented the presence of six adult Steelhead in the Santa Clara River. In 1994, one adult Steelhead and 83 outmigrating smolts were observed at the Vern Freeman Diversion Facility (CDFG 1994).

Major impacts to Southern Steelhead populations are a result of urbanization and watershed disturbances, blocked access to headwater spawning and rearing areas, and partial and total dewatering of streams by water diversions and groundwater pumping. Those stocks, south of and including the Santa Ynez River, have been impacted most greatly and are the most imperiled.

Water development appears to be the primary cause of localized extinctions and decline in numbers within Southern Steelhead populations. Titus et al. (1994) found that 35% of the Southern Steelhead populations reviewed were negatively impacted by water diversions, 24% by dams lacking functional fishways, 18% by artificial barriers other than dams (impassable culverts and bridge supports), and 5% from stream channelization. Overall, 21% of the 165 populations reviewed were impacted by blocked access to spawning and rearing tributaries due to main stem impediments.

Most remaining Southern Steelhead stocks are on the verge of extinction. Perhaps the most striking aspect of the decline of Southern Steelhead is that, in a span of a few decades, the known southern limit of Steelhead in North America has moved several hundred miles northward from the Santo Domingo River in northern Baja California to Malibu Creek in Los Angeles County (with the exception of the newly discovered San Mateo Creek population). Reduction in population and localized extinctions continue to creep northward and are concomitant with urban development and an increasing demand on water resources (Titus et al. 1994).

Life History

Steelhead Trout are the anadromous form of Rainbow Trout, a salmonid native to western North America and the Pacific coast of Asia. In North America, Steelhead are found in Pacific Ocean drainages from southern California to Alaska. In California, known spawning populations are found in coastal rivers and streams predominantly from Malibu Creek in Los Angeles County to the Smith River near the Oregon border, and in the Sacramento River system.

Steelhead are similar to some Pacific salmon in their ecological requirements. They are born in fresh water, then they emigrate to the ocean where most of their growth occurs, and finally they return to freshwater to spawn. Unlike Pacific Salmon, Steelhead do not necessarily die after spawning. Post-spawning survival rates are generally quite low and vary considerably between populations.

In California, most Steelhead spawn from December through April in small streams and tributaries where cool, well-oxygenated water is available year-round. The female selects a site where good intergravel flow exists, then digs a redd and deposits eggs while an attendant male fertilizes them. The eggs are then covered with gravel when the female begins excavation of another redd just upstream. The length of time it takes for eggs to hatch depends mostly on water temperature. Hatching of Steelhead eggs in hatcheries takes about 30 days at 51ºF (Leitritz and Lewis 1980). Fry emerge from the gravel usually about four to six weeks after hatching, but factors such as redd depth, gravel size, siltation, and temperature can speed up or slow down this time (Shapovalov and Taft 1954). The newly emerged fry move to the shallow, protected areas associated with the stream margin (Royal 1972, Barnhart 1986). They soon move to other areas of the stream and establish feeding locations, which they defend (Shapovalov and Taft 1954). Most juveniles inhabit riffles but some of the larger ones will inhabit pools or deeper runs (Barnhart 1986).

The life history of Steelhead differs from that of Pacific salmon principally in two aspects: (1) juvenile Steelhead have a longer freshwater rearing requirement (usually from one to three years); and (2) both adult and juvenile Steelhead are much more variable in the amount of time they spend in fresh and salt water. Throughout their range, Steelhead typically remain at sea for one to four growing seasons before returning to fresh water to spawn (Burgner et al. 1992). However, some individuals will remain in a stream, mature, and even spawn without ever going to sea. Others will migrate to sea at less than a year old, and some will return to fresh water after less than one year in the ocean.

Lack of genetic differences indicates that substantial gene flow exists in anadromous and resident forms. It is not uncommon in anadromous salmonids for males to mature as parr, and then assume a resident life style (Titus et al. 1994). The variability in life history patterns probably confers a survival advantage, especially in unstable, variable climatic and hydrographic conditions, such as in southern California environments at the southernmost limit of Steelhead distribution. The major river systems in this area are subject to extreme variations in rainfall, which can result in high volume, flash flood runoff, or droughts lasting several years. It is common for the lower reaches of many southern rivers to become intermittent during the dry season. Juvenile Steelhead rearing in the perennial headwaters of these rivers at times have no access to the ocean for several years. In addition, sufficient flow is needed to breach sandbars, which close the mouths of most coastal streams. When a storm event provides sufficient flow, a brief window of opportunity is created to allow movement of Steelhead between their marine and fresh water environments. This life history flexibility to survive, and possibly spawn, until the next storm event opens a migration corridor, has allowed Steelhead to exist in the suboptimal environments existing along their southern margin range.

