



The State of the Tujunga



An Assessment of
the Tujunga/Pacoima
Watershed



CALFED
BAY-DELTA
PROGRAM



Tujunga Watershed Project

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Prepared by The River Project
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Overview

Reason for the Assessment

The State of the Tujunga Report has been developed to give us as accurate an assessment of the current functional condition of the watershed as the available data and information can define.

It is intended to answer some basic questions: What are the essential attributes of this watershed? What's unique and useful about it? What is the natural capacity of the eco-system? What functions are possible? Is it functioning at its best? What have we done to compromise or change its functioning? What things tell us whether or not we're living on the land responsibly - in other words, are we doing a good job of balancing economic, social and environmental concerns? What can or should we do differently to maximize nature's services for the future? Can we do better?

This report aggregates and integrates a broad range of information. It describes the physical, socioeconomic and political conditions in the watershed. It looks at the natural condition, the stressors imposed upon it and the management issues associated with it. It examines the cultural and historic framework that led to this point and discusses the socio-economic impacts of all aspects of the current condition. It discusses the linkages among land use, natural processes, and limiting factors; identifies key data gaps and monitoring needs; looks at priorities for restoration; and makes general management recommendations.

An assessment is an important step towards developing a Watershed Management Plan. A watershed assessment generally consists of an evaluation of existing watershed condition and processes that establish the current baseline condition. The assessment then informs development of the Plan, which is intended to be a guide to help us manage our resources sustainably.

The Tujunga Watershed Management Plan will be stakeholder-defined and will include specific projects, programs and actions that can be taken to improve watershed condition and the relationship between people and the watershed. This assessment provides the background necessary to inform stakeholder discussions over which approaches can best accomplish the Goals and Objectives that have been defined through consensus. Those Goals and Objectives are found in Appendix 1, and can generally be summarized as: *To revitalize the Tujunga Watershed, balancing water supply, water quality, community open space needs, environmental protection and restoration, and public safety.*

Who Should Read this Report

The primary audience for the report is the Tujunga Watershed Project Steering Committee, the Technical Advisory Committee, the Regional Water Quality Control Board, and the CALFED Bay-Delta Watershed Program. The broader audience includes all stakeholders: residents; businesses; regulators; elected officials and their staff; public agencies and staff; Neighborhood Councils; community and environmental organizations; academia; students; and anyone interested in working towards a sustainable future for the region.

How this Report was Developed

Assessments of watershed condition in smaller or less developed areas are often derived by identifying a healthy 'reference reach' from which to compare the rest of the watershed. Essential ecological attributes, indicators of stress, and monitoring data are analyzed to establish an evaluation of overall condition. While that approach might serve us if we were only assessing the upper watershed, it would not suffice in the highly modified, urbanized lower watershed because it neglects to account for the complexities introduced by human presence and intervention. Still, generally determining health requires some reference for defining good conditions.

The approach we've taken bases the definition of good health on the desired condition as described by stakeholder-defined Goals and Objectives for the watershed (Appendix 1). These articulate the consensus vision for how functional we want our watershed to be, and how we might best accommodate human needs while allowing our natural resources to thrive.

We identified the essential ecological and human attributes, and organized the assessment into associated sections. We evaluated which attributes pertained to the various Goals & Objectives, and connected them to watershed conditions (Appendix 2).

We then set out to discover what we could about current condition by examining all the available information: the history, the research, the models, the monitoring data. Specific approaches utilized for each section are described in the Methodologies section of this report.

The Goals and Objectives then drove the basic inquiries: Are our local water resources being optimized? Is our water quality good? Do we have hydrologic function? Is there enough native habitat and is it connected? Is there a network of accessible open space? Is there broad watershed awareness and stewardship? Are our plans and projects watershed-based? Do our policies support progress? Are we collaborating effectively? If not, then what factors have caused change to the system?

We looked for physical and chemical characteristics that indicate stress and change to the system. Decline sometimes is seen less rapidly than changes in stressor levels (think canaries and coal mines). Identifying causal mechanisms that compromise watershed condition helps allocate management responsibilities.

After analyzing the information and reaching some conclusions about the current condition, we compared that to the desired condition to determine relative health. Lastly we made recommendations suggesting some means to accomplish closing the gap.

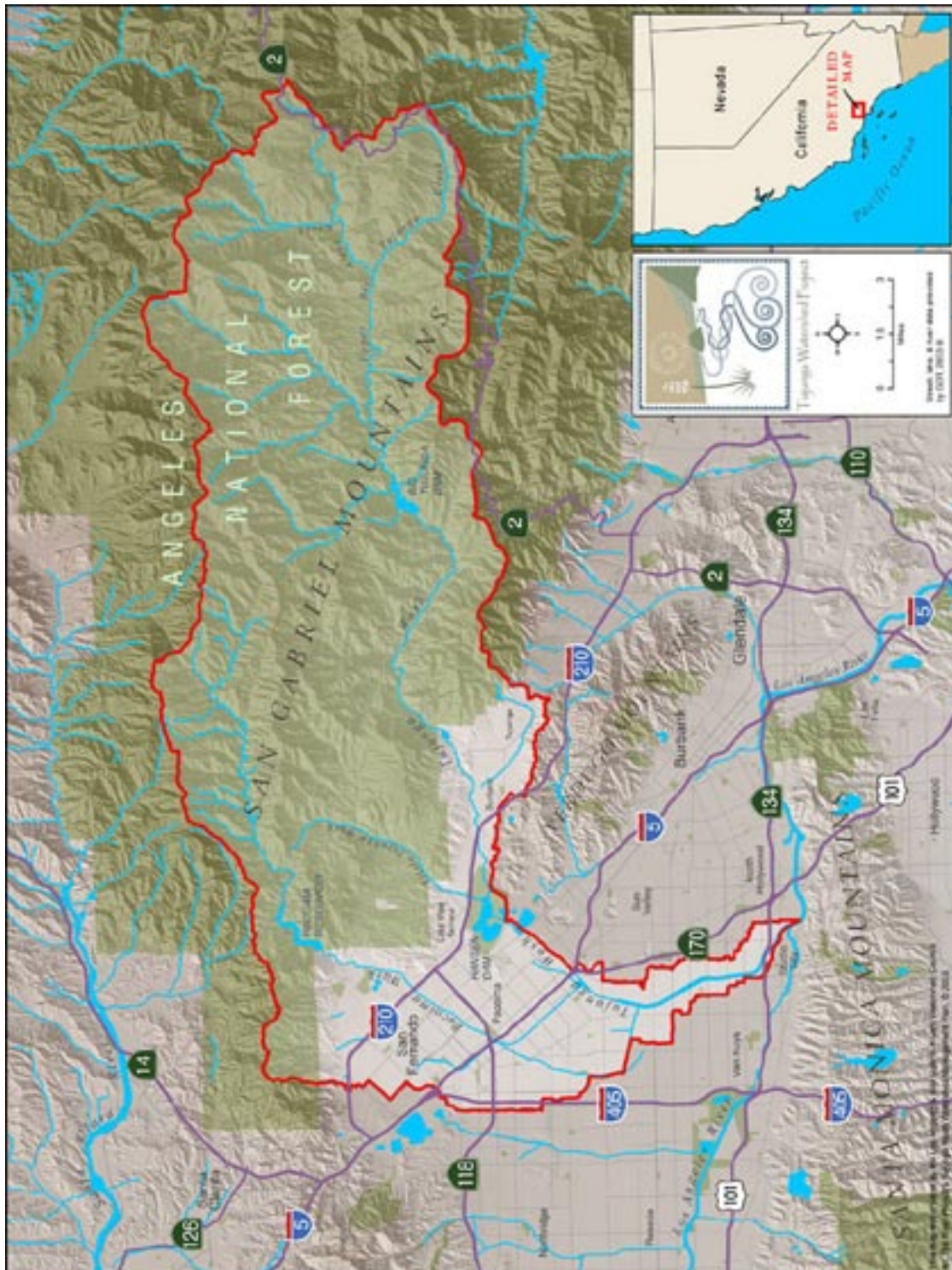
Regional Setting

The Tujunga Watershed is the largest subwatershed of the Los Angeles River Watershed. It encompasses 225-mi² in north-central Los Angeles County, California.



Study Area

The Tujunga Watershed includes Big Tujunga, Little Tujunga and Pacoima Washes, draining the south and west slopes of the western San Gabriel Mountains and the alluvial plains of the eastern San Fernando Valley before its confluence with the Los Angeles River in Studio City.



Tujunga Basics

The Tujunga is the largest subwatershed of the upper Los Angeles River Watershed. The 225-mi² area comprises both remote open space of the Angeles National Forest, and the highly urbanized lands of the cities of Los Angeles & San Fernando. The watershed has a very steep slope - the high elevations of the San Gabriel Mtns. (above 7100 ft.) in the upper watershed drop rapidly to the valley floor at an average rate of 41 ft/mile. Dozens of blue line streams feed the three main tributaries – the Big Tujunga, Little Tujunga, and Pacoima Washes. Since the mountains are geologically young and highly dynamic, its waterbodies are a “young” stream system. Pacoima Wash becomes channelized below the Lopez Debris Basin. Big and Little Tujunga Wash come together in the Hansen Dam Reservoir. Below Hansen Dam, Pacoima Wash joins the channelized concrete box Tujunga Wash as it flows to its confluence with the Los Angeles River in Studio City.

The mountains of the upper watershed are historically prone to episodic fires, common to the chaparral plant communities that dominate the southern slopes, with fire frequency intervals estimated between 20-100 years. A fire history computed for the Tujunga watershed using data from the U.S. Forest Service estimated that 95 percent of the watershed may have burned during the period 1878-1975. In the post-fire scenario, runoff and erosion increase significantly. Additionally, frequent activity along the numerous fault lines within the San Gabriel range can increase the amount of fractured bedrock available for sediment transport by large storms. Prior to the engineering and channelization of the region’s rivers and streams, these washes formed a network of as many as five wide, alluvial channels across the eastern valley.

Historically, the Tujunga Watershed was a major contributor of groundwater supply. The Valley sits atop the San Fernando Groundwater Basin - a huge aquifer that has become depleted over the years as we have made the valley floor impervious. Rain that used to soak into the ground now runs off of concrete and asphalt and directly into the stormdrains, channellized washes, and river. Although Los Angeles averages only 15 inches of annual rainfall, the higher elevations of this watershed receive some of the most concentrated rainfall in the United States. The depleted basin currently provides nearly 15% of drinking water supplies to Los Angeles. Prior to the channelization of our river systems and the subsequent intense development, it was estimated by Los Angeles County flood control engineers that 80% of stormwater percolated to groundwater. Current estimates are that around 8% percolates, the rest being lost to the ocean via the channelized system, carrying contaminants from urbanized land use.

Habitats include alluvial fan scrub, riparian woodland, willow thicket, mulefat scrub, coastal sage scrub, oak woodland and conifer woodland forests. These habitats currently provide critical cover, forage, nesting and breeding sites for many bird, mammal, reptile, amphibian and invertebrate species, including several threatened and endangered species listed for Los Angeles County.

The watershed includes the City of San Fernando as well as the communities of Arleta, Granada Hills, Mission Hills, North Hills, North Hollywood, Pacoima, Panorama City, Sherman Oaks, Studio City, Sunland, Sylmar, Tujunga, Valley Glen, Valley Village & Van Nuys within the City of Los Angeles. The watershed has a population of nearly 525,000, is roughly 61% Latino with 32% of the population under the age of 17 and 19% living in poverty. While the upper watershed encompasses more than 165 square miles of the Angeles National Forest and a large regional recreation area behind Hansen Dam, the lower watershed is extremely park-poor.

The watershed contains numerous facilities, including 4 dams and reservoirs, 16 debris basins, and 5 spreading grounds. In addition, four gravel mining operations and a power generating station occur within the watershed boundary. Transportation corridors include Interstates 5, 405 & 210, and Highways 170, 101, 118 and 14. Metrolink and Amtrak lines and the Metro Rapidway dedicated bus corridor cross the lower watershed. The Metrolink corridor is heavily industrialized.

Methodologies

Data & Information Collection

Spatial data collected for the Tujunga project was compiled into a centralized database from a variety of sources. These sources include data from the City of Los Angeles and City of San Fernando, County of Los Angeles, Southern California Association of Governments (SCAG), the Army Corps (USACE), CalTrans, and many others. Additional data sets were then purchased or developed by the project team to fill in any data gaps that were identified.

Because the project called for certain types of modeling and analysis to be done using two different geographic information systems (GIS) (i.e. ESRI's ArcGIS and ArcView 3.x), all vector data was converted into the ESRI shapefile format. This allows the project team the flexibility to incorporate the use of both systems. All spatial data was then converted (if needed) into a State Plan Coordinate System to conform to general standards used by the City and County of Los Angeles. Next, extraneous data was removed from the database using a clipping procedure within the GIS. Data was clipped to the following project spatial extent¹ –

Bounding Direction	Lat/Long (dec. degrees)	Albers (meters)	State Plane – V (feet)	UTM – Zone 11 (meters)
West	-118.57	131,660	6,389,813	355,650
East	-117.89	193,891	6,593,643	417,777
North	34.44	-395,911	1,982,734	3,811,486
South	34.10	-433,695	1,858,980	3,773,766

Full metadata records are only available for select datasets that were developed primarily at the state level. Most locally-acquired data was delivered with little-to-no metadata. Because the local data represents a large portion of the database, a Data Inventory Catalog was created to define key attributes that may be needed for analysis (see Appendix 3). This includes scale, file type, creation date, source origin and contact, resolution, original spatial extent, share ability, and a short description of the data. New information was entered into the Catalog if it was uncovered during a thorough data review process.

For organizational purposes and general ease of use, the database is divided into 14 basic categories as described below -

- **Cadastral:** parcels, right-of-way
- **Civic:** airports, city facilities, parks, schools, landfills, gravel pits, transmission corridors
- **Climate:** precipitation
- **Demographics:** census (tract, block group, and block level)
- **Digital Raster Graphic (DRG):** 24K, 100K
- **Elevation:** DEM, LIDAR
- **Geology:** faults, liquefaction zones, landslide zones, soils
- **Habitat:** fire history, habitat occurrence, threatened and endangered species, land cover, sensitive plants, invasive plants

(1) Exceptions occurred where data was left at its original extent (i.e. groundwater basins were not clipped so area could be assessed).

- **Hydrology:** rivers, lakes, storm drains, groundwater basins, stream gauges, watersheds, water quality
- **Imagery:** b/w Digital Ortho Quarter Quadrangles (DOQQs), City of LA Imagery
- **Jurisdictions:** assembly, congressional, senate, City and neighborhood councils, cities, conservancies, County supervisorial districts, Angeles National Forest
- **Miscellaneous:** indexes, project extent, masks
- **Planning:** land use, general plans, community plans, zoning, vacant parcels, SEAs
- **Transportation:** roads, bridges, railroads, bikeways
- **Utilities:** substructure diagrams

Analysis

The climate assessment was based on a topic-related web search for Southern California climate with particular emphasis on the Los Angeles River Watershed and Tujunga Watershed. Information regarding global climate change was obtained from the Climate Action Team Report to the Governor and Legislature prepared by the Climate Action Team (CAT) in March 2006.

The geology and geomorphology section of this report was based on information from numerous professional and scholarly publications; analyses of recent and historical topographic, geologic, soils, and survey maps; and digital data primarily obtained from online sources in text, tabular, and spatial format. Fieldwork and unpublished reports were substantiated by other data. The Tujunga Watershed (~582 km²; 225 sq mi) falls within ten USGS (United States Geological Survey) 7.5' quadrangles. A USGS topographic map of one 'quad' is often referred to as a 'topo map'; the large scale allows for comprehensive surveys. Digital and hardcopy topo maps available for the entire watershed are not complemented by coverage of the region on geologic maps at equivalent detail levels. Digital versions of smaller-scale geologic maps (30' x 60' quads) for Los Angeles and San Bernardino were acquired with GIS data layers and individual mapping unit descriptions. Maps covered 5000 km² (1930 sq mi) each; consequently, data subsets were derived for the watershed. Original maps were new syntheses of existing regional data, intended to illustrate the distribution of rocks and surficial deposits and their stratigraphic relation to one another, based on published and unpublished data and reports plus maps produced for various purposes at multiple scales. Two 7.5' quads (San Fernando; Sunland) have recent digital geological maps; these augment smaller-scale digital and earlier hardcopy maps. Digital format earthquake fault, mine, and soil-slip susceptibility data supplemented paper maps and reports. USGS digital elevation models at 10 m resolution and a subset of the USGS National Hydrology dataset were used with other data layers within a GIS throughout this analysis.

The hydrologic conditions were defined by characterizing the hydrologic cycle in the watershed. The hydrologic conditions were first assessed by comparing the natural (i.e., prior to urbanization) hydrologic cycle to the existing hydrologic cycle. The description of the existing hydrologic cycle in the Tujunga Watershed was further described in detail based on the flow of water from the headwater through the watershed via the stream network. Information of the stream network was obtained from prior studies of the Tujunga Watershed, as well as from federal and local agencies. The hydrologic conditions were then assessed for flooding history, monitoring programs, and flooding potential based on reviewing, compiling, and summarizing prior hydrologic and hydraulic studies. The flooding history of the watershed describes the historical events that have led to the implementation of the current flood control system. Monitoring programs that keep records of the hydrologic conditions were reviewed, which included a summary of the numerous active monitoring gage locations, data monitored, and responsible agencies. Data from precipitation, evaporation, and flow gages were then quantified to show general and seasonal trends. The flooding potential summarizes the level of protection of the flood control system within the Tujunga Watershed.

The water supply and use section of this report was based on analyses of historical and current data; a review of relevant water management plan documents; information from numerous professional and scholarly publications; websites and personal interviews. Sources and interviews included federal, state, county, and local agencies; the Upper Los Angeles River Area Watermaster; and non-profit organizations. GIS was used to calculate impervious surfaces, which was derived from a 2001 NLCD (National Land Cover Database) impervious GIS dataset developed by USGS. The impervious layer was clipped to the lower watershed extents and a total area summary table was generated for each imperviousness percentage present in the data. This table was then used to generate a weighted average for the overall (lower) watershed. Additional mapping of relevant water use was extrapolated from the Tujunga GIS database.

Water quality data in the Tujunga Watershed is extremely limited. Surface water quality was assessed according to 303(d) listed impairments, review of available in-stream data, consideration of NPDES stormwater permit and monitoring data, and a comparison to constituents of concern for other watersheds in the Los Angeles River Basin with similar land use composition. Groundwater quality was assessed according to data available from regulatory agencies and the Upper Los Angeles River Area Watermaster. An assessment of potential pollution sources was based on comparing existing land uses with impairments known to be associated with various types of land use.

The habitat section of this report was based on information about vegetation, wildlife, and historical conditions within the watershed and the surrounding region as obtained from numerous scholarly and professional publications; fieldwork in the Tujunga Watershed; conversations with biologists, botanists, ecologists, geographers, naturalists, and other individuals; tabular and spatial format digital data acquired online and from other sources; and analyses of recent and historical topographic, soils, and survey maps and aerial photographs. Data from federal and state agencies were very useful. Unpublished reports and data were substantiated by other sources. Additionally, USGS digital elevation models at 10 m resolution and a subset of the USGS National Hydrology dataset were used with other GIS layers, particularly the California Natural Diversity Database, throughout this analysis.

Existing land use conditions were assessed using various resources including newspapers articles, white papers, personal interviews, historical publications, relevant plan documents (local watershed management plans, master plans, and land management plans), published hardcopy maps, and relevant land use features presented in the Tujunga Wash GIS database. This section is divided into six key areas (parks, schools, transportation & utilities, vacant lots, brownfields, major facilities) that highlight potential opportunities and illustrate prospective obstacles as we move forward toward developing project lists for the watershed management plan. Land use conditions were assessed from three perspectives: a) as a whole (the overall perspective), b) the lower “urbanized” watershed, and c) the upper watershed (i.e. Angeles National Forest). Tables and maps supplement descriptions of area land use, parks & open space, schools, transportation routes, and major single-use facilities. General land use figures for the watershed were analyzed and quantified using basic tools within the GIS. The schools assessment was characterized through interviews, testimonials, and online research, a short data review in the GIS, as well as a review of the most recent LAUSD (Los Angeles Unified School District) School Design Guidelines. The parks assessment was derived from the TPL (Trust for Public Land) Greenprinting model, a statistical GIS analysis, and information described in the recent update to the National Forest Land Management Plan. Existing transportation conditions were defined through online research and GIS input as well as an in-depth review of various MTA (Metropolitan Transit Authority) bus, rail line, and bikeway hardcopy maps. Facilities, brownfields, and vacant lots were assessed using historic records, online research, personal interviews, field review, and descriptions from existing plans that have been adopted within the region.

Assessment of the cultural historical evolution of the watershed utilized a variety of sources including historical documents, numerous scholarly and professional publications, personal interviews, photo archives, planning documents, newspaper articles, white papers, online research, and demographic data. This data was synthesized to recount the history of the region, with a particular emphasis on the cultural evolution in watershed.

The community economic assessment was collected from a variety of plans, studies and resources relating to the current economic and community conditions in the Tujunga watershed. Demographic, economic, and housing data were derived from US Census Bureau data for watershed communities at multiple geographic scales. The recommendations are supported by successfully implemented precedent cases and studies.

For the management and policy assessment, topic areas were identified, and the relevant agencies' documents were reviewed for information about regulatory and other policy responsibilities and practices. Where important policy documents are subject to regular or periodic revision (e.g. Basin Plan, general plans), adoption and/or revision dates are cited. Most agencies' websites include mission and/or policy statements and descriptions of areas of responsibility. Some include procedures, operations and maintenance practices. Rather than "findings" related to physical conditions in the watershed, this section presents "issues" related to each topic area. The issues generally reflect policy areas with a potential for change(s) that could result in realizing the Goals and Objectives of this watershed plan. Recommendations were developed to identify specific policy changes responsible agencies might implement to align with plan Goals.

Assessment

Climate and Climate Change

Introduction

The findings of the climate assessment for the Tujunga Watershed are presented below in two sections. The first section addresses the Southern California climate and regional effects such as El Niño and La Niña. The second section addresses global climate change with information on long-term climatic change predictions and the associated impacts on California for the next 100 years.