Southern California Stock

In addition to Southern Steelhead tolerance to the harsh environmental conditions of southern California, including warmer waters, drought, natural disaster, and extremely variable habitat conditions, the location of Southern Steelhead populations on the periphery of the Steelhead range suggest that these fish contain unique genetic adaptations. Mitochondrial and nuclear DNA analysis has shown that Southern Steelhead are genetically distinct from northern populations (Nielsen 1994).

For example, the warmer more productive waters of the Ventura River result in a more rapid growth of juveniles, compared to the more northerly populations (Moore 1980b). This relatively high growth rate allows juvenile Southern Steelhead to achieve smolt size and emigrate to the ocean after only one year in fresh water, a relatively short time period compared to more northerly populations in California and the Pacific Northwest where two- and three-year old smolts predominate (Withler 1996).

In addition to their tolerance of warmer water, Southern Steelhead migration is contingent upon rainfall and stream flow much more than northerly populations of Steelhead. Average annual rainfall is substantially lower and more variable in Southern California, which results in the formation of sand bars across the mouths of streams, and, in some cases, the complete dewatering of the lower reaches during the dry season. Southern Steelhead are more dependent on storm events to open migration corridors than are more northerly populations.

Natural disasters such as droughts, floods, and fire are common occurrences in Southern California, and in such a natural disaster prone environment, severe habitat alteration and localized extinction of Rainbow Trout populations were probably natural and recurring events. The ability to rapidly recolonize affected habitat, when suitable conditions are reestablished, is an adaptation to the periodic unsuitability of habitat in an unstable environment. Steelhead from unaffected populations in nearby stream systems can serve as source populations for recolonization. Adult Steelhead are known to stray from their natal streams to spawn in nearby streams, and, in hydrologically variable streams (such as those in southern California), straying is likely to be more prevalent than in less variable streams (Quinn 1984).

Southern California is at the southern periphery of Steelhead natural range, hence environmental conditions that are suboptimal for Rainbow Trout may exist more frequently than in areas further north. Ecological theory suggests that in environments near the limits of a species' range, physiological, behavioral, and dispersal mechanisms may exist to allow the persistence of populations in an environment that may be suboptimal.

Conditions in marginal habitats may be extreme, and these unavoidable adverse conditions may select for more extreme genetic characteristics (such as high thermal tolerance) in a population occupying such habitat (Thorpe 1994). The warm water temperatures of southern California streams, in some cases much higher than the preferred range for Rainbow Trout, suggests that they can withstand higher temperatures. Southern Steelhead populations may be particularly important as genetic stocks, since these populations are better adapted to warmer water conditions than more northerly populations (Swift et al. 1993).

The Ventura River

The San Antonio Creek watershed studied for this project is a major tributary to the Ventura River system. The Ventura River discharges to the Pacific Ocean near the west end of the City of San Buenaventura. It flows in a southerly direction, terminating in a small estuary that is subject to tidal influence when not closed by a sand bar. The following summarizes Southern Steelhead within the Ventura River from CDFG's *Steelhead Restoration and Management Plan for California* (1996).

The Ventura River at one time probably supported one of the largest runs of Southern Steelhead on the south coast (Point Conception to San Diego County). Restoring Steelhead runs in this river will be crucial to restoring the Southern Steelhead stocks. The river still has adequate habitat to sustain Steelhead populations, and it has had good winter flows in certain years, especially 1992 and 1993. There were several reports of adult Steelhead observed on the river in 1993, including several that were observed at Soule Golf Course in 1998 and downstream in San Antonio Creek in 2004. Suitable Steelhead habitat in this system exists in the main stem and in Matilija, North Fork Matilija, San Antonio, and Coyote Creeks.

The major obstacle to Steelhead restoration in the Ventura River system is blocked access to headwaters and excessive water diversion. The Robles Diversion, built by the U.S. Bureau of Reclamation in 1958 and operated by the Casitas Municipal Water District (District), is the largest diversion on the river. It functions to divert water from the Ventura River to Casitas Reservoir located at Coyote Creek, a tributary to the Ventura River. The diversion dam is approximately 14 miles upstream from the ocean and is the only major barrier on the lower river. The District has a flow release requirement of 20 cfs for downstream users. The Diversion can cause substantial dewatering of a portion of the river, and the diversion Dam was a substantial barrier to migration before the construction of a fish latter.

When the Robles Diversion was being planned in 1956, CDFG and the District discussed the installation of a fish passage facility at the Diversion to accommodate Steelhead migration. Initially, CDFG had taken the position that a ladder was necessary, but later reversed its position, requiring only that a provision be made in the initial construction of the diversion facility to accommodate the construction of a ladder in the future if found necessary (CDFG 1956). Now it is realized that the installation of a fish passage facility at the Robles Diversion Dam is key to rehabilitating Steelhead runs in the Ventura River system. In April 1992, CDFG submitted a proposal to the Wildlife Conservation Board to fund construction of a dam fishway, which was constructed in 2003.

Prior to the completion of the Matilija Dam in 1948, Steelhead had access to about ten miles of spawning habitat in Matilija Creek and its tributaries. About 50% of the Steelhead entering the Ventura River spawned above the current site of the Matilija Dam (Clanton and Jarvis 1946). A trap-and-truck facility was constructed several years after dam completion to transport adult Steelhead upstream of the dam. The operation trapped only seven adult Steelhead and lasted for only one year.

Large cracks in the concrete of the Matilija Dam generated concern about its integrity. Consequently, the dam has been notched several times to reduce the amount of water it can impound. Because of reduction in effective height of the dam and accumulation of sediment in the reservoir, capacity has been reduced to about 1,000 acre-feet. The dam is essentially ineffective for flood control and has limited value as water supply storage (Wetlands Research Associates 1992). The Ventura County Flood Control District and the U.S. Army Corps of Engineers proposed the removal of the Matilija Dam 2001; however, approval is still pending on environmental review. A Matilija Dam Ecosystem Restoration Feasibility Study has recently been conducted to explore alternative dam removal methods. The removal of the dam will open up 30 miles of prime Steelhead spawning and rearing habitat, including all upstream tributaries.

RIVERINE WETLAND FUNCTIONS

Since the functions of wetlands can be complex and sometimes difficult to accurately assess, a wetland assessment model is often very useful to objectively demonstrate how proposed projects may in fact improve (or degrade) wetland functions. The functions of wetlands considered under these assessments are based on a rapid assessment method currently under development nationwide by the Corps and EPA, known as the Hydrogeomorphic (HGM) approach (Smith et al. 1995). The HGM approach depends on development of local models for each biogeographic region for each general wetland type: riverine, estuarine, lacustrine fringe, depressional, slope, and flat. The channels of San Antonio Creek and its tributaries are considered Riverine wetlands under the HGM wetland assessment approach.

Three regional riverine wetland HGM models have been developed and are undergoing field-testing in California coastal areas that may be applicable to the San Antonio Creek watershed region:

- Draft Guidebook to Hydrogeomorphic Functional Assessment of Riverine Waters/Wetlands in the Santa Margarita Watershed (Santa Margarita HGM) (Lee et al. 1997, 2003);
- Draft Guidebook to Functional Assessments in 3rd and 4th Order Riverine Waters/Wetlands of the Central California Coast (Central Coast HGM) (Lee et al. 1996); and
- Draft Guidebook for Reference-Based Assessment of the Functions of Riverine Waters/Wetlands Ecosystems in the South Coast Region of Santa Barbara County, California (Santa Barbara South Coast HGM) (Lee et al. 2001).

The three riverine models listed above identify fourteen critical functions that streams such as San Antonio Creek fulfill:

1. Maintenance of characteristic channel dynamics;
2. Dynamic surface water storage and energy dissipation;
3. Long-term surface water storage;
4. Dynamic subsurface water storage;
5. Nutrient cycling;
6. Detention of imported elements and compounds;
7. Detention of particulates;
8. Organic carbon export;
9. Maintain characteristic plant community;
10. Maintain characteristic detrital biomass;
11. Maintain spatial structure of habitat;
12. Maintain interspersion and connectivity;
13. Maintain taxa richness of aquatic macroinvertebrates; and
14. Maintain spatial distribution of vertebrates.