Findings

Climate

The Tujunga Watershed is located in Southern California which is known for its Mediterranean climate. This distinction relates to the mild winters and warm summers with little annual precipitation of 15"-20" per year. The climate is moderated by the Pacific Ocean such that temperatures during the summer are not too hot (76°F avg) and temperatures during the winter are not too cold (53°F) as shown in Table A-1. In summer, the subtropical high pressure belts drift north to the northern hemisphere inhibiting the formation of clouds, thereby limiting precipitation. From November through March, precipitation-bearing, low-pressure depressions move southerly from the north towards the equator resulting in precipitation within Southern California. In autumn and winter, the area is subjected to Santa Ana winds, which are winds that blow from the inland areas towards the Pacific Ocean. These forceful winds bring hot temperatures and low humidity often spreading brush fires that endanger wildlife, property, and human life.

Information on the Tujunga Watershed climate obtained from the California Climate Data Archive website (Calclim) is summarized in Table A-1. The nearest stations with available climate data are Tujunga, Pacoima Dam, and Big Tujunga Dam. At Tujunga, the average daily temperature ranges from 53°F in December to about 76°F in July. At the Pacoima Dam weather station, February is the wettest month with an average rainfall of 4.99 inches between 1971 and 2000. The driest month is July with an average rainfall during the same period of 0.04 inches. At the Big Tujunga Dam weather station, January is the month with the most rainfall with an average rainfall of 5.58 inches between 1949 and 2005. The driest month is July with an average rainfall of 0.04 inches. The data reveals that precipitation is higher in the mountain areas (Big Tujunga Dam station compared to the other two stations). This is likely due to the orographic effects of the mountains that cause cooling of the air as it rises over the mountains resulting in increased precipitation (Table A-1 and Figure A-1).

Table A-1. Tujunga Watershed Climate Data

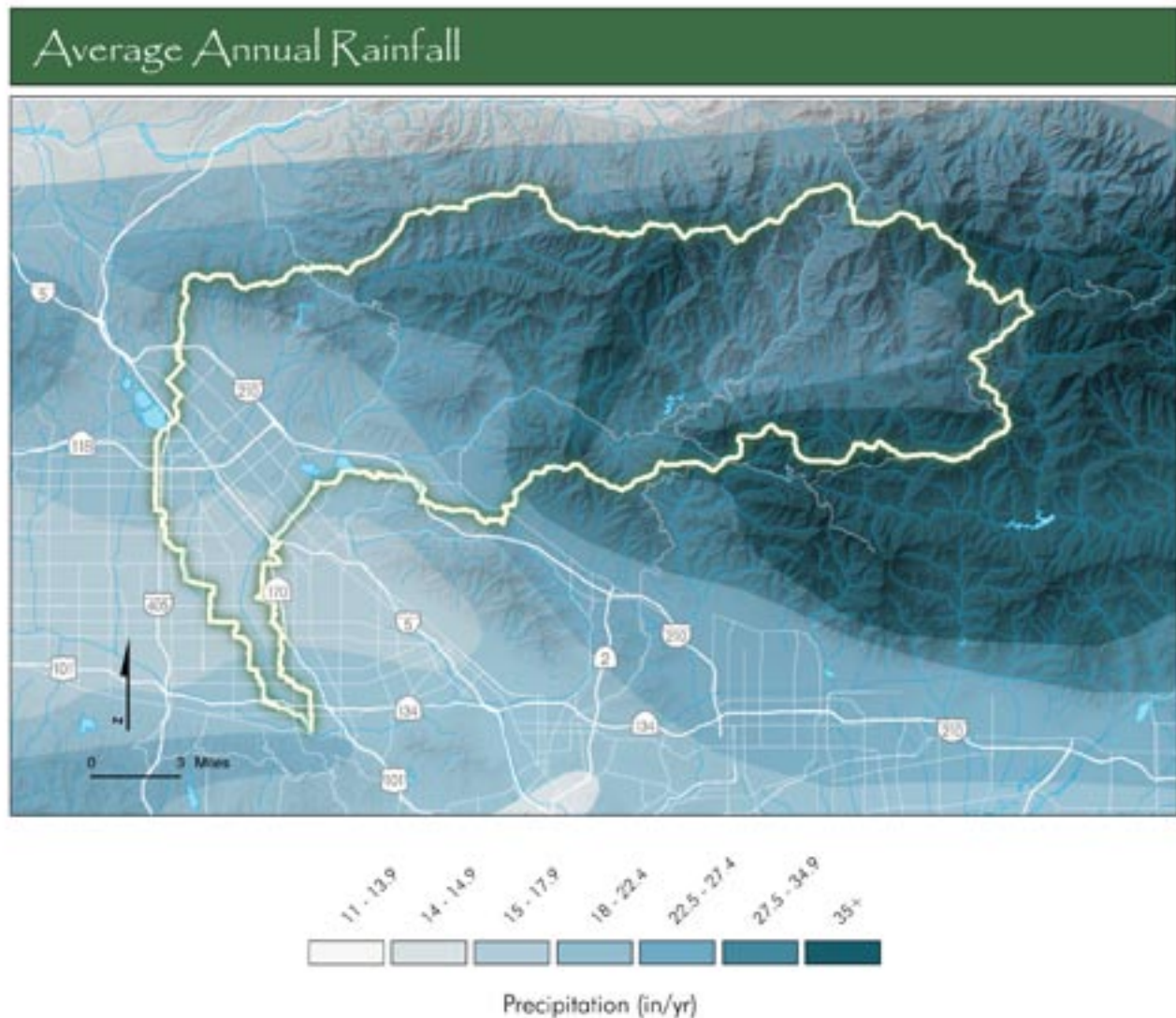
Station	Average Daily Temperature (°F)	Precipitation (inches)	
		Annual Total	Average Monthly Total
Tujunga ¹	53 (Dec) - 76 (Jul)	19.39	0.00 (Jul) – 4.71 (Feb)
Pacoima Dam ¹	Not available	20.77	0.04 (Jul) – 4.99 (Feb)
Big Tujunga Dam ²	Not available	25.62	0.04 (Jul) – 5.58 (Dec)

(1) Period of Record: 1971-2000

(2) Period of Record: 1949-2005

Source: California Climate Data Archive

Figure A-1. Precipitation in the Tujunga Watershed
(Source: Casanova 2006)



winter seasons. These two extreme phases of the climate cycle are often referred to collectively as the El Niño/Southern Oscillation (ENSO).

Recently, climatologists identified a much longer lasting water temperature shift in the Pacific Ocean, which lasts on the order of decades, usually 20 to 30 years. This phenomenon is called the Pacific Decadal Oscillation or PDO. During the cold phase of PDO, the water temperatures of the ocean surface layers are colder and La Niña events predominate. The reverse occurs during the warm phase of PDO when water temperatures are warmer and El Niño events predominate. The period between 1947 and 1976 was identified as a cold phase of PDO, in which La Niña events dominated. This cold phase was followed by the warm phase occurring from 1976 to 1999. During this warm phase, El Niño events dominated. There has been speculation that the PDO is currently switching back to the cold phase, bringing risks of increased drought to the impacted areas, including Southern California and the Tujunga Watershed.

Global Climate Change and Its Implications

In California, an effort was called for by Governor Schwarzenegger's Executive Order (EO) in June 2005 to create climate change emission reduction targets for the state. In response to this EO, the California Environmental Protection Agency created the Climate Action Team (CAT). The CAT studied climate change and evaluated the resulting impacts on California. In March 2006, the CAT published the final Climate Action Team Report (CAT 2006). Climate change was studied under three future emissions scenarios based on the following three different assumptions about global development paths: High Emissions, Medium High Emissions, and Lower Emissions (see Figure A-4). These scenarios were analyzed using several climate simulation models and the results are discussed below.

Climate Change

The earth's climate has always been changing as evident by the extremes of the 100,000-year ice age cycles. The climate of the last 10,000 years, especially the last millennium during which our societies developed, has been quite stable. However, during the 20th century, there have been noticeable observations of rapid change in the climate and climate change pollutants attributed to human activities. Human activities have been influencing the climate by altering the chemical compositions of the atmosphere and by modifying the land surface.

The global mean temperature has been warming at a rate that cannot be explained by known natural causes alone (Figure A-2). Research has shown that the global mean surface temperature has increased by 1.1° F since the 19th century (IPCC 2001 Synthesis report). It is expected that warming in the 21st century will be significantly larger than in the 20th century. Scientists have examined scenarios that indicate the average U.S. temperatures will rise by 5°F to 9°F over the next 100 years.

The rate of carbon dioxide (CO₂) accumulation is currently about 150 parts per million (ppm) per century, which is more than 200 times faster than the background rate of the past 15,000 years. The high concentration of CO₂ is attributed to the high consumption of fossil fuels and destruction of forests to make space for agriculture, growing human populations, and other human activities. As depicted in Figure A-3 below, the CO₂ concentration is projected to continue to rise, likely reaching between two and three times the late 19th-century level by 2100. The growing concentrations of other climate change pollutants (CH₄, N₂O, O₃, and water vapor) generated from human activities alter the composition of the atmosphere and trap heat near the earth surface in a process commonly known as the "greenhouse effect" and it is this effect that is generally accepted to be the cause for most of the human-induced global warming.

Figure A-2. Variations of the Earth Surface Temperature: Year 1000 to 2100
(Source: CAT 2006; IPCC 2001 Synthesis report)

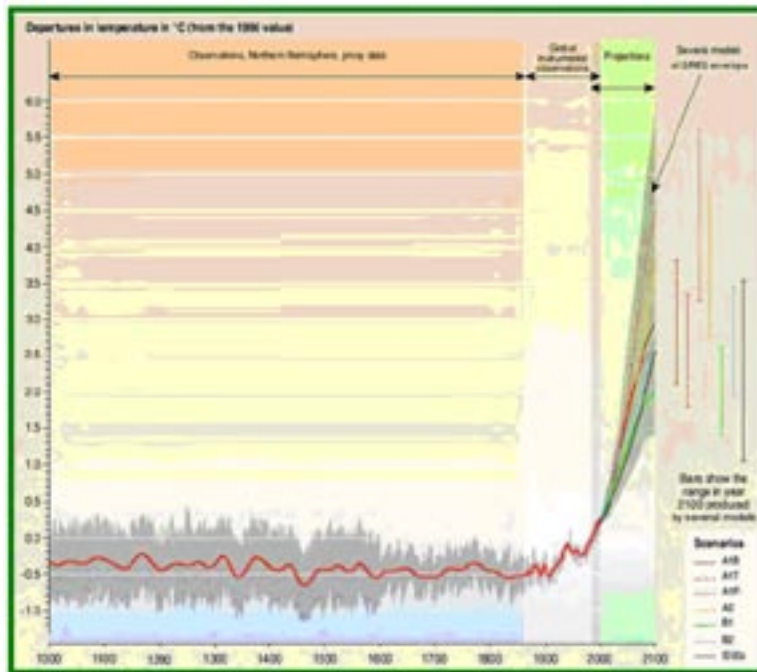
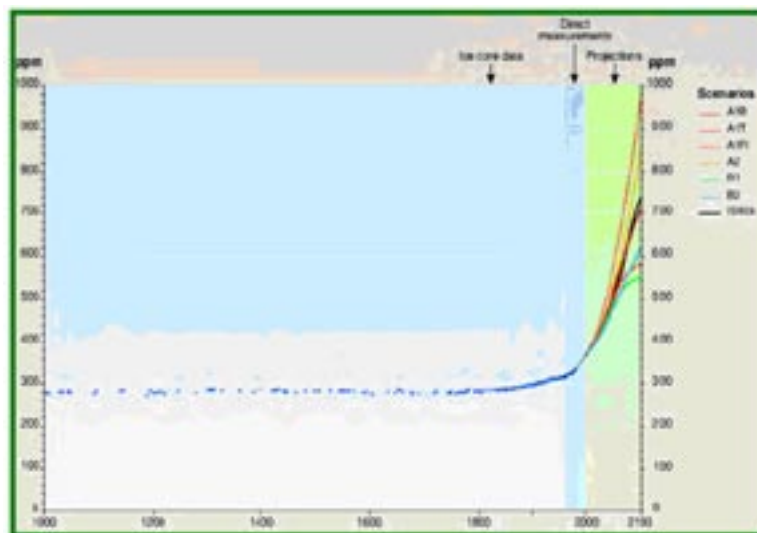


Figure A-3. CO₂ Atmospheric Concentrations: Years 1000 to 2100
(Source: CAT 2006; IPCC 2001 Synthesis report)



Water Resources and Recreation Impacts

Precipitation is projected to change only slightly over this century. Nevertheless, rising temperatures are expected to diminish snow accumulation in the Sierra Nevada and other mountain areas in California. High temperatures will result in more precipitation as rain instead of snow and earlier melt of the snow that does fall. Reductions in snow accumulation and earlier snowmelt will have cascading effects on water supplies, natural ecosystems, and winter recreation. By the end of 21st century, snowpack could decrease from 30% to 90%. The snowpack has been providing natural storage for water since it holds the winter precipitation

in the form of snow and releases that water in the spring and early summer as the snow melts. This loss in storage could lead to more water shortages in the future.

Coastal Sea Level Impacts

Mean sea levels along California coast have been rising historically at about 0.08 inches/year in the last century based on a small set of long-duration California tide gages in San Francisco and San Diego. However, global model projections predict that California's open coast and estuaries will experience increasing sea levels ranging from 4 to 33 inches during the next century. The excessive rise in sea levels implies that historical coastal structure design criteria will be exceeded, the duration of events will increase, and these events will become increasingly frequent as sea level rise continues. On the open coast, impacts during these events will continue to be exacerbated by high surf from wind, waves, and by floods that may further jeopardize levees and other structures at river deltas and estuaries.

Public Health Impacts

The health of Californians will be affected by climate change due to increases in the frequency, duration, and intensity of conditions conducive to air pollution formation, oppressive heat, and wildfires. The annual health and economic impacts caused by air quality conditions in California is estimated at 9,000 deaths and \$60 billion per year. The current air pollution control programs for motor vehicles and industrial sources cost about \$10 billion per year. Climate change will slow progress toward attainment of ozone level controls and increase control costs by boosting emissions, accelerating chemical processes, and raising inversion temperatures during summer stagnation episodes. Results from statistical analyses indicate that the number of days meteorologically conducive to pollution formation may rise by 25 percent (lower projected warming range) to 85 percent (higher warming range) in the high ozone areas of Los Angeles (Riverside) and the San Joaquin Valley (Visalia) by the end of the century.

Analyses of various climate change scenarios project that the future will have a greater number of extremely hot days and fewer extremely cold days with large increases in heat-related deaths predicted for the cities studied (Los Angeles, Sacramento, San Bernardino, San Francisco, and Fresno). In Los Angeles, the number of days with temperatures above 90°F will increase to about 50 to 100 days by the end of the century. Individuals likely to be the most affected include the elderly, ill, and poor.

Agriculture Impacts

Agriculture is the sector of the California economy that is likely to be most affected by climate change. Climate change affects agriculture directly through increasing temperatures and rising CO₂ concentrations and indirectly through changes in water availability and pests.

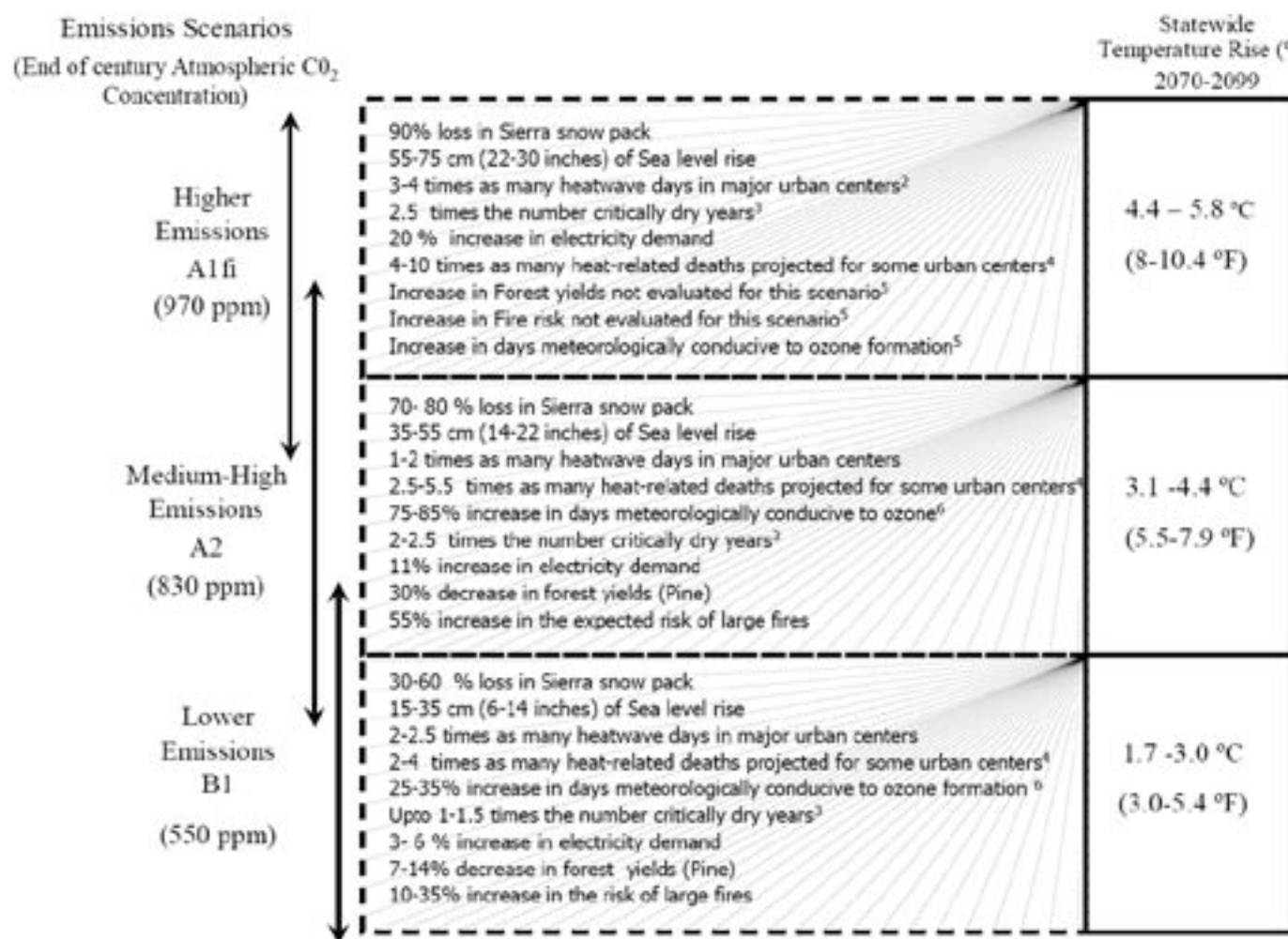
Forests and Natural Landscapes Impacts

Climate change is expected to alter the extent and character of forest and other ecosystems. The distribution of species may shift, while the risk of climate-related disturbances such as wildfires, disease, and drought are expected to rise. Projections suggest that the risk of large wildfires statewide may rise almost 55 percent under a medium-high emissions scenario. Changes in fire frequency may lead to an increase in grasslands, largely at the expense of woodland and shrub-land ecosystems. There may be more poor air quality days as well as increased damage costs of approximately 30 percent above current annual damage costs. While some studies have projected increases in forest productivity under climate change, other recent studies indicate that conifer tree growth would be reduced under projected climate change. The reductions in yield were 30 percent for pine plantations.

Electricity Sector Impacts

Climate changes will affect both the generation and demand for electricity. Currently, about 15 percent of California electric power is generated by hydroelectric facilities. The changes in precipitation levels as well as patterns and timing of snowmelt would change the amount of hydroelectricity that could be generated. It would also change the seasonal availability, with less electricity generated in the late spring and summer when demand is the highest. A recent study showed that under a medium range of temperature increase and decreased precipitation levels, annual generation by the end of the century would decrease by about 30 percent and stream flows would decrease by 28 percent. Electricity demand is projected to rise about 3 to 20 percent by the end of this century, based on the correlation between electricity demand and temperatures, and current socio-economic conditions.

Figure A-4. Projected Impacts at the end of the 21st Century
(Source: CAT 2006)



1. Impacts presented relative to 1981-1990.

2. Los Angeles, San Bernardino, San Francisco, Sacramento, and Fresno.

3. Measures for the San Joaquin and Sacramento basins.

4. For Los Angeles, Riverside, and Sacramento.

5. Impacts expected to be more severe as temperatures rise. However, higher temperature scenarios were not assessed for the project.

6. Formation in Los Angeles and the San Joaquin Valley.

Conclusions

Global warming and the associated climate changes are likely to continue due to emissions from fossil fuels being consumed at existing or increased rates in the future. These changes in climate are likely to lead to increased cycles of drought and wet periods in various parts of Southern California, including the Tujunga Watershed.

Increasing droughts would potentially decrease the amount of imported water available for use within the Southern California area, including the Tujunga Watershed.

Increasing drought periods would potentially reduce the amount of rain that can be stored in surface water impoundments and subsequently infiltrated to groundwater basins.

The potential reductions in water associated with the three items above could be addressed, at least partially, through increases in water storage with particular emphasis on groundwater storage to minimize evaporative losses.

Increasing temperatures would potentially increase the rate at which surface water is lost to the atmosphere through evaporation.

The increased storm intensity associated with climate change could potentially exceed the capacity of the existing flood protection system within the Tujunga Watershed.

Climate change could impact the amount of water needed to sustain landscaped areas requiring more water to maintain vegetation that is not drought-tolerant..

Recommendations

Human activities within the Tujunga Watershed that impact climate change could be modified to reduce contributions to greenhouse gases. This could include increased utilization of public transportation as well as inducements to decrease the average distance between the location where people live and work. Replacing existing landscaping plants that are not drought-tolerant with plants that are drought tolerant could reduce water needs during future droughts.

The water supply system of Southern California should be modified and/or improved to address the potential decreases in imported water, cyclic reductions/increases in rainfall, and evaporative losses attributed to climate change. This could include an increase in the amount of stormwater retained within Southern California via surface water impoundments and groundwater storage with particular emphasis on groundwater storage to minimize evaporative losses. This could be achieved through a strategy that involves both expansion and improvement of the existing water supply infrastructure with particular focus on improving the percentage of stormwater that is captured during storm events. Increased conservation of existing water sources (e.g., increased low flow toilet programs, widespread use of pervious material to replace hardscape, and increased utilization of drought-tolerant, preferably, native plants) will also be important in meeting the water needs of Southern California in the future given climate change predictions as well as policy-related reductions in imported water (e.g., federally-mandated Colorado River allotment reductions). To be successful, flood protection, water storage, and land uses within the Tujunga Wash Watershed will need to be managed in a way that is more effective for the heavier, flashier storm conditions that are predicted to occur in the future.