The HGM functional assessment approach is used to determine the index for each function for both pre- and post-project conditions. The wetland functions can be grouped into three general functions: hydrologic (Functions 1-4 above), biochemical (Functions 5-8 above), and habitat (Functions 9-14 above).

Riverine wetlands in the San Antonio Creek Watershed can be characterized as performing various hydrology/geomorphology, biogeochemistry, plant habitat, and wildlife habitat functions (Table 1, Ecosystem Functions of Riverine Wetlands). The performance of these functions is largely dependent upon the maintenance of natural channel morphology and native plant communities. A substantial portion of the native vegetation outside of the existing streams and lowlands has been altered by development projects, which have had negative effects on the overall ecosystem function of San Antonio Creek, its tributaries, and its associated riparian wetlands. Mitigation of these impacts is needed to restore wetland functionality to watershed streams.

The HGM model considers the state of twenty-eight (28) variables that are assessed in various combinations to measure the level of functioning for each of the fourteen (14) wetland functions, to obtain an index score for each function. Each index is scaled based on reference standards that were established for the Santa Barbara South Coast region, located in Santa Barbara County (Lee et al. 2001). Lee et al. (2001) cautions, however, that the model may not be accurate in all aspects outside the reference domain, the Santa Barbara County south coast region. With this caveat in mind, the Santa Barbara South Coast HGM model is applicable for most projects, restoration efforts, or mitigation requirements that may be associated with this Cit of Ojai Urban Watershed Assessment and Restoration Plan.

This model provides a systematic method to measure the relative change in wetland functions a proposed project will have, identify those specific variables and functions that are expected to change, and provide permitting agencies a relative numerical measurement of pre-project (baseline) and post-project conditions (usually two projects with variations). The benefits of using the HGM model are that project comparisons are relative to baseline conditions, and should be valid and stable from that perspective.

Table 1. Ecosystem Functions of Riverine Wetlands

Function	Definition
Hydrology/Geomorphology	
Maintain Alluvial Corridor Integrity	Maintenance of physical attributes and processes that result in characteristic channel width, depth, slope, and roughness.
Maintain Surface Water Hydrology	Maintenance of a characteristic hydrograph, including the amount and time of water delivery to the channel network.
Maintain Subsurface Water Hydrology	Maintenance of surface and ground water interactions between the channel and the local and regional aquifers.
Sediment Mobilization, Transport, and Storage	Maintenance of a characteristic sediment regime through the maintenance of a hydrograph and sediment delivery to the stream network.
Biogeochemistry	
Element and Compound Cycling	Abiotic and biotic processes that convert elements and compounds from one form to another.
Organic Carbon Export	Export of dissolved and particulate carbon, primarily through leaching and flushing.
Plant Habitat	
Maintain Native Plant Association	Maintenance of characteristic plant associations in terms of species composition of trees, saplings, seedlings, shrubs, and herbs.
Maintain Spatial Structure of Plant Association	Maintenance of the structural characteristics required for supporting native plant habitat and their animal associates.
Maintain Characteristic Detrital Biomass	The production, accumulation, and dispersal of dead plant biomass of all sizes. The sources may be up slope, up gradient, or on site.
Maintain Interspersion and Connectivity for Plant Populations	Maintenance of characteristic spatial relationships between plant habitats such that native plant species are capable of completing their life cycles.
Wildlife Habitat	
Maintain Native Vertebrate Associations	Maintenance of the diversity, density, and spatial distribution of aquatic and terrestrial vertebrates.
Maintain Native Invertebrate Associations	Maintenance of the diversity, density, and spatial distribution of aquatic and terrestrial invertebrates.
Maintain Interspersion and Connectivity for Animal Populations	Maintenance of characteristic spatial relationships between animal habitats such that native animal species are capable of completing their life cycles.

PROJECT AREA

The project area includes the entire San Antonio Creek watershed. The focus of this project is on the limits of the City of Ojai, which occupies an area of 4.5 square miles and is the smallest and slowest growing City in Ventura County (Figure 1, Project Location Map). The creek portions occurring within the immediate City limits were all walked, characterized, and sampled for stream and fish habitat characterizations and water quality assessments. Creeks outside of or upstream from the City of Ojai were delineated for this report; however, no field studies or surveys were conducted in these portions of the streams (Figure 2, Aerial Photograph with Delineated Ojai Valley Streams).