Geology & Geomorphology

Geology- Introduction

Geology, geography, and climate shape the topography of the Tujunga Watershed. Elevations range from 171.4 to 2172.8 meters (562 to 7128 feet) above sea level, and major distinctions can be drawn between upper and lower watersheds. In the upper watershed, the western San Gabriel Mountains, part of the Transverse Ranges, are an exceptional geologic assemblage shaped by extreme tectonism. Most rocks are ancient but the mountains are very young and actively rising. California's tectonic history is complex and dynamic because we are on a plate boundary. Relevant local events began about 16 to 12 Ma (millions of years ago), south of the Sierra Nevada, where basins formed and existing mountain ranges, aligned north to south, moved north along faults. By about 5 to 3 Ma, in response to a change in Pacific Plate motion which caused it to compress against the North American Plate, local ranges had broken and rotated to an east-west direction, transverse to other California mountains and to the overall tectonic motion at the plate boundary. Further compression began uplifting the low coastal region to form high mountains. Additional horizontal or transverse motion along the plate boundary is associated with compression, thus forces become more complex and are termed 'transpressional' (Norris & Webb 1990; USGS & CGS 2006).

Geologic Time

Earth is dynamic; earthquakes, volcanic activity, landslides and floods can produce change rapidly. It is much more typical, however, for processes to transform landscapes over extraordinarily long time-spans through a series of imperceptible changes. Annual sea level rise at 5 mm (2 in) is 5m (~16.5 ft) over 1000 years. Fault movement at the same rate over a million years translates to 50 km (~31 mi). In the geologic scheme, one million years is comparatively short. Earth was formed about 4.6 billion years ago. To write this, the convention is 4600 Ma. Earliest fossils are dated at about 3800 Ma. About half the Upper Tujunga Watershed rocks are dated 1200 Ma or older, and are among the oldest in the Western United States. In contrast, consolidated sediments in the lower watershed are at least 3 to 5 orders of magnitude younger. To understand local geology, a grasp of geologic time is helpful (Norris & Webb 1990); a simplified chart is presented below (Table B-1).

Table B-1. Simplified Geologic Time Scale
(Geological Society of America 1999; major revisions made by International Commission on Stratigraphy 2004)

Eon	Era	Period		Epoch	Age [Ma]
Phanerozoic	Cenozoic		Quaternary	Holocene or Recent	< 10 Ka
		Neogene		Pleistocene	10 Ka – 1.8
		Paleogene	Tertiary	[Pliocene-Paleocene]	1.8 – 65
	Mesozoic	Cretaceous			65 – 144
		Jurassic			144 – 206
		Triassic			206 – 250
	Paleozoic			[Permian –Cambrian]	250 – 543
Proterozoic	Precambrian	Proterozoic			543 – 2500
		Archean			2500 – 3800

Structural Features: Geologic Mapping Units in the Tujunga Watershed

In tables or map legends (Table B-2; Figure B-2), rocks are listed from youngest to oldest. Over one billion years (1000 Ma) separates the youngest unconsolidated sediments from the oldest watershed rocks; this is an exceptionally broad range. As would be expected, younger rocks are of sedimentary origin, and products of recent weathering. Sedimentary rocks are classified by grain size (e.g., clay, silt, sand, gravel, pebble, cobble, boulder); method of erosion, transport and deposition (e.g., alluvial deposits are loose clay, silt, sand, gravel, and larger rocks washed down from the mountains and deposited in lower areas); the age of the deposits (e.g., recent, young, old, or very old alluvial deposits; all are still comparatively very young); and whether deposition occurred in a marine or non-marine environment. Sedimentary rock may contain fossils; rock units are called formations.

Metamorphic rocks have been transformed by heat, pressure, or both processes; depending on the stressors, this causes varied types of deformation or remelting; resultant rocks often are classified by composition, texture, and structure. Igneous rocks are classified by their mineral composition, which occurs along a continuum. Granite, quartz monzonite, granodiorite and quartz diorite are all 'granitic' igneous rocks which contain quartz, plagioclase feldspar, and orthoclase feldspar, but the percentages of these constituents varies. Igneous rocks are extrusive, formed out of molten lava or ash which has reached the surface of the earth, or intrusive, formed when magma cooled below the surface. Igneous rocks of the Tujunga Watershed are almost entirely intrusive. Each type is distinct; for example, crystals do not form in most volcanic rocks because they cool quickly as compared to intrusive igneous rocks. Many coarse-grained igneous rocks with large crystals are present in the upper watershed. Temperature, water content, and other factors affect the rate of crystallization and determine which minerals form in a given situation. Gold, titanium, iron, lead, and other minerals have historically been mined in the watershed; however, major present-day activities are primarily sand, gravel, and stone quarrying operations (Figure B-2) (Compton 1985; Kohler 2004; MRDS 2006).

Figure B-1. Red line depicts the San Gabriel Fault acting as a barrier to down slope movement of groundwater.
(Source: Vik Andresen, Former Hydrologist, Angeles National Forest)



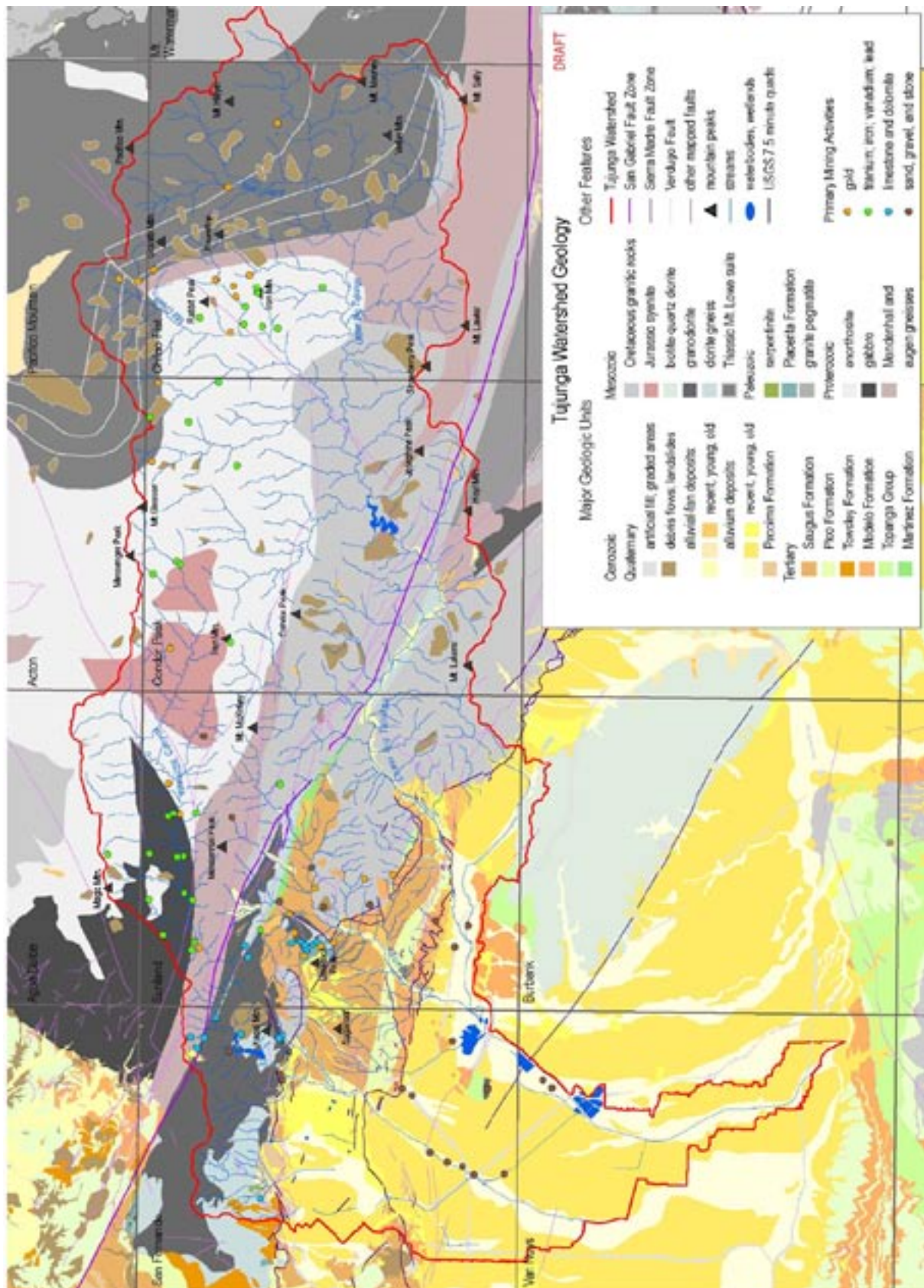
Table B-2. Important Geologic Units of the Tujunga Watershed
(Yerkes & Campbell 2005; Morton et al 2003; Norris & Webb 1990)

Age	Unit Name	Description	Watershed location; USGS 7.5 minute quads
late Holocene	artificial fill; graded areas	Large deposits of sand, silt & gravel resulting from human construction, mining, or quarrying activities; also cuts & fills under urban areas and artificial stream channels.	Lower watershed: San Fernando; Sunland; Van Nuys.
Holocene; late Pleistocene	debris trains, talus, landslide deposits	Unconsolidated, unsorted gravel, sand & silt; commonly includes angular rocks broken in varying degrees from relatively coherent large blocks to disaggregated small fragments.	All mountainous terrain: all quads except lowest elevation Van Nuys.
Holocene; late to middle Pleistocene	alluvial-fan deposits: recent, young & old	Unconsolidated bouldery, cobbley, gravelly, sandy, or silty deposits on active and recently active alluvial fans, deposited primarily by flooding streams and debris flows; with age, surfaces become consolidated, show slight to well-developed soils; oldest deposits dissected.	Lower watershed: San Fernando; Sunland; Van Nuys.
Holocene; late to middle Pleistocene	alluvium deposits: recent, young & old	Unconsolidated gravel, sand & silt in active or recently active streambeds and canyon floors, chiefly stream deposited with some debris-flows; older surfaces consolidate, become dissected, and show slight to well-developed pedogenic soils with a distinctive reddish "B" soil horizon.	Lower watershed: San Fernando; Sunland; Van Nuys.
middle to early Pleistocene	Pacoima Formation	Indurated, yellow-brown, locally intensely folded and faulted conglomerate; unconformable on the Saugus Fm; overlain unconformably by fairly undeformed terrace deposits.	Slopes facing northern San Fernando Valley: San Fernando.
early Pleistocene to late Pliocene	Saugus Formation	Light-colored, slightly consolidated, poorly sorted, coarse-grained, cross-bedded sandstone and pebble conglomerate; mainly non-marine, with some interfingering marine and brackish water deposits; unconformable on Pico Fm strata, overlain by beds of Pacoima Fm.	Lower slopes south of San Gabriel Fault; Little Tujunga drainage from lower Pacoima Canyon to Big Tujunga: San Fernando; Sunland.
Pliocene	Pico Formation	Marine clayey siltstone and sandy siltstone. Soft, olive gray; interbedded with very fine-grained sandstone. Locally abundant foraminifera & well-cemented shells of invertebrates in siltstone.	East-trending band from Santa Susana Mtns. into NW watershed: San Fernando; Sunland.
early Pliocene to late Miocene	Towsley Formation	Interbedded sandstone, conglomerate & mudstone. Overlaps Modelo Fm; conformably overlain by and gradational into Pico Fm.	Far NW watershed only; San Fernando.
late Miocene	Modelo Formation	Predominantly gray to brown thin-bedded mudstone, diatomaceous clay shale, or siltstone, containing interbeds of very fine-grained to coarse-grained sandstone.	Primarily slopes above Tujunga Valley: Burbank; San Fernando; Sunland.
middle Miocene	Topanga Group	Heterogeneous series of sedimentary and intrusive and extrusive basaltic and andesitic volcanic rocks interlayered with marine sandstone and shales; contains a marine facies having distinctive Miocene molluscan fauna.	Pacoima Knoll, NW Verdugos; Burbank; San Fernando; Sunland. Main deposits across San Fernando Valley syncline in Santa Monica Mtns.
Paleocene	Martinez Formation	Coarse-grained marine sandstone, thin interbeds of black shale and lenticular beds of cemented pebble conglomerate; only Transverse Range Martinez Fm to retain name, others have been renamed (eg, Santa Susana Fm).	Upper Little Tujunga drainage; strata in slices within San Gabriel Fault Zone: San Fernando; Sunland.

Table B-2. Important Geologic Units of the Tujunga Watershed (continued)

Age	Unit Name	Description	Watershed location; USGS 7.5 minute quads
late Cretaceous	granitic rocks	Extensive areas of plutonic (intrusive) igneous rocks whose mineral compositions are similar but variable; includes granite, quartz monzonite, granodiorite, tonalite, quartz diorite, and diorite.	Central southern upper watershed; both sides of San Gabriel Fault Zone: Chilao Flat; Condor Peak; San Fernando; Sunland
Jurassic	syenite	Massive, dark-red weathering augite and augite-quartz syenite (syenite is a plutonic rock lower in quartz than granite).	Central northern upper watershed: Acton; Agua Dulce; Condor Peak; Sunland.
Mesozoic	biotite-quartz diorite	Medium-grained quartz diorite; slightly gneissic (resulting in a layered structure without the rock being altered through metamorphism).	Pacoima Knoll; main rock of Verdugos: Burbank; San Fernando; Sunland.
Mesozoic	granodiorite	Quartz diorite; mostly massive, commonly gneissoid near contacts with older rocks.	San Fernando; Sunland.
Mesozoic	diorite gneiss	Dark gneiss includes metadiorite and schists; intrudes Placerita Fm and intruded by Cretaceous granitic rocks. Gneisses are banded or layered by regional metamorphism.	South of San Gabriel Fault Zone: Burbank; Condor Peak; San Fernando; Sunland.
late Triassic	Mount Lowe intrusive suite	Layered pluton (massive igneous rock); each layer with distinct composition and appearance. Predominantly plagioclase feldspar, but matrix varies in proportions of principal minerals; colors range from almost white to dark grey; with large phenocrysts of orthoclase, garnet, hornblende. Formerly mapped as Mount Lowe Granodiorite.	Exposed over large areas of San Gabriel Mtns.; in NE watershed in bands crossing Mill Creek fault. Primarily in Chilao Flat & Pacifico Mountain.
Mesozoic to Paleozoic	serpentinite	Light to dark green, foliated, sheared and slickensided serpentinite (peridotite altered to augite/olivine); fragments can be large boulders.	Far NW watershed only; San Fernando.
Paleozoic	Placerita Formation	Metamorphosed sedimentary rocks, including marble, dolomite, gneiss, quartzite, and various schists. This is the only deposit of this type in the watershed.	Upper Little Tujunga drainage between Sierra Madre and San Gabriel Fault Zones; Limestone Peak: San Fernando; Sunland.
Paleozoic	granite pegmatite	Granite pegmatite (exceptionally coarse-grained rock; last to crystallize from molten magma, with high concentrations of rarer minerals).	Outcrop in anorthosite along N fork of Pacoima Canyon. Agua Dulce.
Proterozoic ~1200 Ma	anorthosite	Medium to very coarse-grained light gray and white plagioclase feldspar rock; shattered and sheared. Same rock as the lunar highlands.	Widespread in northern San Gabriel Mtns. Acton; Agua Dulce; Pacifico Mtn.
Proterozoic	gabbro	Gray, mottled with greenish or brownish black; also solid dark greenish and brownish black. Contains large amounts of ilmenite and massive titanomagnetite bodies (titanium and iron ores).	Upper Pacoima Canyon: Agua Dulce; Sunland.
Proterozoic > 1200 Ma – 1700 Ma	Mendenhall gneiss	In gneiss, metamorphism has altered the original structure, producing layers of granular minerals alternating with minerals with flaky or elongated prisms. Mendenhall gneiss is tinted a distinctive dark color by blue quartz.	Along San Gabriel Fault Zone; type locality on Mendenhall Peak. Chilao Flat; Condor Peak; San Fernando; Sunland.
Proterozoic ~ 1700 Ma	augen gneisses	Rare aluminous and augen gneisses (a textural term; inclusions are eye-shaped) interlayer with the Mendenhall gneiss. The ancient gneisses are among the oldest rocks in the western US.	Chilao Flat; Condor Peak; San Fernando; Sunland.

Figure B-2. Tujunga Watershed Geologic Map



Structural Features: Folds and Faults

Transverse Range transpressional forces have folded, squeezed, crumpled and shattered local rock, which is especially apparent in formations initially deposited as flat sheets, like the sedimentary layers exposed on slopes of the western watershed. These strata are observed bent into arches, standing on end, or overturned. Arches called anticlines are extensively exposed in the mountains, and may erode to form hogback ridges or lines of cliffs; downward bends or synclines form broad basins underlying adjacent valleys. Folding may occur simultaneously with faulting, often accompanied by magma intrusion. Folding slowly produces change over geologic time but faulting may be quick; abrupt slips cause earthquakes. Igneous and metamorphic rocks often break rather than fold. Under heat and pressure, a few local sedimentary deposits have transformed into metamorphic rocks like quartzite, but most watershed metamorphic rocks were derived from igneous materials. Extreme deformation of granitic-composition rocks has resulted in abundant layered gneiss, a high-grade metamorphic rock (De Witt & Woodley 1975; Norris & Webb 1992; Yerkes & Campbell 2005; USGS & CGS 2006).

A fault is a three-dimensional plane, not a linear feature. A fault line refers to the trace often visible on the earth's surface. Major faults are typically a zone one to two kilometers (miles) wide of roughly parallel fractures along which relative displacement of the sides has occurred. Several terms describe faults and movement along them. Dip and strike are geographic and angular measurements; dip is the angle between a fault plane, rock outcrop, or other geologic surface and the horizontal. Dip would be the direction a ball placed on the tilted surface would roll; on a north-dipping plane it would roll northward. Strike is the slope angle, aligned perpendicular to dip (Compton 1985; SCEDC 2006).

Two of three basic fault types predominate here, corresponding to large-scale tectonism. Lateral motion with little vertical displacement occurs on a strike-slip fault; it is characterized as either right- or left-lateral, which refers to apparent motion of the opposite side. Along the fault, shifted alluvial fans or stream drainages may be evident. The San Andreas Fault, just north of the watershed, is a right-lateral strike-slip fault, as is the allied San Gabriel Fault (Figure B-1) that crosses the upper watershed.

Vertical displacement is predominant on normal and reverse faults. Some reverse slip may also occur on strike-slip faults. Normal faulting is gravity-controlled; one side slides downward with respect to the other side. Caused by crustal extension, it is uncommon here. In a crustal compression zone like the Transverse Ranges, reverse faulting is instead typical: one side of the fault (the hanging wall) moves upward with respect to the other (the footwall). A ground rupture called an escarpment or fault scarp may mark where vertical displacement occurs; this appears as a low rock face or line of cliffs. The Sylmar-San Fernando earthquake (1971; M 6.6) raised the San Gabriel Mountains about 2 m (6 ft) above the adjacent San Fernando and Tujunga Valleys, producing 1m (3 ft) fault scarps visible in the lower watershed in Lopez Canyon and elsewhere (De Witt & Woodley 1975; Norris & Webb 1992).

A thrust fault is a specific type of reverse fault, with greater horizontal compression than vertical movement and dip less than 45 degrees. Thrust faults signify compressional tectonics. High-angle thrusts have dips greater than 30 degrees. The Sierra Madre Fault Zone along the western and southern San Gabriel Mountains is a system of high-angle thrust faults. In low-angle thrust faults, the upper fault block is shoved atop the lower block, interrupting the predictable stratigraphic sequence of rock layers; consequently, older rocks may overlie younger rocks, or formations may be inverted. These are also locally common. Shallow-dipping blind thrust faults are a variant; they show no trace because their fault plane terminates below the surface, cut off by a different fault plane; uplift occurs, but no surface break is visible. Their presence becomes known when a fault ruptures. The Northridge earthquake (1994; M 6.7) was traced to a previously unknown blind thrust; it affected some Tujunga Watershed areas although no movement along faults within the watershed

is believed to have occurred. Research indicates that multiple blind thrust faults may crisscross the region underneath the Transverse Ranges as a natural response to transpressional forces (Jones 1995; SCEDC 2006).

Structural Features: Major Faults affecting the Tujunga Watershed

San Andreas Fault Zone

Transform (lateral movement) boundary between the North American and Pacific Plates, the 1200 km (750 mi) San Andreas Fault extends from the Gulf of California to San Francisco Bay. This strike-slip fault trends northwest to southeast, except for the “Big Bend” section north of the San Gabriel Mountains that runs west to east. Located 20-30 km (12-18 mi) north of the watershed at the Mojave Desert interface, this fault exerts the major influence on the existence and alignment of the Transverse Ranges, affecting every aspect of the physical and biological environment of the Tujunga Watershed. Annual slip rate is about 20-35 mm (0.75-1.35 in); however, the last major rupture on the Mojave segment was in 1857 (Fort Tejon EQ, M 7.9) (Norris & Webb 1990; SCEDC 2006)

San Gabriel Fault Zone

This 140 km (90 mi) fault zone originates near Gorman, runs south, then southeast, and enters the San Gabriel Mountains south of Sand Canyon, north of San Fernando. It crosses the Tujunga Watershed in a northwest to southeast arc, north of Pacoima Reservoir to south of Big Tujunga Reservoir. Visible in Little and Big Tujunga Canyons, the fault slices crystalline igneous and metamorphic rocks dated late Cretaceous (~75 Ma) to Proterozoic (>1200 Ma). Upper Big Tujunga drainage is controlled by a northern branch before it turns east to regulate the San Gabriel River. The San Gabriel Fault parallels the San Andreas with a similar geometry. It is believed the San Gabriel was an active section of the San Andreas in late Miocene-early Pliocene and then abandoned. Northward dip is steep and annual slip rate about 4-5mm (2 in). The western half is more active than the eastern half, but Holocene (Recent, < 10 Ka) surface ruptures have occurred between Castaic and Saugus, not in the watershed. Latest fault activity here was dated late Quaternary to Quaternary (10 Ka – 1.6 Ma) (Jennings 1994; Yerkes & Campbell 2005; SCEDC 2006; USGS & CGS 2006).

Sierra Madre Fault Zone

Reverse slip on these high-angle thrust faults has contributed greatly to the abrupt steepness of the San Gabriel Mountains. Future earthquake events are likely; Recent and late Quaternary breaks have occurred. Different fault geometries keep segments separate; in theory, simultaneous rupture will not occur but single- or multiple-segment breaks could happen. It was suggested that a large event (> 7.0 M) on the San Andreas could trigger major breaks on reverse faults like these south of the San Gabriel Mountains (SCEDC 2006; USGS & CGS 2006; Treiman 2000; Jennings 1994). The fault zone is 55-100 km (35-62 mi) long, with roughly 15 km (9 mi) north-dipping overlapping segments along the western and southern mountain edges. The segments are simpler than the entire zone, but they are complex parallel branching systems, not individual faults. Three sections join in Big Tujunga Canyon. The Vasquez Creek division is least active, and may be part of the San Gabriel Fault; it runs between the San Gabriel Fault Zone and the intersection of the Sierra Madre and San Fernando sections of the Sierra Madre Fault Zone. From Big Tujunga, the Sierra Madre section runs east, becoming the Cucamonga Fault. Slip is about 0.36-4 mm (0.1-1.5 in) per year. Part of the San Fernando section trends northwest, following the San Gabriel Mountain and Tujunga-San Fernando Valley interface; a southern trace transects the upper San Fernando Valley. About 15 km (9 mi) long, its last major event caused ground fractures, landslides, rockfalls, severe property damage, and 65 deaths (1971 Sylmar-San Fernando EQ); slip is about 5 mm (2 in), and it may connect to the Santa Susana

Fault (Barrows 1975; Stover & Coffman 1993; Jennings 1994; SCEDC 2006).

Verdugo Fault

This northeast-dipping reverse thrust fault has raised the Verdugo Mountains well above the adjacent San Fernando Valley; latest movements are dated as Recent and late Quaternary. Only a small part of the fault intrudes into the watershed, but this was not the case historically. Streams draining the western Verdugo slopes which are located east of the present-day watershed and channelized lower Tujunga Wash were within the historic Tujunga Watershed (USGS 1902; USDA 1917; SCEDC 2006).

Geomorphology- Introduction

Geomorphology, broadly defined, is the analysis of landforms, the physical features of the landscape. Closely integrated with geology, hydrology, geography, and other disciplines that examine the earth's surface, geomorphology has evolved from a science with an emphasis on qualitative descriptions of landforms and interpretations of their evolutionary history to a process-driven quantitative approach that informs environmental science and engineering by studying relevant and diverse topics such as groundwater flow and percolation, physical and chemical weathering of rock and soils, conditions along tectonic boundaries, slope stability, and response to past and potential climatic change.

In most complex natural systems, cause and effect are not absolute. For instance, the same climate trends, acting upon identical terrain, could produce varied geomorphic responses with different types of erosion and deposition, which would result in distinct stream channels. Human activities compound uncertainty (Ritter et al 2002). Multivariate systems-based geomorphology recognizes that local landforms are linked to regional climate and tectonic activity. Apparent first to geologists in the western United States (Gilbert 1877), this concept replaced an alternative model (Davis 1899) that envisioned long-term landscape change as a progression through definitive, predictable stages.

Current theories integrate hydrologic research that indicates interdependent natural events continually modify landscapes, generating a balance between processes and landforms created. For example, normal river conditions include water discharge and sediment load in constant flux; in response, to maintain quasi-equilibrium, rivers adjust hydraulic variables: water velocity and channel width, depth, roughness, and slope (Strahler 1950; Leopold & Maddock 1953). Time-intervals distinguish types of equilibrium. Static equilibrium exists over steady-time, days to months; no change occurs. In steady-state equilibrium, over 100 to 1000 years, the system remains constant as changes to both landforms and processes offset one another. Dynamic equilibrium exists over millions of years; system conditions progressively change (Schumm 1977). Adjustments to the landscape are often rapid but will reflect episodic fluctuations in the magnitude of disruptive natural occurrences (Ritter 1988).

Tujunga Watershed Geomorphology

Two landforms both dominate and define the Upper and Lower Tujunga Watersheds: the San Gabriel Mountains and the Tujunga Wash Alluvial Fan. Created by the ongoing forces of tectonism and weathering, they are linked by flowing water from rainfall and snowmelt. Fluvial processes - the effects of flowing water - are almost certainly the single most important geomorphic change agent (Ritter et al 2002). Tectonic activity significantly amplifies effects of water to produce distinctive landforms; uplift allows erosion and deposition to continue (Schumm et al 2000). Landscape features naturally present in the Tujunga Watershed such as alluvial fans and anastomosing streams illustrate this synergy.

Unique patterns of environmental variables create local landforms. Climate and geology influence the weather. In our mediterranean climate, the result of latitude and proximity to a cool ocean current, winter storms approach from the Pacific Ocean and encounter the west to east trending Transverse Ranges, at which point air is forced to rise over mountains. Orographic precipitation results: rising air cools and cannot hold as much water, therefore it rains. Descending dry air on the opposite side of the mountains creates a subtle to pronounced rain shadow. Adjacent to the Tujunga Watershed, measurably more rain falls on south- vs. north-facing slopes in the Santa Monica and Santa Susana Mountains. The two upper watershed sites with climate data (Table A-1; Climate) cannot fully explain weather diversity within the upper watershed. However, note that both sites are at low elevations along rivers, but at Big Tujunga Dam (~698 m; 2290 ft), located farther into the upper watershed, average rainfall was 20% higher than at Pacoima Dam (~596 m; 1955 ft) (Calclim 2006).

Highest Tujunga Watershed elevations in the western San Gabriel Mountains are double to triple those in the nearby Santa Monica and Santa Susana Mountains; eastern San Gabriel peaks are even higher (USGS 2006). The mountains present a formidable barrier to storms; consider that the rain shadow they create to the north is part of the Mojave Desert. Weather stations located on south-facing slopes of the San Gabriel Front Range (e.g., Mt. Wilson, Opids Camp), slightly to the south and continuing east of the watershed, receive incredible rainfall amounts, double to triple those of the foothills and valleys to the west and south, but also roughly 40% higher than measured locations within the upper watershed (Calclim 2006; NOAA, 2006). The central part of the southern Upper Tujunga Watershed begins just north of this first range of mountains.

Rainfall received by south-facing upper watershed slopes may be very significant, while perhaps less extreme than amounts described above because locations are farther inland. Unfortunately, there are neither climate records nor permanent weather stations in this region; well-placed stream gauges could be an effective proxy. Official records do have shortcomings: in the western US, climate data are of variable quality, available for relatively brief time periods, and difficult to correlate. Furthermore, rainfall patterns are notoriously erratic and unpredictable; historical averages are matched about 20% of the time. In the lower watershed, annual rainfall may approach four or forty inches (Orsi 2004; Calclim 2006). Winter rainfall is expected; as noted, most rain falls in February. The rainy season is of short duration, but individual events and storm series often are of great intensity. Anecdotal documentation of floods and droughts experienced at lower elevations, including crop records from Spanish Missions and interviews with observers (e.g., see Reagan 1915; Lynch 1931; Van Wormer 1971; Gumprecht 1999; Orsi 2004) provides key ancillary data to supplement existing climate data.

Not surprisingly, watershed elevations are highest on its perimeter. Mt. Sally, Mt. Lawlor, Strawberry and Josephine Peaks, and Mt. Lukens are high southern peaks (~1500-1850 m; 4900-6100 ft). The valley north of these mountains is the drainage of Upper Big Tujunga Creek; its major tributaries, Mill and Alder Creeks, converge from the north. In the west-central watershed, a second ridge to the north of Big Tujunga Creek divides Big Tujunga and Little Tujunga drainages from Pacoima Creek drainage. Mendenhall Peak, Condor Peak, Mt. McKinley, and Iron Mountain are steeper, lower (~1400-1665 m; 4600-5500 ft) peaks. Highest elevations (~1750-2173 m; 5750-7130 ft) are along the north and east edge; most slopes face south. Messenger Peak and Mt. Gleason sit above upper Pacoima Canyon; Roundtop and Granite Mountain divide Mill and Alder Creek headwaters of Big Tujunga; Mt. Hillyer, Mt. Mooney, and highest Pacifico Mountain surround upper Alder Creek. Completing the perimeter, Vetter Mountain divides Alder Creek drainage from Upper Big Tujunga Creek (USGS 2005, 2006).

Peculiarities of local geology supply far more ingredients to shape local landforms. As noted earlier, the San Gabriel Mountains are relatively young with exceptionally steep slopes. They have sharp ridges and narrow, deep V-shaped stream-cut canyons, with few of the uplands and rounded peaks of the San Bernardino Mountains. Active tectonism is ongoing; major faults slice through the area. The mountains are recent, but bedrock formations throughout the upper watershed are old to ancient (~80-1200+ Ma) plutonic igneous rocks (e.g., granite) or their altered states (e.g., gneiss) with similar but variable mineral constituents (Norris & Webb 1990; USGS 2005; SCEC 2006). Except along terraces and slopes facing the San Fernando and Tujunga Valleys from Big Tujunga to Pacoima Canyons, where consolidated sedimentary stream deposits are found, granitic bedrock is typical. Big Tujunga Creek flows through Cretaceous (~80-100 Ma) granites from Mill Creek to Tujunga Valley. Upper Pacoima Creek cuts a section of Jurassic (~150-200 Ma) rock. Upper Big Tujunga and Alder Creeks cross a four-layer Triassic (~220-250 Ma) granitic suite. All other bedrock in the northwest San Gabriel Mountains north of the San Gabriel Fault Zone, half the upper watershed, has been dated as over one billion years old: Proterozoic anorthosite exposed from Pacoima to Alder Creeks was dated at ~1022 Ma; the Pacoima Canyon gabbro and the augen and Mendenhall gneisses are older yet ~1400 -1700 Ma (Table B-2; Figure B-2) (Norris & Webb 1990; Yerkes & Campbell 2005).

Weathering

These are the functional physical components of the Tujunga Watershed ecosystem: under natural conditions, the rapidly-rising mountains of the Upper Tujunga Watershed are continually weathered, then are eroded by flowing water and deposited as boulders, cobbles, pebbles, and sand on the gently sloping alluvial plain of the Lower Tujunga Watershed. As dynamic braided streams cross the eastern San Fernando Valley to their confluences with the Los Angeles River, the heaviest rock fragments are deposited closest to the mountains, while suspended fine sand is transported to replenish our beaches. Other mountain sediments aggrade to form stream deposits and characteristic Tujunga soils. These deep alluvial soils extend south and east along the Santa Monica Mountains and follow the Los Angeles River channel almost to the LA Basin (USGS 1902, 1911; USDA 1917, 1969).

Soil development is a place-specific interaction over time between the parent rock, climate and topography, and decaying organic materials (Birkeland 1999). Tujunga soils are classified as neutral pH, fairly coarse-textured sand or sandy loam that is highly permeable, or 'somewhat excessively drained' (USDA 1969). Water is not retained in upper soil horizons but percolates downward rapidly (Craul 1999). The Tujunga Watershed naturally recharges the San Fernando Valley Aquifer. All features of the physical landscape directly influence distribution and abundance of regional biological communities (e.g., see Schoenherr 1992; Rundel & Gustafson 2005; Schiffman 2005).

Environmental alteration through natural processes continues despite human intervention; all landscapes are subject to weathering. Erosion begins with transport of weathered materials; deposition occurs when transport ceases. Several distinct mechanisms produced our local landforms. Mountain-building has fractured the crystalline rocks from which they are made. Not surprisingly, given the age and type of bedrock, and the tectonic history of the region, decomposed granite is omnipresent. Weathering includes many physical and/or chemical processes which disintegrate rock or decompose it by altering its chemical makeup. Resistance depends on multiple variables, including mineral composition and the nature of the stressors applied. Individual minerals collectively contain a broad range of chemicals and each responds differently to moisture and atmospheric gases. Two common minerals in granitic rocks are feldspar and quartz. The feldspar group of minerals is much more abundant, but not as persistent because it is structurally weak and also more susceptible to weathering and alteration to various types of clay. Quartz is hard, strong, and resistant to weathering, thus stream and beach sands are mainly quartz (Norris & Webb 1990; Ritter et al 2002).

A distinctive weathering process called exfoliation removes thick or thin concentric shells from granitic rock surfaces; this may be a reaction to the atmosphere combined with moisture or a response to differential stresses. Minerals tend to be most stable under the same conditions that they were formed. Unlike volcanic rocks, which cool at the surface from extruded molten lava or ash, plutonic (intrusive igneous) bedrock melted and cooled below ground, emplaced within older rock which may have since eroded (Norris & Webb 1990; Yerkes & Campbell 2005).

In the upper watershed, liquid water is not too effective as a weathering agent. Granitic rocks are not rainwater-soluble. At higher elevations, where temperatures regularly reach the freezing point of water, ice may form and then expand within cracks in rock, lengthening and widening fractures until rocks are shattered. At lower elevations, sedimentary rocks found on slopes facing the San Fernando and Tujunga Valleys are less resistant to effects of water. Porous, soft sandstones are more easily eroded, and eventually crumble. Limestone is highly soluble, but there are comparatively few deep-water marine formations in the watershed, thus very little limestone (Norris & Webb 1990; Yerkes & Campbell 2005). Weathering processes create rocks which range in size from massive boulders to fine silts and clays, although fine sand is characteristically the smallest soil particle found in the Tujunga Watershed (USDA NRCS 1969). Erosion and deposition then act in various ways.

Landform Creation by Erosion and Deposition

Debris Flows

In the upper watershed, narrow stream channels follow fractures in the rock; water takes the path of least resistance. Flashy seasonal precipitation events fill tributary streams within incised deep canyons in the shattered mountains. Torrential rain, steep slopes, and fine sediment are required to initiate debris flows, a gravity-induced high-velocity form of mass movement (Ritter et al 2002).

Debris flows – often called mudslides - are frequent events. Most happen during above-normal rainfall winters, but their likelihood of occurrence involves several critical factors: the overall rainfall amount, storm intensity and duration, and slope vegetation. Vegetation conditions correlate with slope aspect but are most strongly affected by fire. Recently burned areas have a much higher potential for debris flows – even with less rainfall – because the surface material has often become hydrophobic and does not require soil saturation to begin to slip. The viscous dense mud of a debris flow does not behave like water; it may follow a stream channel downslope, or it may not. Capable of transporting extremely large boulders over long distances, flows may also abruptly stop moving. Rocky toes or endpoints of prehistoric, historic, and recent flows and landslides are evident in the upper watershed below canyon mouths and steep slopes (Morton et al 2003). Debris flows may be devastating from a human perspective, and are usually less than successfully controlled by man (e.g., see McPhee 1989; Gumprecht 1999; Morton et al 2003; Orsi, 2004); nevertheless, they are natural events.

Alluvial Fans

The intent of fluvial geomorphology is to describe and analyze landforms created by flowing water (Schumm 1977; Gordon et al 2004). Flowing water and tectonism also combine to produce distinct lower watershed landscape features. Syntectonics is the response of a river to tectonic activity; in stream valleys, uplifting associated with tectonism increases stream gradients and may cause streams to cut through alluvial deposits to create broad terraces that were formerly part of the valley floor (Laurel & Woodley 1975; Nilsen & Moore 1984; Schumm et al 2000). Rivers and streams transport rock debris from erosional sites associated with uplifted steep slopes in the rising mountains to depositional sites downstream, where slopes are gentler.

With the decrease in channel slope, steep-gradient streams lose velocity and carrying capacity when they meet adjacent basins, and deposits of coarse sediments accumulate at the entry to these basins. Alluvial fans are low and broad cone-shaped deposits of water-transported rock debris, or alluvium, which form near canyon mouths and spread farther out with each new depositional episode.

The Tujunga Wash Alluvial Fan is built from an enormous volume of generally unsorted boulders, cobbles, gravels, and smaller fragments transported downstream and deposited over millions of years by the major river channels: Big Tujunga, Little Tujunga, and Pacoima Washes. As expected, these deposits reflect both the rapid rate of tectonic uplift and the geologic diversity of the Tujunga Watershed. Geologically recent, young, and old (0-2 Ma) Tujunga alluvium covers the entire lower watershed, filling the eastern half of the broad, downfolded San Fernando Valley syncline with sediment derived from the San Gabriel Mountains (Figure B-1) (USDA 1969; Norris & Webb 1990; Yerkes & Campbell 2005). Alluvial fans may be constructed of materials of any grain size, but older alluvial-fan deposits are typically considered synonymous with a conglomerate. Clast size decreases with distance and deposits farther from the mountains across the alluvial plain are usually finer textured. Debris flow deposits reach alluvial fans near the mouths of canyons (Nilsen & Moore 1984). Larger streams that drain the interior of mountain ranges, like Big Tujunga, are able to create long, broad, and expanding areas of alluvial deposits, called fanhead valleys, as they exit the mountains, although they are confined within deep mountain canyons for considerable distances. Fanhead valleys are a hydrologically analogous upstream extension of the fan. In Big Tujunga, bed materials in active channels are also texturally similar to alluvial deposits, indicating formation under a similar hydrologic regime (Scott 1973).

Intermittent water flow and high-intensity storm events are key factors determining fan structure. Stream channels in the fanhead valleys and on the fan are inherently unstable ephemeral washes in their natural state. Like those in desert regions, they shift their course in response to flow changes. Completely new channels may radiate from the apex of the fan; flows may jump to old or new channels; and rapid lateral shifts in channel position may occur, which may cause unanticipated erosion of stream terrace banks. During record breaking floods in 1969, Big Tujunga Wash radically shifted its channel. A comprehensive study documented dramatic effects of scour and fill, including a net elevational change to the channel thalweg which varied from about 14 feet of scour and as much as 16 feet of fill. The report considered these extensive changes which occurred in the Wash in the context of both channel morphology and urban planning. The author noted that some changes would have occurred naturally in a storm event of this size, but others would not have happened except for human channel modifications related to urbanization. His conclusion was that the potential magnitude of natural changes in these ephemeral systems was not appreciated, nor was the harmful effect of human modifications fully considered (Scott 1973).

Anastomosing Streams

Rivers are simply classified as straight, meandering, or braided. By this classification of alluvial streams, the Tujunga Wash is a braided stream. Braided streams are a fluvial form characterized by divergent and convergent channels, mostly where there are almost no lateral confining banks (Fairbridge 1968). In its natural state, the Tujunga Wash has a different geometric pattern: it is an anastomosing stream, a specific variant of a braided stream channel. An anastomosing or anabridged pattern of branching and rejoining channels differs from braided channels because they are composed of multiple channels which are separated by a floodplain, rather than braided channels which have multiple thalwegs in a single channel. Anastomosing rivers are associated with both partially blocked valleys and tectonic uplift; a reduced gradient appears to be important, so presence of these streams frequently indicates ongoing tectonic activity. Drainage patterns are affected by regional slope, climate, and erodability of banks. Channels easily change stream patterns to and from straight, meandering, braided, or anastomosing, to any other pattern. Fluvial deposition changes

as patterns change (Schumm et al 2000; Ritter et al 2002).

Rivers are the most sensitive component of the landscape, acting as change indicators, and adjusting to fluctuations in hydrology and sediment load as well as to active tectonism. Avulsion to another location on the flood plain may be related to episodic tectonic events although it is also a natural river response to deposition. Alluvial rivers flow through sediments eroded and deposited by the river; they are not typically constrained by bedrock or old terrace alluvium. Channel morphology reflects a balance between the erosive power of the stream flow and the erosional resistance of the bed and bank material. Morphology of the channel can change as a result of fluctuating water discharge, sediment load, sediment type, and gradient. For hydraulic variables, flow velocity and stream power increase with erosion and decrease with deposition. Local geology and variation in sediment load affect channel shape, but only the width to depth ratio show consistent increase with deposition and decrease with erosion (Schumm et al 2000; Ritter et al. 2002; Gordon et al 2004).

Channels are also classified according to the type of sediment load moving thru the channels, suspended-load, mixed-load, or bed-load. Water discharge determines the dimensions of the channel but the relative proportions of bed load (sand and gravel) and suspended load (silts and clays) determine the shape of the channel and the width-depth ratio and the channel pattern. Sediment size increases with erosion but sediment storage and bar size increases with deposition. Rivers with gravel beds are straighter in areas of uplift and most sinuous in depositional reaches. Increased precipitation generates higher discharge and a larger channel width, but a dry climate limits river discharge and channel mobility. Overall, studies of rivers conclude that they are highly variable (Schumm, 1977; Schumm et al 2000; Ritter et al. 2002; Gordon et al 2004).

Spatial and temporal variations in water velocity and turbidity, or the degree of particle mixing are important parameters relevant to fluvial processes in general. Those which specifically inform development of the Tujunga WMP are detailed in the hydrology section of this report. A comprehensive suite of hydrologic and hydraulic models has been assembled which incorporates characteristics of natural and artificial watershed stream channels under various conditions; this watershed-specific approach is unique and fundamental to the development of the Tujunga WMP (TRP 2006).

Concrete stream channels now cross the wide lower alluvial plain, but an intricate network of older branching streams becomes very evident through analyses of older topographic and soils maps and new geologic maps. Identification of the multiple former channels of the dynamic Wash indicates the river has avulsed across the alluvial outwash plain many times in the recent geologic past and anastomosing streams were once the major landscape feature of the entire eastern San Fernando Valley, north to south (Wheeler; Hall 1888; USGS 1902, 1911; USDA 1917; Hall 2006). Processes which form anastomosing streams still exist in the Tujunga Watershed today but natural systems have been virtually eradicated.

Figure B-3. Northern Lower Tujunga Watershed shown on southern section of 'San Fernando' USGS 15' series topographic map, 1929 overprint (with new reservoir/aqueduct) on 1911 edition; surveyed 1897.