Figure 1. Project Location Map

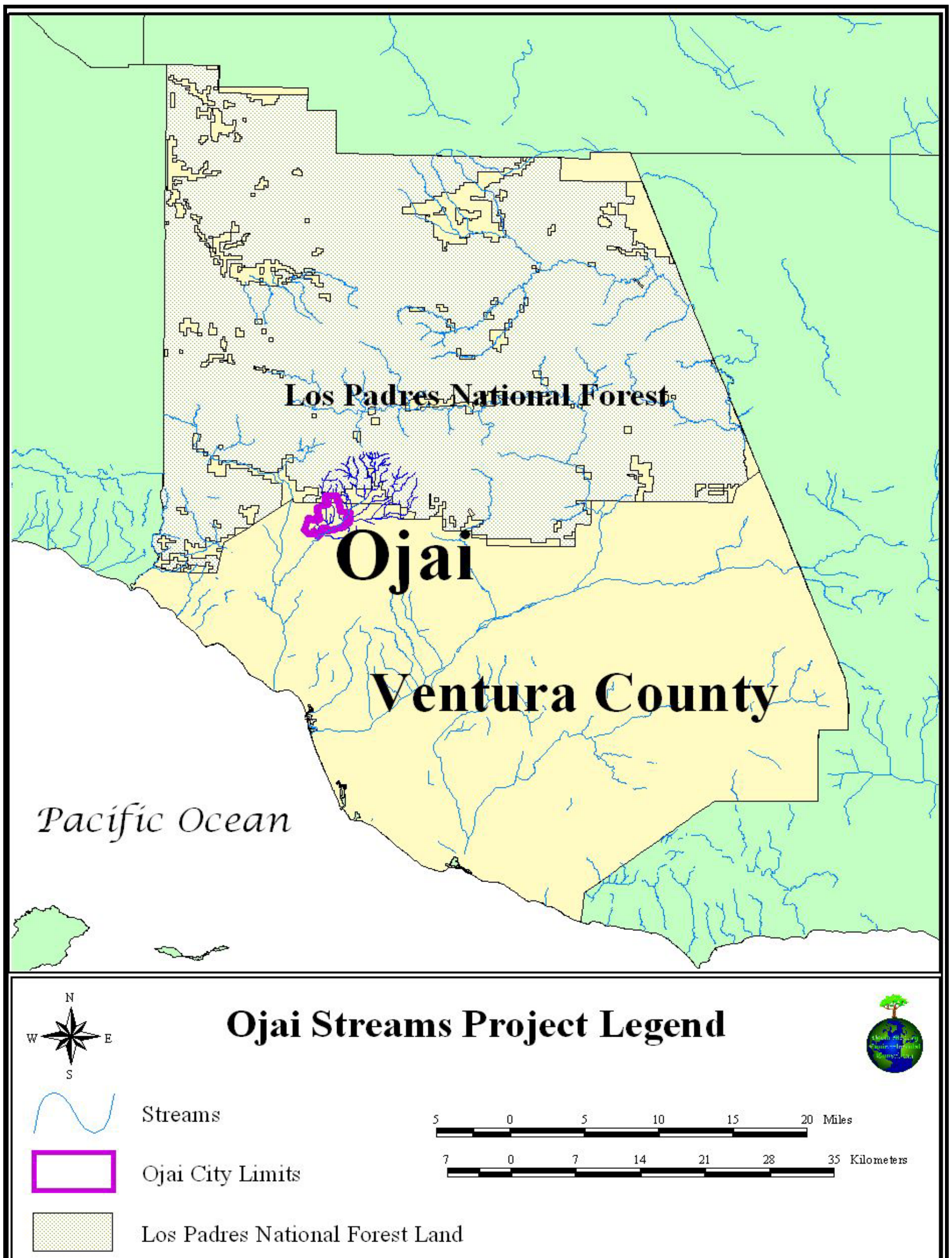