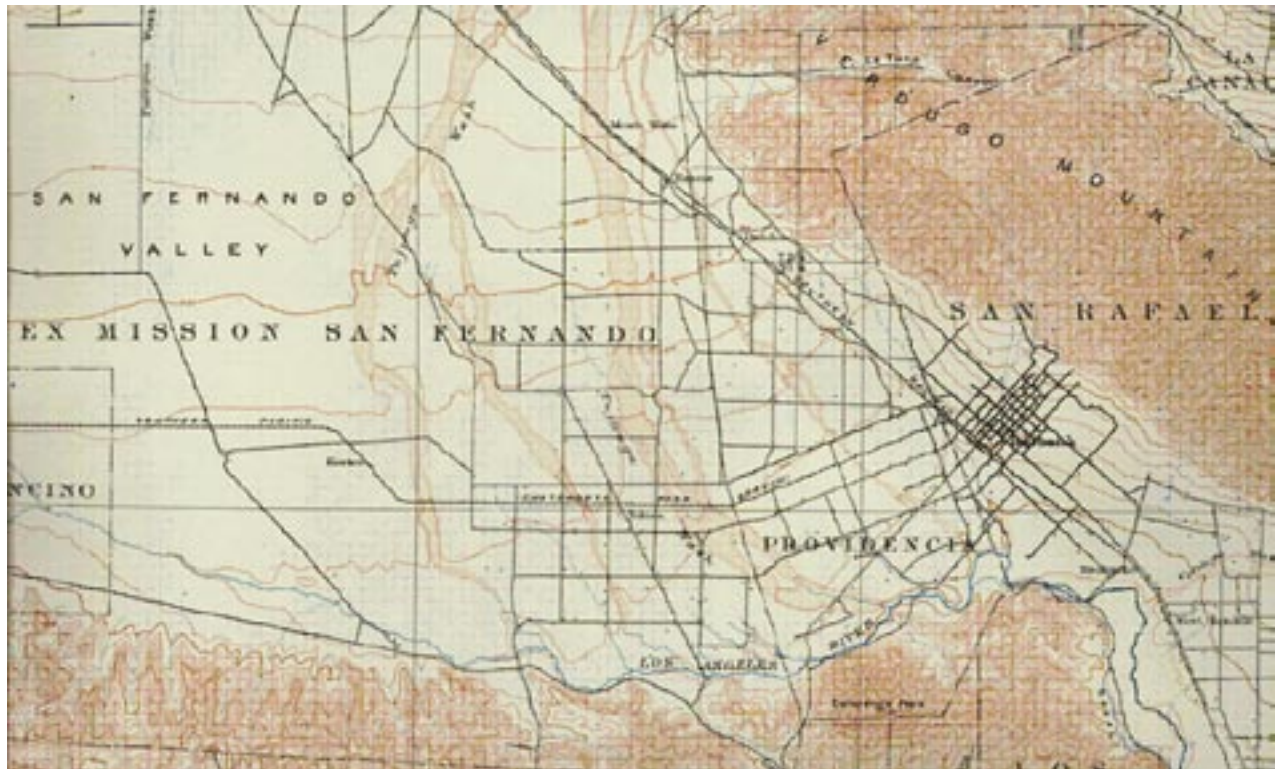
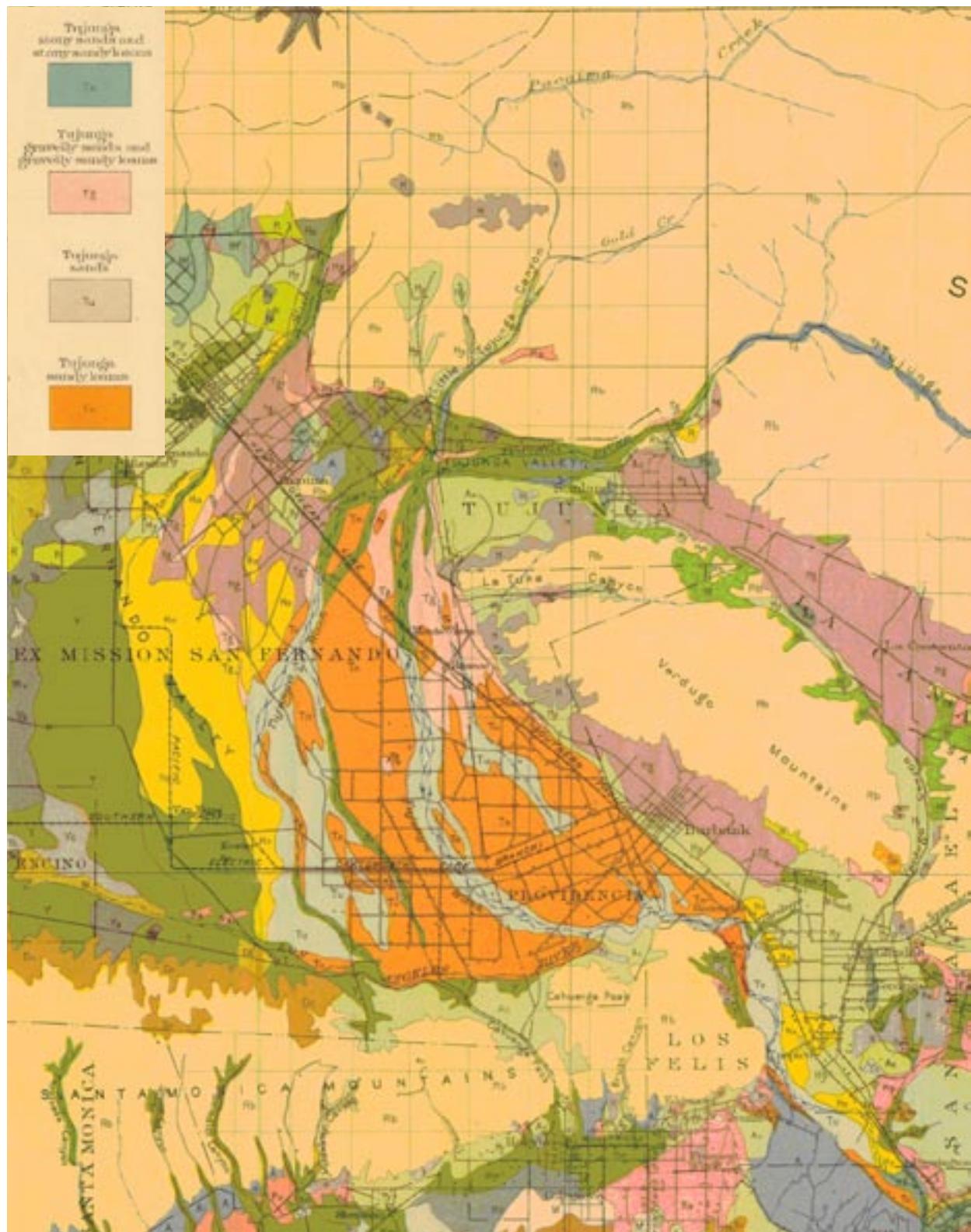


Figure B-4. Southern Lower Tujunga Watershed shown on northern section of 'Santa Monica' USGS 15' series topographic map, 1902 edition; surveyed 1893-4. The anastomosing stream channels are an obvious feature.

Figure B-5. Lower and part of Upper Tujunga Watershed clipped from 1917 USDA Soil Map of Los Angeles County to match historic topo map region (Figures B-2 & B-3). Note Tujunga soils (see legend) cover the eastern San Fernando Valley and extend downstream on the Los Angeles River, past Los Feliz.



Conclusions

Over historic time, the lower watershed has been transformed. Unlike the relatively natural upper watershed, most of the alluvial fan lies hidden beneath an urbanized environment, covered with concrete and asphalt, but it has by no means been eradicated. Closer to the mountains, remnants of the original alluvial fan environment persist, including the large sections along Big Tujunga Wash. Smaller sections occur elsewhere. Remnant environments are special locales which require vigilance. The alluvial fan supports a highly endangered, unique suite of vegetation, Alluvial Fan Sage Scrub, discussed in the habitat section of this report.

Recommendations

Alluvial fans are highly porous and permeable. Multiple opportunities exist for functionality of this natural system to be restored along historic and present-day stream channels within the upper and lower watershed; this functionality includes natural groundwater recharge within the San Fernando Valley aquifer by allowing water to percolate through the soils.

By re-thinking the utilization of spreading grounds and other facilities, and following natural anastomosing stream channels, multipurpose objective riparian corridors may be both effective habitat linkages for animals and avenues for various forms of human recreational use.

Ideally, locations where Alluvial Fan Sage Scrub remains should be protected.

Hydrology

Introduction

The findings of the hydrology assessment for the Tujunga Watershed are presented in six sections. The first section addresses the natural hydrologic cycle while the second section addresses the existing hydrologic cycle. The third section addresses the hydrologic basin and stream network system throughout the Tujunga Watershed. The flood history of the Tujunga Watershed is discussed briefly in the fourth section and the fifth section contains information pertaining to the various hydrologic monitoring that is performed throughout the Tujunga Watershed. Finally, the flood potential throughout the Tujunga and Pacoima stream systems is summarized in the sixth section. Conclusions and recommendations relevant to the Tujunga Watershed are presented following the findings below.

Findings

Natural Hydrologic Cycle for the Tujunga Watershed

Within the Tujunga Watershed, precipitation in the upper watershed falls in the mountainous terrain of the San Gabriel Mountains within the Angeles National Forest. The very steep slopes, shallow soils, and bedrock channels in the San Gabriel Mountains transported runoff, sediment, and debris (e.g., trees) down Pacoima Creek and Big Tujunga Creek. More than half of Pacoima Creek and Big Tujunga Creek lie within mountainous terrain. A schematic of the natural hydrologic cycle in the Tujunga Watershed is shown in Figure C-3.

Both creeks flow westward around the Verdugo Mountains and then southwest through the San Fernando Valley. Pacoima Creek historically served as a direct tributary to the Los Angeles River but now it is connected to the Tujunga Wash (MRCA 2000). Big Tujunga Creek turns into Tujunga Wash, which joins the Los Angeles River and ultimately flows into the Pacific Ocean. Historically, Tujunga Wash was a braided channel system with at least three channels (Figure C-1). The main channel occurred along the same curved path as the current Tujunga Wash with a narrower active channel within a larger channel that flowed during large flood events. During large storm events two minor channels branched off on the eastern side of the main channel. The historical channel width (prior to 1927) is estimated to have ranged between 1,200 ft and 2,850 ft with a flow capacity of 13,400 to 80,900 cubic feet per second (cfs). The historical channel slope is estimated to be similar to the existing channel slope (MRCA 2000). The historical average natural channel slope (e.g. Upper Tujunga) was estimated to be 15% (Board of Engineers 1915).

In the San Fernando Valley prior to urbanization, the runoff was able to infiltrate into the ground, eventually percolating to ground water. The lower portion of the Tujunga Watershed overlies part of the San Fernando Valley Ground Water Basin and Sylmar Ground Water Basin. The historical infiltration rates prior to urbanization are estimated to have ranged from 0.2 to 0.5 inches per hour in the upper watershed (above Lopez and Hansen Dams) based on the various soil types. The lower watershed had historical infiltration rates that are estimated to have ranged from 0.4 and 0.5 inches per hour.

Existing Hydrologic Cycle for the Tujunga Watershed

The flood control system of dams and lined channels, as well as urban development in the Tujunga Watershed, has modified the natural hydrologic cycle in the Tujunga Watershed. A schematic of the existing hydrologic cycle is shown in Figure C-4. Modifications to the natural hydrologic cycle (e.g., dams, impervious surfaces, ground water pumping, and spreading grounds) have redistributed water between precipitation, evapotranspiration, interception, infiltration, and runoff.

Figure C-1. 1890's Hydrology of the Tujunga Watershed
(Source: Historic USGS Quads)

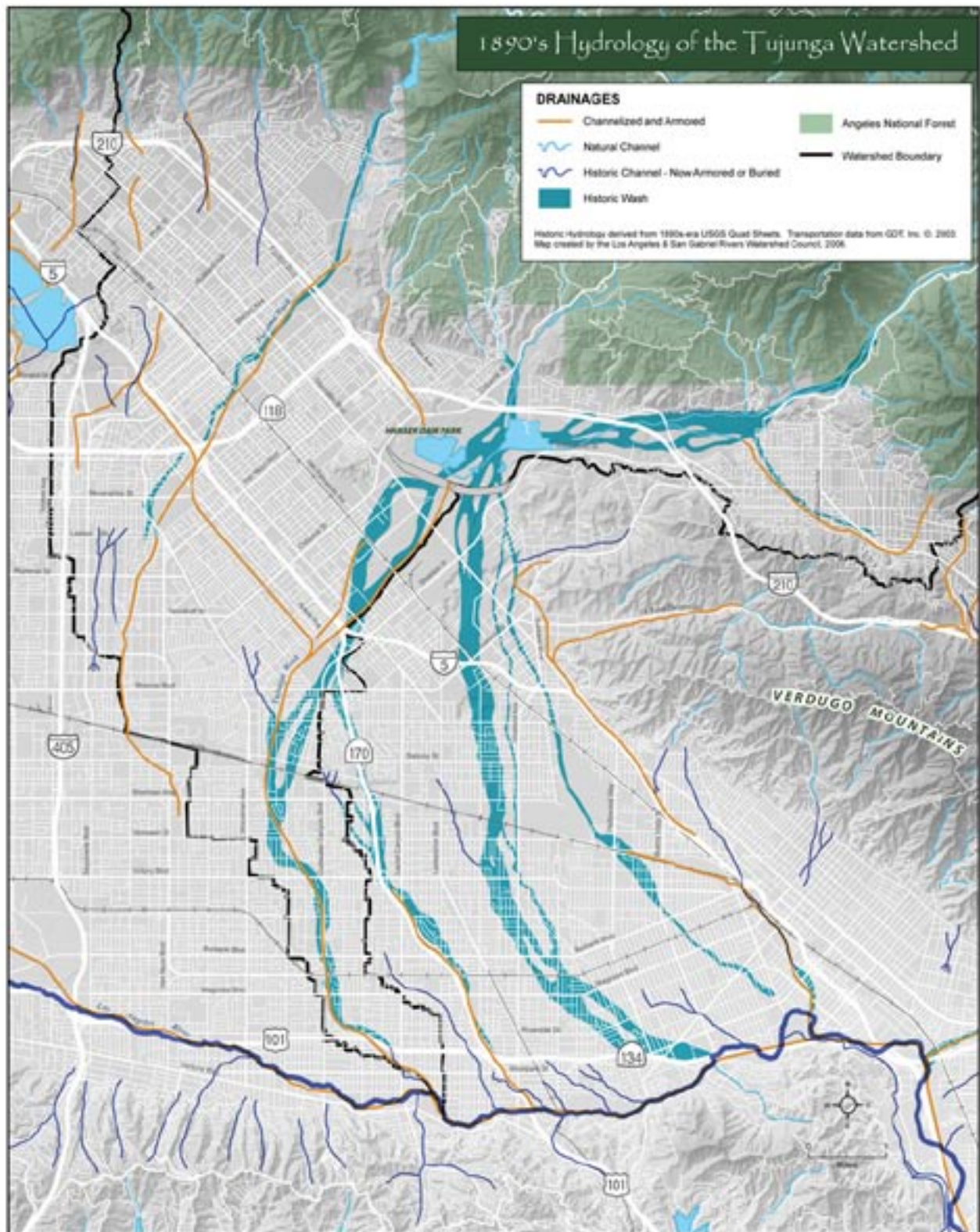


Figure C-2. Current Hydrology of the Tujunga Watershed
(Source: Historic USGS Quads)

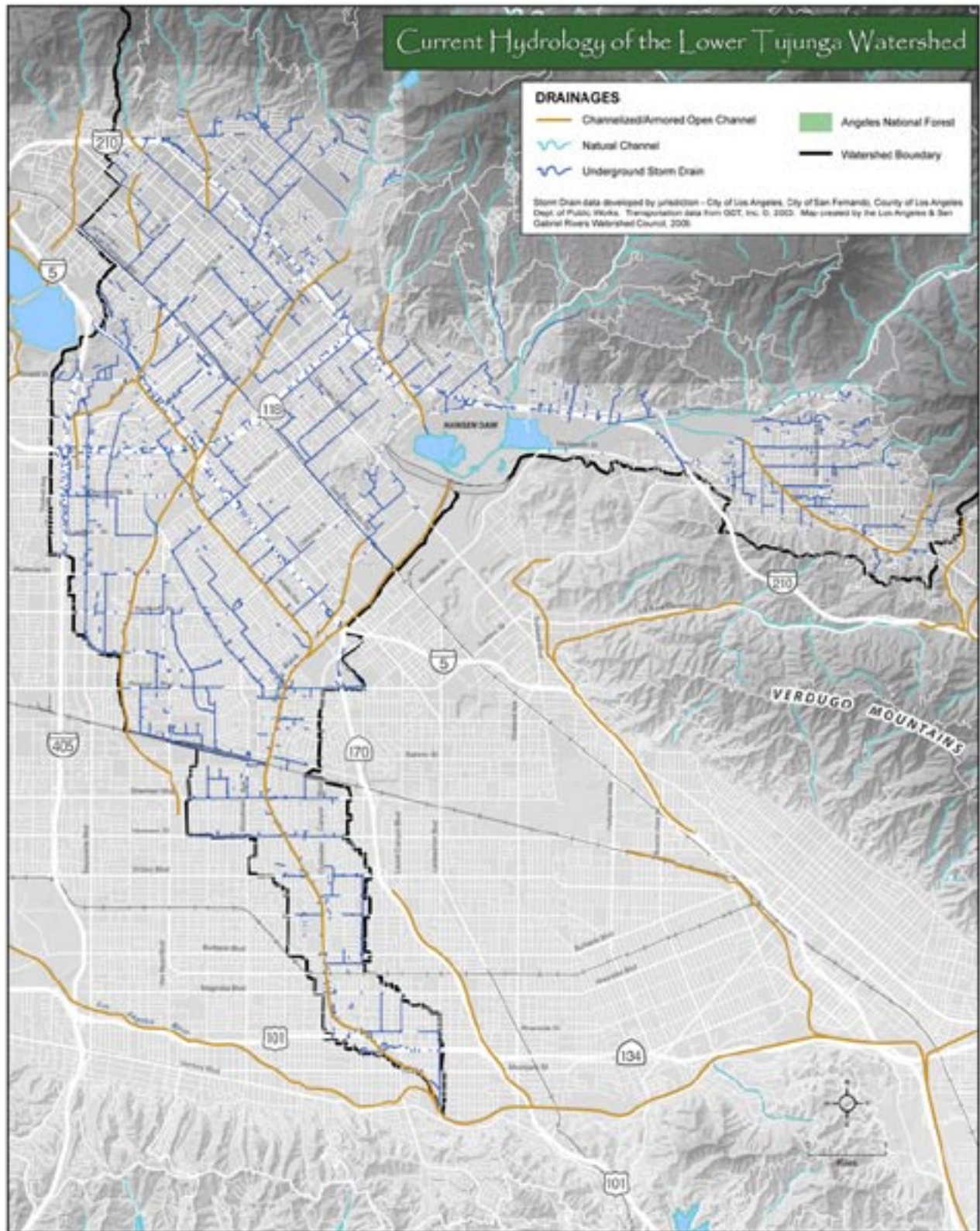
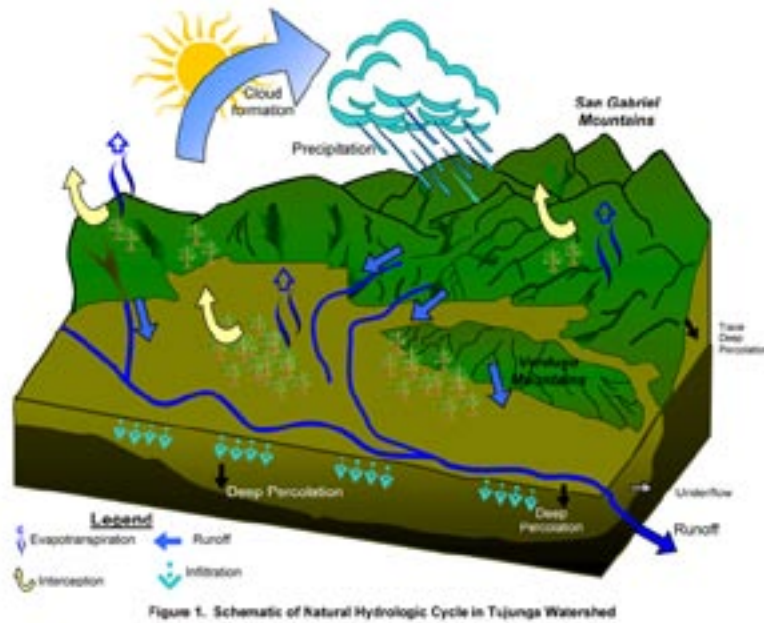
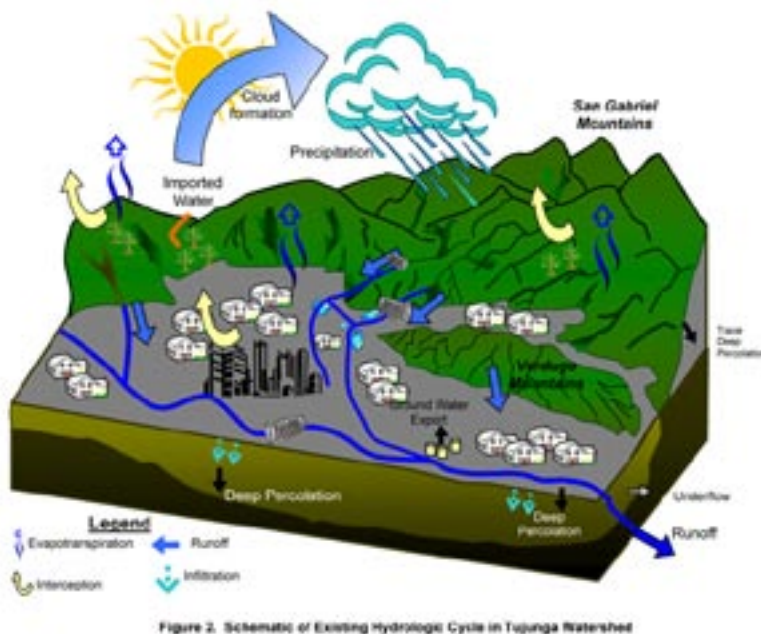


Figure C-3. Schematic of Natural Hydrologic Cycle in the Tujunga Watershed
(Source: Everest International Consultants 2006)



Flood control dams and reservoirs in the upper watershed control runoff from the mountains and prevent coarse-grain sediment and debris from moving downstream. Smaller debris basins also reduce the amount of sediment and debris moving downstream. Portions of the natural streams have been lined with concrete to efficiently move flood waters from the mountainous terrain through urban areas and then down to the ocean. Some of these flood control channels have altered the natural flow paths. In addition, urbanization of the lower watershed has modified the timing and magnitude of the flood flows resulting in larger peak flows that occur over shorter durations.

Figure C-4. Schematic of Existing Hydrologic Cycle in the Tujunga Watershed
(Source: Everest International Consultants 2006)

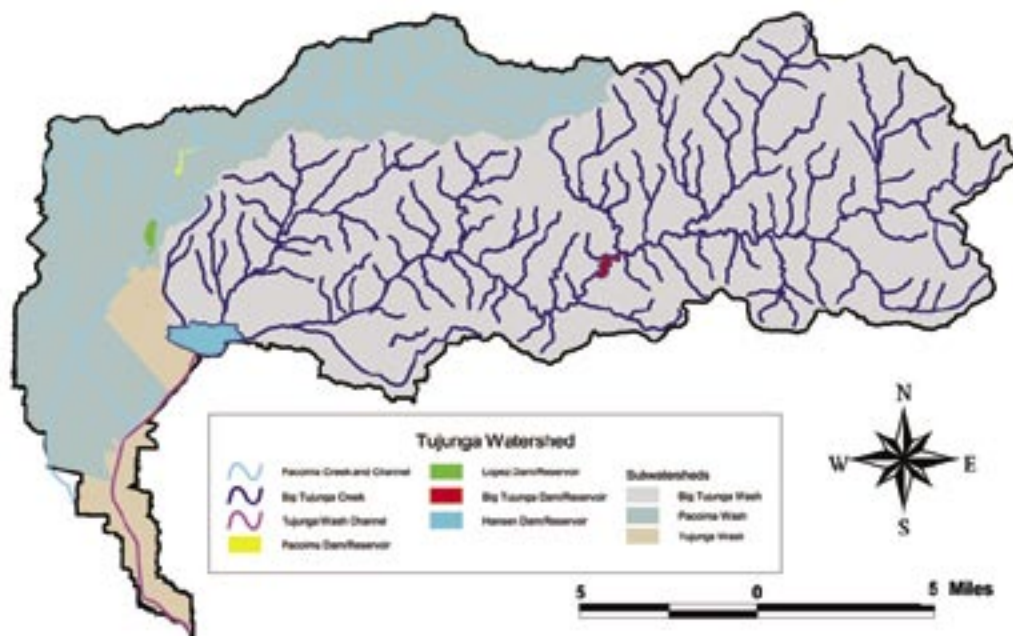


In the watershed, urban areas such as roads, parking lots, and structures, have increased the amount of impervious areas and decreased vegetation; hence, increasing the amount of runoff and reducing the amount of infiltration and sediment erosion. The reduced infiltration has resulted in a decrease in percolation to the ground water. The pumping of ground water to provide drinking water and the reduction of infiltration rates have resulted in significant lowering of the ground water table. Starting in the early 1900s, land was set aside to develop spreading grounds aimed at preserving areas to infiltrate surface water into the underlying ground water basins. The ideal location for spreading grounds is along the alluvial fan valleys (i.e., edges of the ground water basin at the base of the mountains) where soil infiltration rates are high and the recharged water has direct access to the ground water basin. In 1915, the Los Angeles County Board of Engineers recommended pursuing a conservation and flood control strategy that included setting aside numerous acres for flood water spreading to conserve water and reduce flood flows. For example, one member of the Board of Engineers (L.B. Lippincott) recommended setting aside up to 3,135 acres in the Tujunga Watershed for this purpose (Board of Engineers 1915). The ideal location for spreading grounds is along the alluvial fan valleys (i.e., edges of the ground water basin at the base of the mountains) where soil infiltration rates are high and the recharged water has direct access to the ground water basin. While some of these locations (comprising 543 acres) are currently being used as spreading grounds, many of the other choice locations have been developed for urban uses (e.g., residential, commercial, and industrial).

Hydrologic Basin and Stream Network for the Tujunga Watershed

The 225-mi² Tujunga Watershed consists of a network of dams/reservoirs, streams, and flood control channels (Figure C-5) that divides the watershed into three smaller subwatersheds: Pacoima Wash, Big Tujunga Wash, and Tujunga Wash. Pacoima Wash Subwatershed to the west and Big Tujunga Wash Subwatershed on the east merge to form Tujunga Wash Subwatershed.

Figure C-5. Tujunga Watershed
(Source: Everest International Consultants 2006)



A summary of the size and percentage of the subwatersheds is shown in Table C-1. Big Tujunga Wash is largest, making up 68% of the Tujunga Watershed, followed by Pacoima Wash (27%) and Tujunga Wash (5%).

Table C-1. Tujunga Subwatersheds
(Reference: LACDPW 1997)

Subwatershed	Drainage Area (mi ²)	Percentage of Tujunga Watershed
Pacoima Wash	61.08	27%
Big Tujunga Wash	152.58	68%
Tujunga Wash	11.24	5%

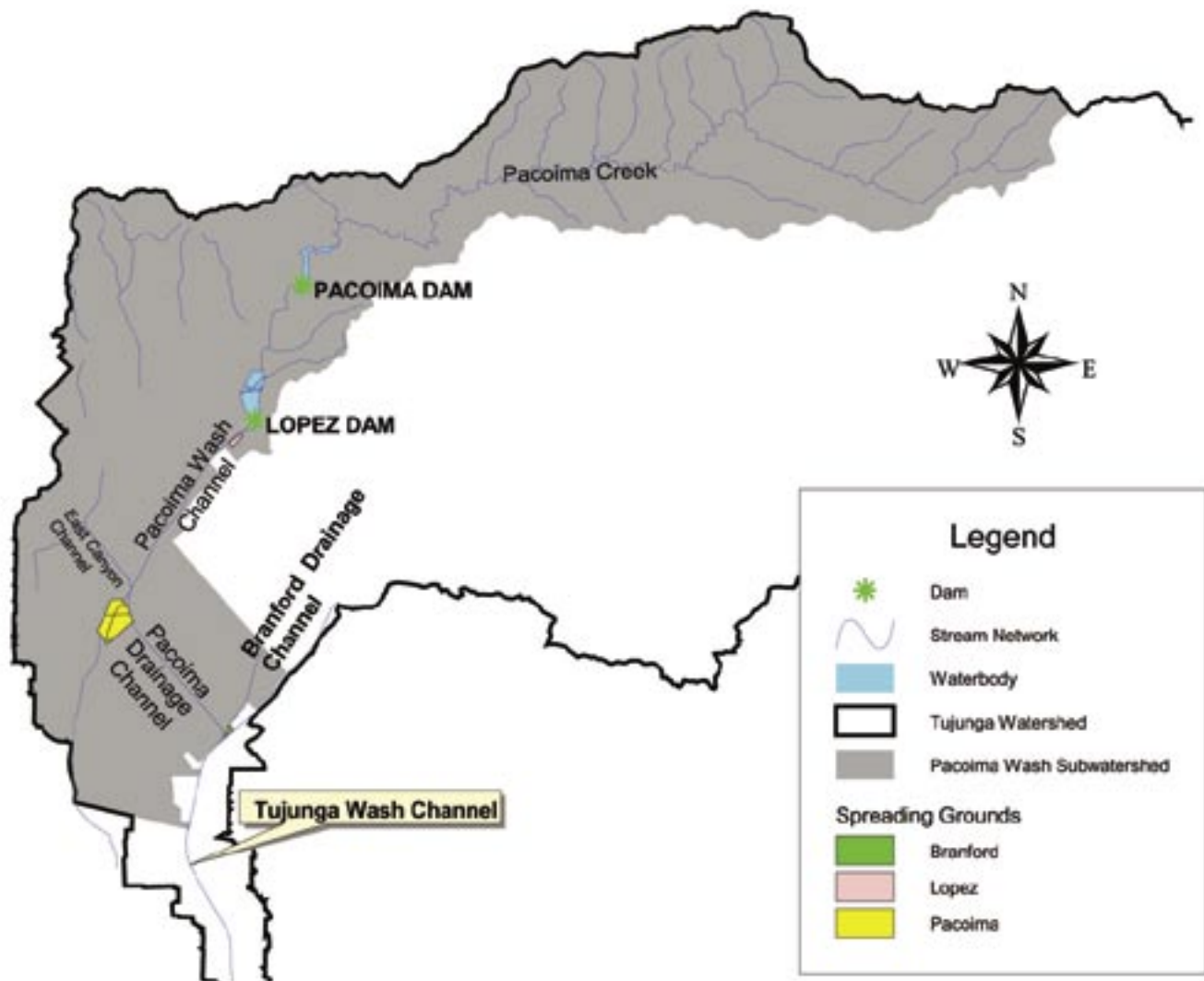
The primary streams, flood control channels, dams/reservoirs, and spreading grounds in the Tujunga Watershed are summarized in Table C-2. Runoff from the San Gabriel Mountains through the Tujunga

Table C-2. Tujunga Watershed Stream Network

Stream Network	Name	Subwatershed
Stream or Flood Control Channel	Pacoima Creek	Pacoima Wash
	Pacoima Wash Channel	Pacoima Wash
	East Canyon Channel	Pacoima Wash
	Pacoima Diversion Channel	Pacoima Wash
	Branford Drainage Channel	Pacoima Wash
	Big Tujunga Creek	Big Tujunga
	Alder/Gold Creek	Big Tujunga
	Lynx Gulch	Big Tujunga
	Wickiup Canyon	Big Tujunga
	Mill Creek	Big Tujunga
	Fall Creek	Big Tujunga
	Fox Creek	Big Tujunga
	Clear Creek	Big Tujunga
	Haines Canyon	Big Tujunga
	Little Tujunga Creek	Big Tujunga
	Lopez Canyon Diversion Channel	Big Tujunga
Dam/Reservoir	Tujunga Wash Channel	Tujunga Wash
	Pacoima Dam/Reservoir	Pacoima Wash
	Lopez Dam/Reservoir	Pacoima Wash
	Big Tujunga Dam/Reservoir	Big Tujunga Wash
Spreading Grounds	Hansen Dam/Reservoir	Big Tujunga Wash
	Lopez Spreading Grounds	Pacoima Wash
	Pacoima Spreading Grounds	Pacoima Wash
	Hansen Spreading Grounds	Tujunga Wash
	Tujunga Spreading Grounds	Tujunga Wash

Watershed flows via Pacoima and Big Tujunga Creek. Channelization of portions of these creeks has changed the flow of water through the Tujunga Watershed and reduced sediment transport to the Los Angeles River. The primary flood control channels are Pacoima Wash Channel, Pacoima Drainage Channel, and Tujunga Wash Channel. There are also four dams/reservoirs and five spreading ground facilities within the Tujunga Watershed. The stream networks in the Pacoima Wash, Big Tujunga Wash, and Tujunga Wash Subwatersheds are shown in Figures C-6, C-7, and C-8, respectively.

Figure C-6. Pacoima Wash Subwatershed
(Source: Everest International Consultants 2006)



Pacoima Creek is a natural stream that originates in the San Gabriel Mountains and flows westward eventually making its way to the Pacific Ocean, in part as a tributary to the Los Angeles River. The Pacoima Creek flows naturally with no major hydromodifications from the headwaters to Pacoima Dam. Between Pacoima Dam and Lopez Dam the Pacoima Creek still consists of a natural stream system with no significant hydromodifications.

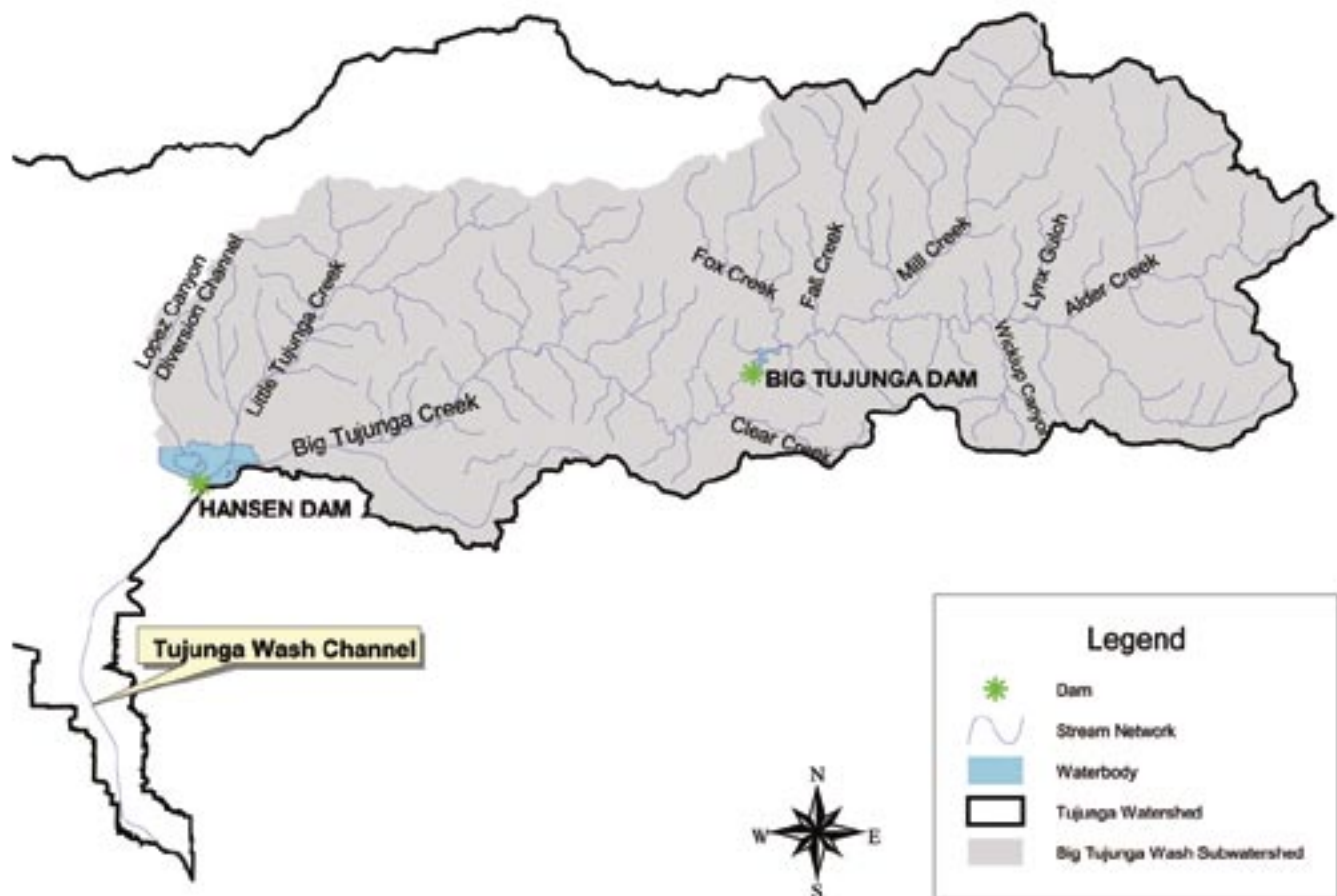
Below Lopez Dam, the Pacoima Creek is channelized and it is known as the Pacoima Wash Channel. Here flow is diverted from the Pacoima Channel to the Lopez Spreading Grounds, a spreading facility owned and operated by LACDPW that is used to recharge ground water. The Pacoima Wash Channel continues in

the southwest direction and is joined by the East Canyon Channel just upstream of the Pacoima Spreading Grounds, which is also owned and operated by LACDPW. The Pacoima Wash Channel and East Canyon Channel flows once drained directly to the Los Angeles River; however, now these flows are diverted to the Tujunga Wash Channel.

From the Pacoima Spreading Grounds the flow is split between the Pacoima Wash Channel and Pacoima Diversion Channel. The Pacoima Wash Channel continues from the Pacoima Spreading Grounds southwest to the Southern Pacific Railroad where a disjuncture in flow occurs. Flows are routed along a storm drain parallel to the railroad that discharges into the Tujunga Wash Channel, forming the southern boundary of the Pacoima Wash Subwatershed. The Pacoima Wash Channel resumes south of the disjuncture to Van Nuys Blvd. where it becomes culverted, then diverted to a stormdrain that runs south under Hazeltine Ave and discharges to the Los Angeles River. The Pacoima Diversion Channel branches off in the southeast direction carrying flows from the Pacoima Spreading Grounds, joining Tujunga Wash just downstream of the Branford Spreading Grounds.

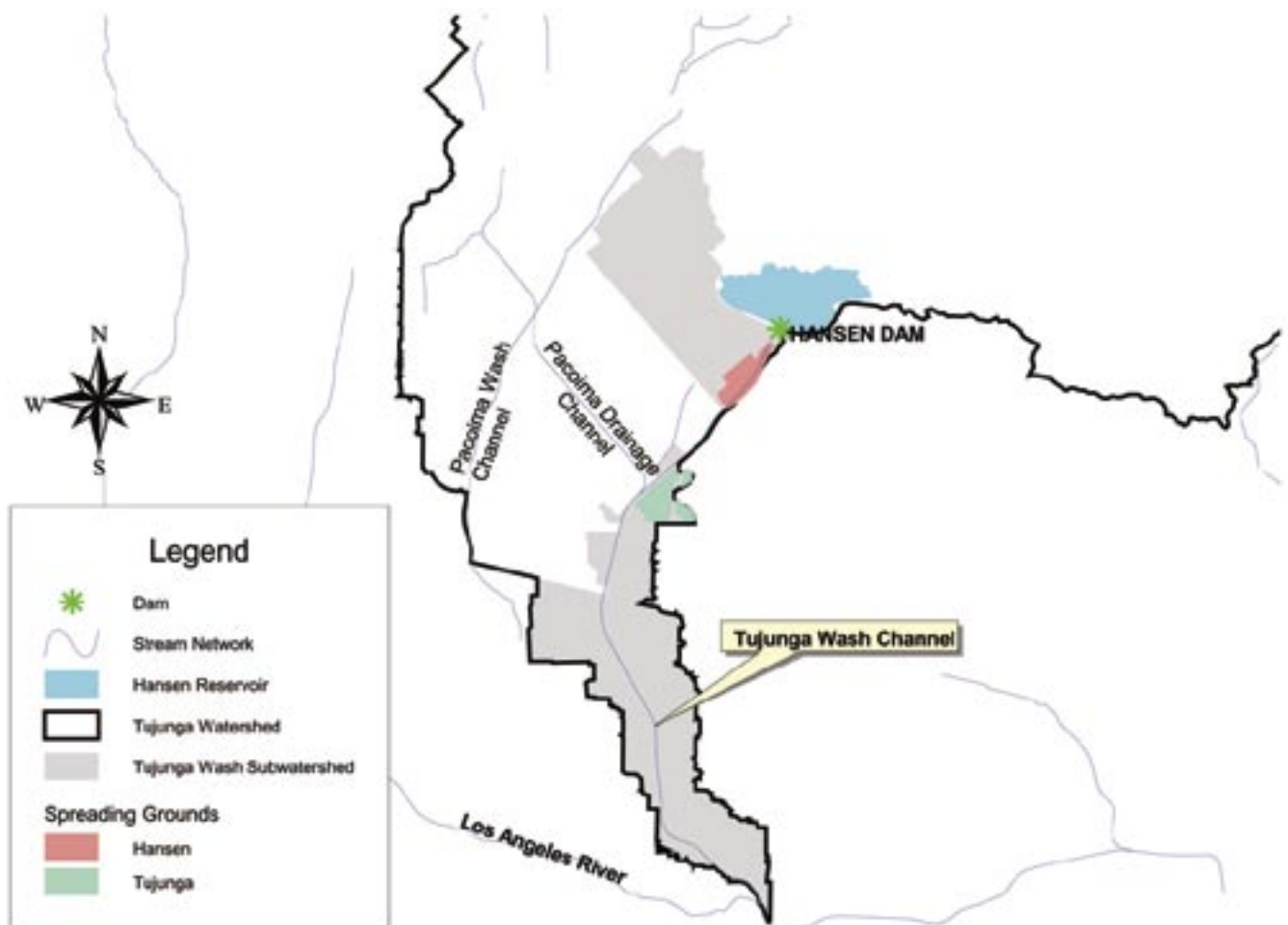
The Branford Drainage Channel joins the Pacoima Diversion Channel just prior to the Tujunga Wash Channel. Flows from the Branford Drainage Channel are diverted to the Branford Spreading Grounds, another spreading facility owned and operated by LACDPW. The Branford Spreading Grounds receive water from local storm drains via the Branford Drainage Channel and upstream flows via the Pacoima Diversion Channel (USACE 1986).

Figure C-7. Big Tujunga Wash Subwatershed
(Source: Everest International Consultants 2006)



Big Tujunga Creek is a natural stream that flows westerly from the Angeles National Forest to Big Tujunga Dam and is joined by numerous tributaries including Alder Creek, Lynx Gulch, Mill Creek, Fall Creek, and Fox Creek. Big Tujunga Creek continues in the westerly direction towards Hansen Dam and is joined by Clear Creek, Haines Canyon, Little Tujunga Creek, and Lopez Canyon Diversion Channel. The Lopez Canyon Diversion Channel is a flood control channel that diverts flows that once discharged in Lopez Dam into the Hansen Reservoir.

Figure C-8. Tujunga Wash Subwatershed
(Source: Everest International Consultants 2006)



Below the Hansen Reservoir, Big Tujunga Creek and Pacoima Drainage Channel both join the Tujunga Wash Channel. Built in 1952, the Tujunga Wash Channel is a rectangular concrete flood control channel that extends approximately 9.5 miles from the base of Hansen Dam along the flow path of the historical main channel to the confluence with the Los Angeles River. The other two historical channels that used to branch off from the Tujunga Wash in the area now known as Sun Valley were filled and subsequently developed. About 0.3 miles below Hansen Dam is the LACDPW Hansen Spreading Grounds, which receives water from a diversion structure at the Hansen Dam outlet. The Pacoima Drainage Channel joins the Tujunga Wash Channel about three miles below Hansen Dam (USACE 1990). Near the Pacoima Drainage Channel and Tujunga Wash Channel confluence is the Tujunga Spreading Grounds, which is owned by the City of Los Angeles Department of Water and Power (LADWP), although this facility is currently being leased to LACDPW (2001).