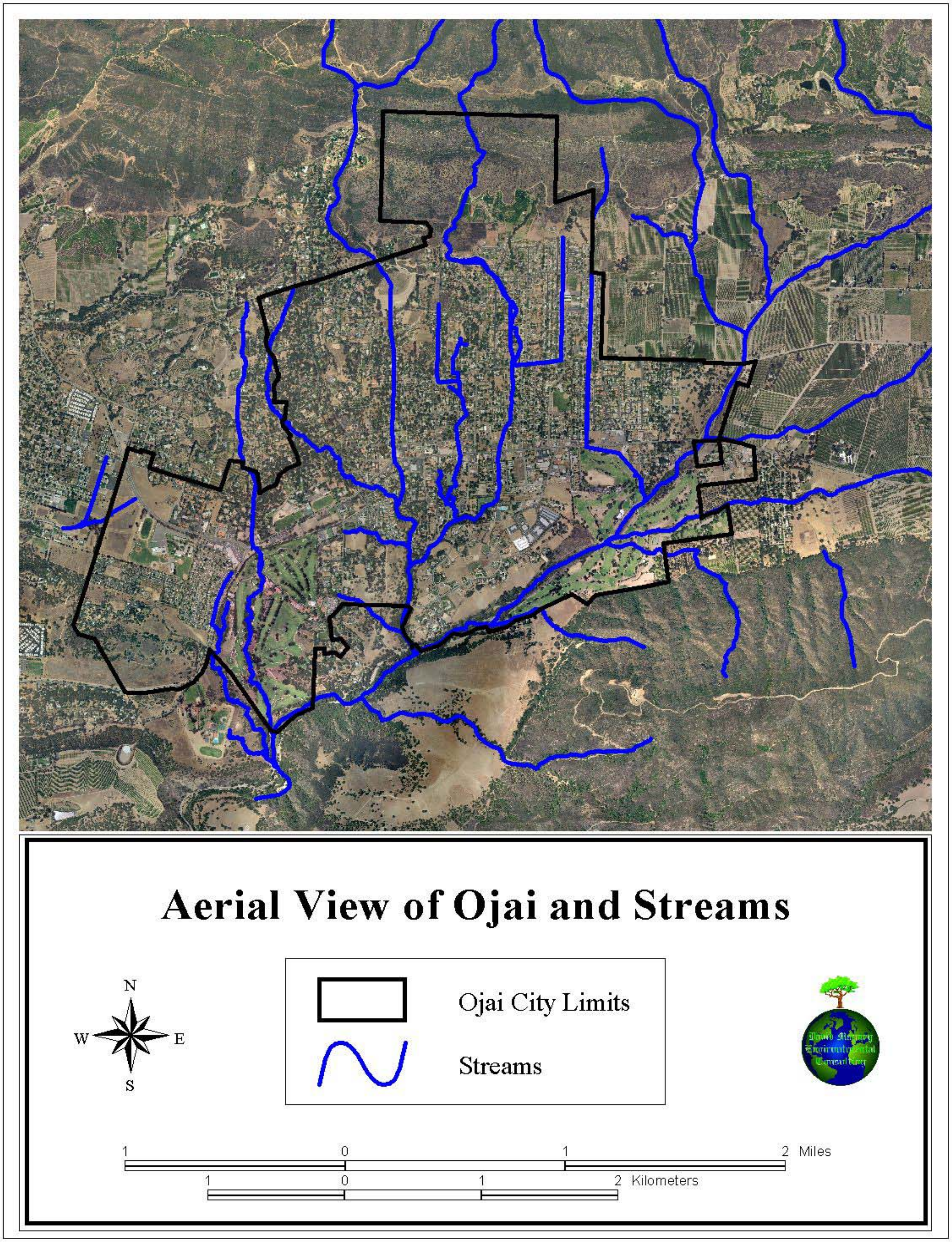