The dams/reservoirs along Pacoima Creek and Big Tujunga Creek impound and control the release of flood waters, thus are the controlling factor for flood flows through the Tujunga Watershed and into the Los Angeles River. Flows along Pacoima Creek are controlled by Pacoima Dam and Lopez Dam. Pacoima Dam, a concrete-arch dam, was the first dam built in the Tujunga Watershed in 1929. It is operated and maintained by LACDPW for flood control purposes. Pacoima Creek continues in the southwest direction approximately 1.5 miles to the Lopez Dam, an earth-filled embankment constructed by USACE in 1954 for flood control purposes.

Big Tujunga Dam and Hansen Dam regulate flows along Big Tujunga Creek. Big Tujunga Dam/Reservoir is the second concrete variable-arch dam built by LACDPW in 1931. The reservoir covers 141 acres with a drainage area of 82.3 mi² and is operated as a flood control reservoir (USGS 2005a). Hansen Dam is a compacted impervious earth-filled dam completed in 1940 and was the first federal dam constructed in the Tujunga Watershed. Hansen Dam/Reservoir occupies 1,468 acres, of which 1,450 acres are leased to the City of LA for recreational purposes. The recreational uses originally included a 130-acre lake, which was discontinued in the 1970's due to sedimentation problems (USACE 1990). These dams along with numerous smaller debris basins, limit sediment and debris from moving downstream.

There are 16 debris basins, seven in the Pacoima Wash Subwatershed and nine in the Big Tujunga Wash Subwatershed. One of the debris basins is owned and operated by USACE while all others are owned and operated by LACDPW.

Five spreading grounds within the Tujunga Watershed are used by LACDPW and LADWP to recharge ground water. A summary of each facility is shown in Table C-3. All facilities utilize native water (i.e., flows from rainfall within the watershed).

Table C-3. Summary of Spreading Grounds
(Source: LACDPW 2001)

Subwatershed	Spreading Grounds	Wetted Area (acre)	Storage Capacity (acre-ft)	Percolation Rate (cfs)
Pacoima Wash	Lopez	12	27	15
	Pacoima	107	440	65
	Branford	7	137	1
Tujunga Wash	Hansen	105	330	150
	Tujunga	83.2	100	120

The Lopez Spreading Grounds is located below Lopez Dam in the Pacoima Wash Subwatershed. This LACDPW facility began operation in water year 1956-57 and has an area of 18 acres with a wetted area of 12 acres.

LACDPW began operating the Pacoima Spreading Grounds in water year 1932-33. It covers 169 acres with a wetted area of 107 acres. Inflow sources include flows from the Pacoima Wash Channel, East Canyon Channel, and imported water.

Near the Pacoima Drainage Channel and Branford Drainage Channel confluence is the Branford Spreading Grounds, which is owned and operated by LACDPW. The Branford Spreading Grounds began operation in the water year 1956-1957 and covers 12 acres with 7 acres of wetted area. It receives water from local storm drains and discharges into the Pacoima Drainage Channel.

About 0.3 miles below Hansen Dam is the Hansen Spreading Grounds, which receives water from a diversion structure at the Hansen Dam outlet. This LACDPW facility began operation in water year 1944-45. It covers 156 acres with 105 acres of wetted area.

Near the Pacoima Drainage Channel and Tujunga Wash Channel confluence is the Tujunga Spreading Grounds, which is owned by the City of Los Angeles Department of Water and Power (LADWP). LACDPW currently has an agreement with LADWP to operate this facility. Tujunga Spreading Grounds has a total of 188 acres with 83.2 acres of wetted area (LACDPW 2001). LACDPW uses native water while LADWP uses imported water. In addition to these spreading grounds, LACDPW recently began recharging ground water along Big Tujunga Creek between Big Tujunga Dam and Hansen Dam.

Watershed changes have been minimal in the upper Tujunga Watershed above Lopez and Hansen Dams. The 28.1-mi² watershed above Pacoima Dam and the 82.27-mi² watershed above Big Tujunga Dam collect runoff from the Angeles National Forest. In the area between Pacoima Dam and Lopez Dam, land use changes include a recent residential development just north of Lopez Dam which lies within the floodplain. Land use changes in the 70.3-mi² drainage area between Big Tujunga Dam and Hansen Dam are limited to residential developments in the Haines Canyon, Lopez Canyon, and Kagel Canyon as well as the recently developed Angeles National Golf Course built directly within the Big Tujunga floodplain.

Approximately 20% of the entire Tujunga Watershed has been urbanized. Urban land uses include residential, commercial, industrial, transportation and utility corridors, and other built-up uses. Urbanization has resulted in increases in impervious areas and surface runoff, along with decreases in infiltration and sediment transport. Surface runoff from the urban areas is routed through a storm drain system that discharges into the flood control channels. The urbanized area in each subwatershed is summarized in Table C-4. Other land uses include open space, recreational facilities (e.g., parks and golf courses), agricultural, vacant, and water (e.g., reservoirs and spreading grounds) land uses. Approximately 38% of the Pacoima Wash Subwatershed has been modified with the greatest changes primarily below Lopez Dam. The 27.1-mi² drainage area between Lopez Dam and Tujunga Wash Channel is now almost entirely urbanized, primarily with residential land uses. The least changes have occurred in the Big Tujunga Subwatershed, where about 7% of the open space has been urbanized. The Tujunga Wash Subwatershed is 96% urbanized with primarily residential and commercial uses.

Table C-4. Summary of Urbanized Areas
(Source: Southern California Association of Governments)

Subwatershed	Urban Land Uses (mi ²)	Other Land Uses (mi ²)	Percent Urban Land Uses
Pacoima Wash	23.2	37.7	38%
Big Tujunga	10.1	142.3	7%
Tujunga Wash	10.8	0.5	96%
Total	44.3	180.4	20%

Flooding History

Floods in the late 1800s through the early 1900s prompted the construction of the current flood control system. The storm of January 1862 is referred to as the greatest storm in Southern California since the 1700's. The floods of February and March 1884 caused significant flooding in the San Fernando Valley. Floods in January and February 1914 resulted in over \$10 million in property damage and the loss of lives

in Los Angeles County. This prompted the State legislature to create the Los Angeles County Flood Control District (LAFCD) in 1915.

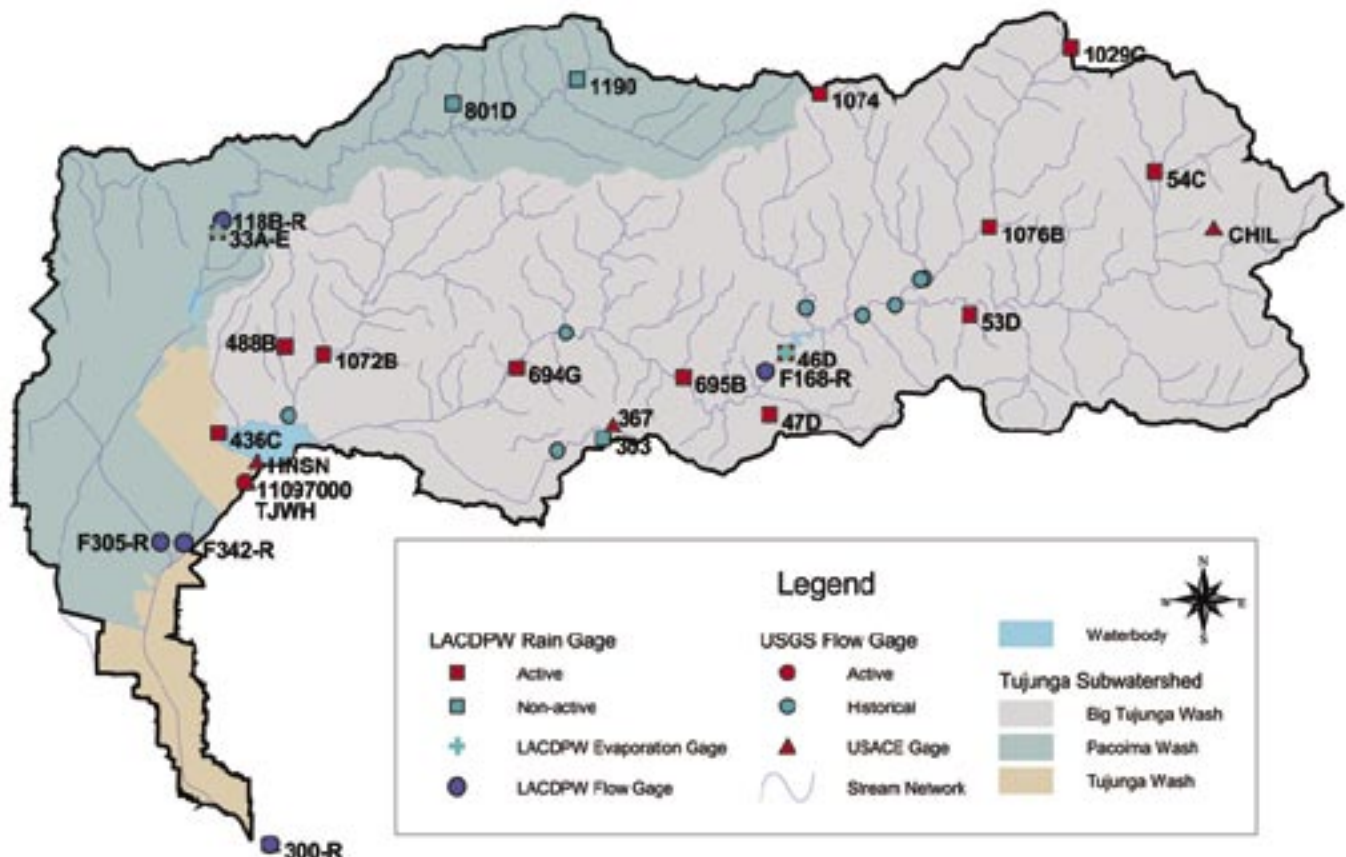
USGS began monitoring flow along Pacoima Creek, Little Tujunga Creek, and Big Tujunga Creek in 1916. In 1929, Pacoima Dam was constructed followed by Big Tujunga Dam in 1931. The storm between February 27 and March 3, 1938 was one of the most destructive floods in Southern California and resulted in the highest flows ever recorded in Big Tujunga Creek below Big Tujunga Dam (33,000 cfs) and the flow near Sunland was estimated at 50,000 cfs (USACE 1991). The flood of 1938 led to the construction of Hansen Dam, which was completed in 1940. The highest 24-hour rainfall in California (26.12 inches) was recorded in January 1943 and has since been used as the standard project design storm by the USACE (Los Angeles District). The Lopez Dam and additional flood control channels were built in 1954.

In 1985, the LACDPW took over the responsibilities and authority of the LAFCD. As a primary tributary to the LAR, Tujunga Watershed is part of the Los Angeles County Drainage Area (LACDA). The dams and flood control channels are part of a comprehensive flood control plan of the LACDA to provide protection of debris-laden floodwaters in the Tujunga Watershed and Los Angeles River Watershed.

Existing Monitoring Programs

Hydrology in the Tujunga Watershed is well monitored by various agencies including LACDPW, ULARA, USGS, and USACE. Precipitation and flow gages, both historical and active gages, operated by LACDPW, USGS, and USACE are shown in Figure C-9.

Figure C-9. Monitoring Stations in the Tujunga Watershed
(Source: Everest International Consultants 2006)



Evaporation is also monitored at two of the LACDPW precipitation stations located at Pacoima Dam and Big Tujunga Dam. A summary of active gages, as well as location, operator, and data record, is presented in Table C-5. In addition to these active gages, spreading grounds operation records and ground water pumping records are maintained by the ULARA Watermaster.

Table C-5. Active Monitoring Stations

Station Name	Latitude/ Longitude	Operator Station ID	Primary Data/ Period of Record
Pacoima Dam	34°19'48"/ 118°23'59"	LACDPW 33A *ALERT 331	Daily precipitation 10/13/1938 – 10/31/2005 Monthly Evaporation 10/1930 – 9/1987 Daily Evaporation 10/01/1987 – 10/31/2005 Annual inflow/outflow 1929 - 2001
Pacoima Creek Flume below Pacoima Dam	34°14'05"/ 118°24'45"	LACDPW 118B-R	Daily flow 02/09/35 – 9/30/01 Water Year Daily Mean flow 1931- 2001
Pacoima Diversion at Branford St	34°14'07"/ 118°25'13"	LACDPW F305-R	Daily flow 10/01/53 – 9/30/01 Water Year Daily Mean flow 1953- 2001
Branford St Channel below Sharp Ave	34°14'05"/ 118°24'42"	LACDPW F342-R	Daily flow 01/12/1962 – 9/30/01 Water Year Daily Mean flow 1961- 2001
Chilao FS North of Monrovia	34°20'00"/ 118°01'33"	USACE CHIL	Precipitation and air temperature / ND
Loomis Ranch-Alder Creek	34°20'55"/ 118°02'54"	LACDPW 54C *ALERT 438	Daily precipitation 10/14/1949 – 10/31/2005
Tujunga-Mill Creek Summit	34°23'22"/ 118°04'49"	LACDPW 1029C *ALERT 306	Daily precipitation 10/11/1975 – 10/31/2005
Colby's	34°18'05"/ 118°06'39"	LACDPW 53D *ALERT 445	Precipitation 10/07/1949 – 10/31/2005
Little Gleason	34°22'43"/ 118°08'57"	LACDPW 1074	Precipitation 11/11/1954 – 10/31/2005
Big Tujunga Dam	34°17'40"/ 118°11'14"	LACDPW 46D *ALERT 334	Daily precipitation 10/12/1924 – 10/31/2005 Monthly evaporation 10/1931 – 9/1987 Daily evaporation 10/01/1991 – 7/31/2005 Annual inflow/outflow 1932 – 2001
Big Tujunga Creek below dam	34°17'19"/ 118°11'38"	LACDPW F168-R	Daily flow 10/01/32 – 9/30/04 Water year daily mean flow 1931- 2001
Clear Creek-City School	34°16'38"/ 118°10'12"	LACDPW 47D *ALERT 408	Daily precipitation 10/11/1957 – 10/31/2005
Tujunga Canyon - Vogel Flat	34°17'12"/ 118°13'32"	USACE LACDPW 695B	Daily precipitation 11/05/1953 – 10/31/2005
Kagel Canyon Patrol Station	34°17'45"/ 118°22'30"	LACDPW 488B	Daily precipitation 10/01/1947 – 10/31/2005
Upper Haines Canyon	34°16'18"/ 118°15'07"	USACE 367	¹ Precipitation and flow
Hansen Yard	34°15'22"/ 118°23'13"	*ALERT 357	¹ Wind, precipitation, relative humidity, temperature, solar radiation, pressure
Hansen Dam	34°16'08"/ 118°23'59"	LACDPW 436C	Daily precipitation 10/11/1960 – 10/31/2005 Water surface elevation 1941 – present Daily-Weekly average flow 10/01/89 – 7/07/05

Table C-5 (continued). Active Monitoring Stations

Station Name	Latitude/ Longitude	Operator Station ID	Primary Data/ Period of Record
Hansen Dam	34°15'37"/ 118°23'04"	USACE HNSN	¹ Precipitation and stage
Big Tujunga Canyon – Camp 15	34°17'22"/ 118°17'17"	LACDPW 694G *ALERT 307	Daily precipitation 10/18/1984 – 10/31/2005
Little Tujunga Ranger Station	34°17'37"/ 118°21'38"	Other 1072B	Daily precipitation 10/20/1979 – 10/31/2005
Hansen Diversion Structure 2	ND	LACDPW 12BSG	5-min flow WY96-present Daily flow prior to WY96
Big Tujunga Creek below Hansen Dam	34°15'13"/ 118°23'17"	USGS11097000 USACE TJWH	Real time stream flow 2003 – present Daily flow 5/1/32 – present Peak flow 1/19/33 – 2/26/04
*Automatic Local Evaluation in Real Time (ALERT) System ND – No data available 1 – Period of record is unknown			

Precipitation is mainly monitored in the Big Tujunga Wash with 12 active precipitation gages and one at Pacoima Dam. Seven of the gages are part of the Automatic Local Evaluation in Real Time (ALERT) System operated by LACDPW. Precipitation in the Tujunga Watershed is typical of the semi-arid climate in Southern California, with rainfall primarily occurring between November and March. The seasonal precipitation generally results in little to no flows in natural creeks during the summer. However, urban runoff can contribute to a base flow during dry periods, primarily in the summer. A summary of the average precipitation by month in inches and the corresponding volumes is shown in Table C-6. The average annual rainfall for the 13 gages ranges between 15.2 and 31.1 inches with an overall average of 20.6 inches. This is higher than the Los Angeles County average of 15.65 inches since a major portion of the Tujunga Watershed is located in the mountains where rainfall tends to be higher compared to coastal areas.

Evaporation also follows a seasonal trend with higher rates during the summer months. Flows in the Tujunga Wash Channel have a seasonal variation with higher flows during winter months and a low base flow during the summer. Pan evaporation is monitored at Pacoima Dam and Big Tujunga Dam. Pan evaporation, which typically exceeds precipitation, is a potential evaporation rate that is used with weather conditions to estimate the actual evapotranspiration rate. A summary of the average pan evaporation by month is also shown in Table C-6.

LACDPW operates four flow gages with three in the Pacoima Wash and one in Big Tujunga Wash. There is only one active USGS flow gage located along Tujunga Wash Channel below Hansen Dam.

LACDPW operates four flow gages with three in the Pacoima Wash and one in Big Tujunga Wash. There is only one active USGS flow gage located along Tujunga Wash Channel below Hansen Dam. A summary of the average flow rate by month below Pacoima, Big Tujunga, and Hansen Dams is shown in Table C-7. The average monthly flow rates for Pacoima Dam and Big Tujunga Dam are based on flow measurements at the LACDPW gage located at the Pacoima Creek Flume below Pacoima Dam (F118B) and at Big Tujunga Creek below Big Tujunga Dam (F168). The average flow rates for Hansen Dam are based on long-term flow measurements between 1948 and 2001 at the USGS gage along Big Tujunga Creek below Hansen Dam (11097000). Records of monthly average runoff volumes are kept by LACDPW and a summary of the average monthly runoff volumes from Pacoima Dam and Big Tujunga Dam are shown in Table C-8. These flow gages show similar seasonal trends as precipitation.

Table C-6. Average Precipitation and Pan Evaporation
(Source: LACDPW)

Month	Average Precipitation (inches)	Average Precipitation (acre-ft)	Average Pan Evaporation (inches)
October	0.7	8,503	7.1
November	2.0	24,411	6.2
December	2.6	30,884	5.1
January	4.0	47,977	4.6
February	5.0	59,971	4.2
March	3.7	44,284	5.0
April	1.5	17,825	5.6
May	0.5	5,636	5.7
June	0.1	1,257	6.4
July	0.1	786	8.5
August	0.2	1,850	8.7
September	0.4	4,602	8.0
Annual Total	20.6	247,987	74.9

Table C-7. Monthly Average Flows
(Source: ULARA 2005a)

Month	Pacoima Dam*	Big Tujunga Dam**	Hansen Dam***
October	1.66	5.86	2.45
November	3.53	9.28	7.55
December	3.87	13.64	3.78
January	15.58	41.72	38.9
February	29.78	68.61	93.6
March	39.11	76.21	79.7
April	20.34	37.31	28.0
May	14.38	19.62	24.2
June	7.27	12.38	7.14
July	3.43	9.41	2.60
August	2.70	8.06	2.08
September	1.94	6.68	3.09
Annual	11.97	25.73	24.4
Units in cubic feet per second *LACDPW gage record between Oct 1934 and Sep 2006 **LACDPW gage record between Oct 1932 and Sep 2006 ***USGS gage record between 1948 and 2001			

Records of runoff volumes are also kept by LACDPW and a summary of the monthly runoff volumes from Pacoima Dam and Big Tujunga Dam for water year 2003 and 2004 are shown in Table C-8. These flow gages show similar seasonal trends as precipitation.

Table C-8. Monthly Runoff Volumes for Pacoima and Big Tujunga Dams
(Source: ULARA 2005a)

Month	Pacoima Dam*	Big Tujunga Dam**
October	101	360
November	210	552
December	238	839
January	963	2,565
February	1,664	3,844
March	2,384	4,674
April	1,212	2,220
May	882	1,198
June	433	737
July	211	575
August	166	493
September	115	397
Units in acre-ft *LACDPW gage record between Oct 1934 and Sep 2006 **LACDPW gage record between Oct 1932 and Sep 2006		

LACDPW operates and monitors five spreading grounds for using stormwater to recharge ground water in the San Fernando Valley Ground Water Basin. LADWP also uses imported water for ground water recharge at the Tujunga Spreading Grounds. A summary of the average monthly volumes (in acre-ft) spread at each facility based operations between water years 1968-69 and 2003-04 is shown in Table C-9. Spreading operations have seasonal variations with the largest volumes in the spring months following the winter rains. Hansen Spreading Grounds is the largest facility, which also uses runoff from the largest drainage area (above Hansen Dam). An annual total of about 30,000 acre-ft is recharged at these five spreading grounds. A comparison of this total to the average annual rainfall volume of 248,000 acre-ft reveals that about 10% of the annual rainfall is recharged. In addition to these spreading grounds, LACDPW recently began monitoring recharge in Big Tujunga Creek above Hansen Dam. Volumes recharged for the 2004 and 2005 water years are shown in Table C-10.

Existing Flood Potential

Flood flows through the Tujunga Watershed are primarily controlled by the four dams, which are important in the Los Angeles River flood control system. Frequency discharge curves (i.e., peak flows for various return periods) are available for all four dams (USACE 1986 and 1990). The peak flows and peak water elevations for selected return periods are listed in Tables C-11 and C-12 for Big Tujunga Dam and Hansen Dam, respectively (USACE 1990). Prior LACDA studies (USACE 1991 and LACDPW 1997) showed that the flood protection system throughout the entire Tujunga Watershed was sufficient to contain the 50-year flood event.