Figure 2. Aerial Photograph with Delineated Ojai Valley Streams



CITY OF OJAI HISTORICAL CONDITIONS

Prior to European settlement, which began in the late 1700s, the Ojai Valley, and area now occupied by the City of Ojai, was undeveloped except for relatively small Chumash villages. There was no man-made impervious cover in the streams or terrestrial lands. Ojai was settled by Americans in the 1880's, primarily with small farms and ranches, dominated by dryland crops, walnut orchards, and later, citrus orchards. The town of Nordhoff was soon established to provide the needs of the local farmers and ranchers, and resort hotels nearby. The name of the town was changed from Nordhoff to Ojai in 1917. The City of Ojai was formally incorporated on 5 August 1921.

As the city grew, urban development expanded around the city core centered along Ojai Avenue. Water diversions and water wells were first dug in the 1880s, and expanded with the growing population and crops. Surface flows in the creeks were perennial to intermittent for most reaches of streams within the City, at least for the larger streams. Nearly all the small streams were ephemeral, containing surface flows either during and shortly after heavy rainstorms, or for weeks to a few months duration during heavier then average rainfall seasons. Many water wells were artesian in the late 1800s. Groundwater levels dropped as withdrawals, primarily for irrigation purposes, increased in the Ojai Valley.

The City population was fairly stable until the 1940s, growing primarily in the 1960s and 1970s, slowing considerably by the late 70s due to restrictions placed on development as traffic congestion became high, and air quality poor. The City of Ojai has grown on average only about one percent per year since, to a current population of approximately 8,000 persons.

The population of the Ojai Valley has grown similarly to that of the City; however, the population has increased at a greater rate in the unincorporated areas of the valley until the late 1990s. The current population of the entire Ojai Valley (which includes the communities of Meiners Oaks, Mira Monte, Oak View, and Casitas Springs) is about 30,000 individuals.

Many anecdotal accounts have noted the presence of Southern Steelhead Trout using several of the streams flowing through Ojai. Specifically, Steelhead Trout have been reported to have been caught from Ojai Creek at Ojai Avenue as late at the 1940s, and have been observed regularly in San Antonio Creek.

Much of the surface water within the City was funneled into urban drainages, converting natural drainages into floodwater conveyance conduits, largely during the 1970s. Ventura County Flood Control District (now the Ventura County Watershed Protection District) constructed, and maintains, many of the drainages within the City (e.g. Fox Canyon Barranca from west of North Montgomery Street, south to Fox Street, Stewart Canyon Creek debris basin and culvert under Cañada Street south to south of the Ojai Bike Trail).

As the City became more urbanized, with paved streets, curbs, flood drains and culverts, water quality into local streams decreased as more pollutants typical from urban areas were washed down the drains to more natural streams downstream.

OJAI VALLEY AND CITY STREAMS

The major subwatersheds of the San Antonio Creek Watershed, the City of Ojai, and the Ojai Valley are Stewart Canyon Creek, Fox Canyon Barranca (Creek), a portion of San Antonio Creek, and a portion of Thacher Creek. Thacher Creek, Stewart Canyon Creek, and Fox Canyon Barranca are all tributaries to San Antonio Creek. San Antonio Creek originates in Senior Canyon on the southerly slopes of the Topatopa Mountains in the northeast quadrant of the basin; it has a drainage area of 135 square kilometers and an average gradient of approximately 11 meters per kilometer. Other major tributaries to San Antonio Creek include Gridley, Reeves, and Lion Creeks. San Antonio Creek is major tributary to the Ventura River system, and joins the Ventura River 13 kilometers upstream from the rivers mouth in Casitas Springs. (Moore 1980b.)

All subwatersheds included in this study are shown in Figure 3, Ojai Basin Subwatersheds, and are listed below in Table 2, Subwatersheds Studied for the Ojai Streams Assessment. All creeks studied within these subwatersheds are shown in Figure 4, Ojai City Streams, and are listed below in Table 3, Creeks Studied for the Ojai Streams Assessment. Tables 2 and 3 also indicate whether each subwatershed and creek is included in or out of the City limits or both. (Refer also to Appendix D, Small Scale Topographic Maps of Ojai Stream Drainages within the north, south, east, and west portions of the City limits.)

Table 2. Subwatersheds Studied for the Ojai Streams Assessment

Subwatershed Name	In the City of Ojai?
Ayers	In and Out
Black Mountain	In and Out
Back Mountain (West)	Out
West Black Mountain	Out
Camp Comfort	In
Del Norte	In and Out
Dennison Park	Out
Fox Canyon Barranca	In and Out
Gridley Canyon	In and Out
Gridley Canyon (East)	Out
Happy Valley Drain	In
Ladera Ranch	In and Out
Mira Monte	In
Upper Ojai (North)	Out
Reeves	Out
Reeves (West)	Out
Lower San Antonio	In
Senior Canyon	Out
Stewart Canyon	In and Out
Thacher Canyon	Out
Lower Thacher	In and Out
Upper Thacher	Out
Upper Thacher (Northeast)	Out
Upper Thacher (Northwest)	Out
Villanova	In

Table 3. Creeks Studied for the Ojai Streams Assessment

Creek Name	In the City of Ojai?
Arbolada Creek	In
Ayers Creek	In and Out
Del Norte Creek	In and Out
Fox Canyon Barranca	In and Out
Grandview-Park Drain	In
Happy Valley Drain	Out
Ojai Creek	In
Nordhoff (Ojai Meadows) Drain	In
San Antonio Creek	In and Out
Stewart Canyon Creek	In and Out
Thacher Creek	In and Out
East End Creek	In
Grandview Drain	In
Oak Creek	In
Post Office Creek	In
Soule Park Creek	In and Out
West Soule Park Creek	In and Out
Villanova Creek	In and Out

Figure 3. Ojai Basin Subwatersheds

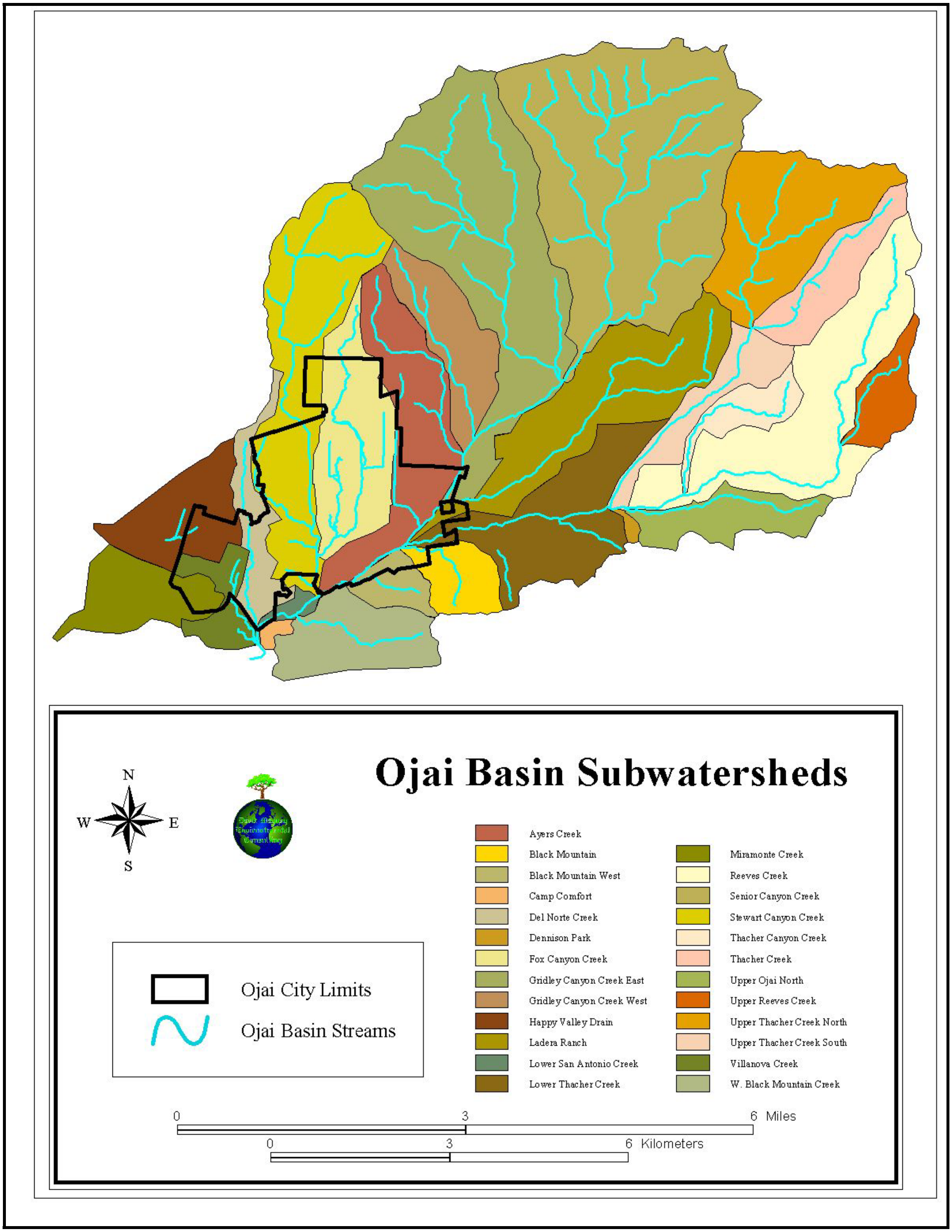


Figure 4. Ojai City Streams