Table C-9. Average Monthly Spreading (Water Years 1968-69 to 2003-04)
(Source: ULARA 2005b)

Month	Lopez	Pacoima	Branford	Tujunga – Native	Tujunga – Imported*	Hansen
October	6	35	21	30	373	320
November	4	199	55	48	449	299
December	10	377	62	78	542	938
January	34	818	93	340	456	1,398
February	79	1,273	97	616	735	2,123
March	153	1,631	102	557	801	3,242
April	122	1,044	30	642	605	2,358
May	72	631	12	494	254	1,213
June	34	298	8	450	125	859
July	10	89	7	195	1	479
August	2	23	13	97	67	333
September	3	36	17	118	203	238
Annual	529	6,454	519	3,663	4,611	13,799
Units in acre-feet * Imported water spread by Los Department of Water and Power (note: last spreading operation 1998)						

Table C-10. Spreading for Tujunga Wash (Big Tujunga Creek above Hansen Dam)
(Source: ULARA 2005b)

Month	Water Year 2003-04	Water Year 2004-05
October	87	362
November	0	1,027
December	119	2,546
January	0	13,948
February	264	8,452
March	454	6,545
April	134	2,137
May	0	1,247
June	0	1,704
July	0	889
August	0	668
September	0	77
Annual	1,058	39,602
Units in acre-ft		

The most commonly used return period for addressing flood protection is the 100-year flood, which is also known as the regulatory flood. The 100-year peak outflow from Hansen Dam is 18,900 cfs. The Tujunga Wash Channel capacity from Hansen Dam to Pacoima Drainage Channel is 20,800 cfs so the channel is sufficient to convey the 100-year flood. However, the Tujunga Wash Channel between the Pacoima Drainage Channel and Los Angeles River was found inadequate for the 100-yr flood event. The channels throughout the rest of the Tujunga Watershed flood protection system were previously found to have adequate capacity to convey the 100-yr flood event.

Prior LACDA flood studies (USACE 1991 and LACDPW 1997) focused on the 133-year flood for improvements to the Los Angeles River flood control system. USACE selected the 133-year event as the peak flow for the lower Los Angeles River to provide an optimal level of protection based on the national economic development criteria (USACE 1991). The 133-year peak flows at various locations within the Tujunga Watershed are listed in Table C-13. The Tujunga Wash Channel capacity from Hansen Dam to Pacoima Drainage Channel is sufficient to convey the 133-year flood. The maximum capacity for the Tujunga Wash Channel below the Pacoima Drainage Channel is 28,200 cfs, which is below the peak discharge for a 133-year flood of 31,200 cfs so this portion of the channel does not have capacity to convey the 133-yr event storm flow. The channels throughout the rest of the Tujunga Watershed flood protection system were previously found to have adequate capacity to convey the 133-yr flood event.

Overall, the existing flood protection system (dams and channels) in the Tujunga Watershed provides sufficient capacity to convey up to a 50-yr flood flow. However, the system lacks sufficient capacity to convey both the 100-yr and 133-yr flood flows in some areas within the Tujunga Watershed.

Table C-11. Return Period Peak Flows and Elevations for Big Tujunga Dam
(Source: USACE 1990)

Return Period (Years)	Peak Inflow (cfs)	Peak Outflow (cfs)	Peak Elevation (ft, NGVD)
2	730	470	2,219.7
5	4,160	540	2,242.3
10	9,050	665	2,281.9
20	19,300	9,820	2,297.7
50	32,200	28,400	2,305.5
100	41,400	36,300	2,308.1
200	51,700	51,700	2,308.5
500	65,200	65,200	2,309.8

Conclusions

As a whole, the hydrologic system is marginally impaired due primarily to land use changes associated with urbanization. However, looking a bit closer it is helpful to view the system in two discrete parts: (i) the upper watershed above Hansen Dam and Pacoima Dam and (ii) the lower watershed below Hansen Dam and Pacoima Dam. The upper watershed is in good condition with little impacts due to humans and this is primarily attributed to the fact that the area is rugged, mountainous terrain with little development potential. In addition, the area has been managed as open space/park, thereby minimizing the human impacts associated with other land uses such as industrial, commercial, and residential. The lower watershed is severely degraded with over 42% covered by highly impervious surfaces.

Table C-12. Return Period Peak Flows and Elevations for Hansen Dam
(Source: USACE 1990)

Return Period (Years)	Peak Inflow (cfs)	Peak Outflow (cfs)	Peak Elevation (ft, NGVD)
2	865	500	999.4
5	2,840	500	1,009.7
10	6,350	2,860	1,010.5
20	13,800	9,840	1,015.6
50	33,500	15,800	1,030.3
100	47,900	18,900	1,043.7
200	64,000	21,100	1,054.2
500	76,500	25,000	1,066.0

Table C-13. 133-Year Peak Flow within Tujunga Watershed
(Reference: LACDPW 1997)

Subwatershed	133-Year Peak Discharge (cfs)
Above Pacoima Dam	9,407
Between Pacoima Dam and Spreading Grounds	14,407
Pacoima Spreading Grounds	3,971
Above Big Tujunga Dam	43,782
Between Big Tujunga Dam and Hansen Dam	33,576
Tujunga Wash below Pacoima Wash confluence	31,200
Tujunga Wash above LAR confluence	38,900

The high level of urbanization (e.g., increased degree of impervious surfaces) and numerous hydromodifications (e.g., lining of channels and storm flow diversions via culverts and pipes) have substantially modified the distribution, quantity, and timing of flows through the stream network. Flood flows have increased peak flow rates and these increased peak flows arrive at a given point in the stream network faster than under less urbanized conditions.

The majority of the streams and washes located throughout the Tujunga Wash Watershed are hardened in one form or another (e.g., concrete channels, culverts, and pipes), thereby severely degrading the natural hydrologic functioning of the stream network. The concrete lining that encases the stream channel prevents surface water in the creek from infiltrating into the underlying ground water basin. In addition, connections between the stream channel and floodplain have been reduced or eliminated and natural sediment transport has been reduced due to the lining of channels and dam construction. For example, the two major dams (Hansen and Pacoima) along the stream network trap sediment behind the structures resulting in relatively low sediment concentrations downstream of these features. This means that the flood flows occurring downstream of these two dams are more erosive (i.e., “hungry” for sediment) than under less urbanized conditions. This additional erosive power is currently not a problem because the channel is encased in concrete, thereby, eliminating sediment erosion.

Overall the Tujunga Watershed is adequately monitored for rainfall and flows. However, while there are numerous rainfall and flow gage stations throughout the Big Tujunga Wash Subwatershed, the Pacoima Wash Subwatershed contains only one active rain gage and two active flow gages. The Pacoima Wash Subwatershed is significantly smaller than the Big Tujunga Wash Subwatershed such that the same level of gage coverage is not needed; however, an additional rain gage would be helpful. This could be achieved through reactivation of one of LACDPW rain gages (e.g., 801D or 1190). The Tujunga Wash Subwatershed also contains limited gage stations; however, this subwatershed is very small in area so the relative contribution of rain and low is small.

The existing flood protection system appears to be adequate to convey storm flows up to at least a 50-yr flood flow. This could change in the future; however, if there are substantial modifications to the watershed such as increases in the impervious surface coverage especially the upper watershed or substantial modifications to the way the dams are operated (e.g., increasing the peak flows). In addition, if global warming in the future results in climatic changes that increase the intensity and/or frequency of storms (i.e., storminess) then the flood protection system may not be adequate to convey storm events with the same return periods (e.g., 50-yr) as today. This is because these changes (i.e., increases in storm intensity and frequency) could yield a reduction in the frequency of various storm events (e.g., a 100-yr event today could be a 70-yr event in the future).

The existing flood protection system is not adequate to convey storm flows with a return period equal to or greater than 100 years. Under an event with a return period of 100 years or greater the existing flood protection system would be overtopped in different locations within the Tujunga Watershed.

Recommendations

Natural streams, washes, and floodplains could be restored in areas of high soil permeability as much as possible to restore a portion of the groundwater infiltration that occurred prior to wide-scale human disturbance. This would help bring back part of the natural hydrologic cycle that occurred throughout the watershed prior to large-scale human influence.

Natural hydrologic functioning could be restored as much as possible throughout the watershed while maintaining public safety. To restore natural hydrologic functioning, functional floodplains could be acquired and restored along and within the major streams and washes. Restoration activities could include bioengineering techniques to stabilize streambanks while providing natural riparian functions. Tributary streams and washes could be daylighted (i.e., replace culverts and pipes with open channels) to restoration natural hydrologic functioning throughout the watershed.

To maintain public safety, stormwater could be captured and infiltrated where it falls to reduce the storm flows that are conveyed in channels, thereby potentially reducing the total volume of stormwater that has to be managed through the flood protection system. Impervious surfaces could be reduced to lower surface runoff rates, thereby decreasing the surface runoff associated with a given rainfall event.

Existing gravel pits could be converted to stormwater detention ponds to help reduce peak flows and provide opportunities to infiltrate captured stormwater in spreading grounds while serving multiple objective purposes (e.g., recreation and water quality improvement).

Structures that are currently located within the floodplain could be elevated, setback, or completely removed from within the Tujunga Watershed such as some of the bridge structures that cross the Tujunga Wash.

Another strategy to reduce the risk of flooding while achieving, or at least not precluding the achievement of, the stakeholder objectives could be to widen concrete channels and remove concrete thereby lowering the water elevations in the channel throughout the flood protection system. Pursuing this type of solution would require analyses to make sure that the newly restored channels do not become blocked with vegetation and to verify that the newly exposed channel would not undergo extensive erosion, thereby conveying unwanted sediment loads to most of the downstream locations.

Sediment bypassing systems could be incorporated into Big Tujunga Dam and Hansen Dam to increase sediment transport through the system to help achieve the stakeholder objectives related to sediment transport. The sediment bypassing systems could be implemented alone or in combination with concrete removal from the channel to increase the flow of sediment within the stream system.

Water Supply & Use

Introduction

Historically civilizations have developed along rivers and waterways for nourishment and accessibility. The development of El Pueblo de Nuestra Señora la Reyna de Los Angeles del Río Porciúncula in 1781 was intimately linked and dependent on the river for access to fresh drinking water and irrigation for crops. The City of Los Angeles relied on El Río de Porciúncula - the Los Angeles River - for its water supply by diverting water through a crude system of dams, water wheels and ditches (or zanjas). It wasn't until 1860 that the city of Los Angeles' Water Company completed its first water system. Over forty years later, on Feb. 3, 1902, the city formally took ownership of the first Los Angeles municipal water works system (LACDPW 2004).

Today only 15% of the water utilized by the City of Los Angeles is derived from local native groundwater: the remaining water supply demands are quenched by waters imported from Owens Valley in the northern Sierra's via the two Los Angeles Aqueducts, from the Bay-Delta Area by way of the California State Aqueduct and from Arizona via the Colorado River Aqueduct (fig. 1). Angelenos' reliance on these water sources is straining to meet the needs and demands of the City's continuously expanding population. Los Angeles is the second most populous city in the United States with almost 4 million people and is projected to increase by another 368,000 new residents by the year 2030. In order to properly plan for the city's water supply, it is important to understand the water demands and the contributing factors that influence them over time (LADWP UWMP 2005).

Findings

Water Sources

Native Groundwater

Groundwater resides and travels through geologic formations beneath the earth's surface called aquifers. An aquifer is a layer of permeable rock, sand, or gravel containing enough water to supply wells and springs. Groundwater is a renewable resource that is dependent both on the amount of pervious surface groundcover and on the rate of water percolation through the soil; porous soils allow greater movement of surface water to reach sub-surface levels which replenish the aquifer or groundwater basin. Urbanization inhibits percolation by increasing impervious surfaces forcing water to runoff rather than percolate to groundwater. The groundwater recharge storage capacity is determined both by geologic characteristics and by the depth of the water table below the surface.

Worldwide, groundwater is 40 times more abundant than fresh water in streams and lakes. In the United States, approximately half of the drinking water is procured from groundwater (Encarta 2005). The California water supply is dependent predominantly on snowmelt and rainfall in Northern California, with roughly 65% of all precipitation soaking into underground storage areas, evaporating or nurturing plants. Groundwater makes up roughly 30% of California's water supply in an average year and about 40% in dry years (DWR 2003). In the Tujunga Watershed, water that does not percolate into the groundwater becomes surface runoff that dumps into our washes via-the storm drain system and eventually flows into the Los Angeles River and then to the Pacific Ocean.

Los Angeles groundwater provides approximately 15% of the total local water supply, and has at times provided as much 30%. The City of Los Angeles owns water rights in four Upper Los Angeles River Area (ULARA) groundwater basins: the San Fernando, Sylmar, Verdugo, and Eagle Rock, as well as Central

and West Coast Basins (LADWP 2005). The Tujunga Watershed includes two of these basins, the San Fernando and Sylmar (Figure D-1). Approximately 85% (90,255 acre-feet) of the City's groundwater supply is extracted from these two basins and used as potable water after treatment to meet all federal drinking water standards. Since 1999, these two basins have provided an average of approximately 11% (as high as 14% in 1999-2000) of the total water supply in the City of Los Angeles (Table D-1).

Figure D-1. Local Groundwater Basins
(Source: DWR 2001)



The San Fernando Groundwater Basin (SFGB) is the largest of the three groundwater basins in the ULARA. It underlies 112,047 acres and is bound by the San Rafael Hills and Verdugo Mountains on the east and northeast, the Santa Susana Mountains and Simi Hills on the northwest and west, and the Santa Monica Mountains on the south. Waterbearing material in this basin extends to at least 1,000 feet below surface and has a holding capacity of approximately 3,200,000 acre-feet.

The Sylmar Groundwater Basin (SGB) underlies 5,565 acres, and is bound by the San Gabriel Mountains on the north, a topographic divide in the valley fill between the Mission Hills and San Gabriel Mountains on the west, the Mission Hills on the southwest, Upper Lopez Canyon on the east, and along the east bank of Pacoima wash and south limb of the Little Tujunga Syncline on the south (Judgment 1979). Water-bearing material in this basin extends to depths in excess of 12,000 feet below surface and has a holding capacity of up to 310,000 acre-feet.

The City of San Fernando lies entirely within the Tujunga Watershed and overlays parts of both the San Fernando Groundwater Basin and the Sylmar Groundwater Basin. The principal source of water for the

City of San Fernando (93% in 2004) comes from groundwater in the Sylmar Basin. The city's goal is to rely solely on groundwater supplies within 5 to 10 years. (Salazar, 2006).

Table D-1. Local Groundwater Basin Supply (From October to September in acre-feet)
(Source: ULARA 2001-06, WBMWD 2005)

Groundwater Basin	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005
San Fernando	98,016	65,409	66,823	73,376	68,626	49,085
Sylmar	2,634	2,606	1,240	3,549	3,033	1,110
Central	11,401	11,640	8,294	10,073	15,209	13,401
West Coast*	0	0	0	0	0	0
Total	112,051	79,655	76,357	86,998	86,868	63,596

*West coast basin at this time is not being pumped due to localized water quality issues

The San Fernando Valley fill material is a heterogeneous mixture of clays, silts, sand and gravel laid down as alluvium (see Figure B-1). West of the 405-Freeway, the Santa Susana Mountains erode silts, which have a moderate percolation rate. East of the 405-Freeway soils eroding from the San Gabriel Mountains are of a much coarser soil composition, allowing a faster rate of percolation. The significant contribution by the Tujunga Watershed to groundwater recharge is facilitated by the coarse granitic soils eroding from the San Gabriel Mountains, creating a porous texture surface and allowing greater amounts of water to percolate into the aquifer.

Groundwater Extraction

The City of Los Angeles entitlement in the San Fernando, Sylmar and Eagle Rock basins was established in a judgment by the Superior Court of the State of California in 1979 (Judgment, 1979). The judgment was based on maintaining a safe yield operation for the basin, whereby groundwater extractions over the long-term will be maintained in a manner that does not create an overdraft condition in the basin (LADWP UWMP 2005).

The 1979 judgment describes safe yield, native safe yield, and native waters as follows:

- Safe yield: The maximum quantity of water which can be extracted annually from a groundwater basin under a given set of cultural conditions and extraction patterns, based on the long-term supply, without causing a continuing reduction of water in storage.
- Native safe yield: That portion of the safe yield of a basin derived from native waters.
- Native waters: Surface and ground waters derived from precipitation within the Upper Los Angeles River Area.

The allowable amount of groundwater that can be extracted from a basin is based on the safe yield and native safe yield assigned to each basin; the return of native or imported water to each basin, and stored water credit by the city. In accordance with the Judgment, the City of Los Angeles has the right to all native water within the ULARA. In the San Fernando Basin the Native safe yield is fixed at 43,660afy and since the city returns approximately 43,000afy to the San Fernando Basin, the Safe yield (yearly entitlement) is approximately 87,000afy (Table D-2). The City of San Fernando has a yearly allotment of 3,255 acre-feet from the Sylmar Basin.

Table D-2. Groundwater Basin Native, Safe Yield and Native Credit Table (Acre-feet)
(Source: ULARA 2001-06)

Basin	Safe Yield	Native Safe Yield	Stored Water Credit City of Los Angeles	Stored Water Credit City of San Fernando
San Fernando	87,000	43,660	325,739*	N/A
Sylmar	6,510	3,850	8,448*	339*

*As of Oct 1 2005 Watermaster report table 2-11A

Imported Water

The City of Los Angeles relies on several sources of imported water: the Los Angeles Aqueduct (LAA) imports water from the Northern Sierra (Mono Lake and Owens Valley); the California State Water Project (SWP) imports water originating from Northern California's Lake Oroville, located on the Feather River with waters passing through the San Francisco-San Joaquin Bay-Delta; and the Colorado River Aqueduct (CRA) supplies water from Lake Havasu on the Colorado River in Arizona (Figure D-1).

The Los Angeles Aqueduct (LAA) was constructed in three parts; the first section originating from the Owens River was completed in 1913 at a cost of \$23 million. In 1940, an additional \$40 million were invested to extend the aqueduct 40 miles north to the Mono Lake region, increasing the City's ability to deliver water from the Mono Basin. In 1970, the City of Los Angeles completed a second aqueduct, paralleling the original one at a cost of \$88 million, doubling the City's ability to import water from the Mono Basin and the Owens River. The entire aqueduct extends approximately 340 miles from the Mono Basin to Los Angeles, traveling a majority of the span in underground pipes. The water is conveyed the entire distance by gravity

Figure D-1. Schematic of Imported Water Aqueducts
(Source: Worley 2006)



alone. The LAA is fed by runoff from the east slope of the Sierra Nevada. Flows are limited by the State Water Resources Control Board.

The Edmund G. Brown California Aqueduct passed by the voters in November 1960 by a margin of only 3% of the vote. Some believe it has not yet been completed, since there is no conveyance through or around the delta, and the north coast rivers have not been dammed, and will not be. They are now wild and scenic. It is the largest aqueduct in the world and is the principal water-conveyance structure of the State Water Project (SWP). The SWP was designed primarily to provide water to urban areas. It is owned by the state and operated by the Department of Water Resources (DWR); it is comprised of 32 storage facilities, 662 miles of aqueduct, 25 power and pumping stations, 130 hydroelectric plants, and more than 100 dams and flow-control structures.

Supplies from these aqueducts can vary widely from year to year (Table D-3). During very wet years, the LAA can provide more than 400,000 acre-feet annually, with a record high delivery of 520,000. Very dry years can produce less than 75,000 acre-feet (LADWP, UWMP 2005).

Table D-3. Imported Water Supply (Acre-feet)
(Source: LADWP, Water Control, Operations Department)

Source	2004*	2005*	2006**
Los Angeles Aqueduct	202,535	368,839	50,132
California Aqueduct & Colorado River	391,833	185,346	65,343
Total Imported	594,368	554,185	115,475

* Calendar Year from January – December 2004

** Calendar Year from January – March 2006

The SWP project requires an annual average energy use of 12.2 billion kWh and is the largest single user of energy in the state (Table D-4). The state signed contracts to deliver 4.2 million acre-feet (maf) of water per year to 29 urban and agricultural agencies throughout California with much of the waters passing through the San Francisco-San Joaquin Bay-Delta. However, on average, it has been able to deliver only 1.86 maf per year during the decade 1991 to 2001. The Metropolitan Water District (MWD) has an allocation of 2maf per year under contract from the SWP. Actual deliveries have never reached this amount because quantities of water available for export through the aqueduct can vary significantly year to year (RUWMP, 2005).

Table D-4. SWP Hydroelectric Power Generation (Acre-feet)
(Source: CA Water Plan 2005)

Largest Annual Energy Output	4.9 billion kWh
Average Total Energy Generated Annually	7.6 billion kWh
Average Annual Energy Use	12.2 billion kWh
Average Net Use	4.6 billion kWh

The Colorado River Aqueduct took eight years to construct and was completed in 1941 by the MWD. It conveys water 242 miles from the Lake Havasu intake to its terminal reservoir, Lake Mathews, in western Riverside County. With a capacity of 1,800cfs, the aqueduct lifts the water 1,617 feet through five pumping plants. There are 92 miles of tunnels, 63 miles of concrete canals, 55 miles of concrete conduits, and 144 siphons totaling 29 miles (CLUI 2005).

The MWD oversees the importation and delivery from both the State Water Project and the Colorado River Aqueduct. Approximately 20 percent of the water utilized in Los Angeles is purchased from MWD; of these supplies approximately 1/3 comes from the Colorado Aqueduct while 2/3 originates from the State Water Project. All MWD water utilized for the Tujunga Watershed area is from the State Water Project (Van, 2006). The City of San Fernando purchased approximately 7% of the water utilized by the city and its 24,600 citizens in 2004 from MWD imported surface water (CSF, WQR 2004). The CA Energy Commission has found that moving water around the state, aqueducts, groundwater, wastewater, etc. consumes 19% of the total energy consumption of the state.

Recycled Water

Currently, almost 65,000 afy of the City of Los Angeles' wastewater is recycled. Approximately 1,950 afy of recycled water is used for municipal and industrial purposes. Recycled water used for Municipal & Industrial purposes reduces demands for imported water supplies. (LADWP UWMP 2005). Wastewaters that have been treated to tertiary standards and not reused are discharged from the Tillman Reclamation Plant to the Los Angeles River.

The East Valley trunkline is the initial backbone of a distribution system to deliver recycled water throughout the San Fernando Valley for irrigation, commercial, and industrial use. State and Federal funding provided 75 percent of the \$55 million total cost for the major portion of the distribution system. The San Fernando Valley Water Recycling Projects facilities will provide recycled water to the Sepulveda Basin, South San Fernando Valley, and Hansen Water Recycling Projects, making recycled water available to areas stretching from the Warner Center in Woodland Hills to North Hollywood and to the Hansen Dam Recreation area. Planned projects will supply approximately 10,000 AFY of recycled water to irrigation and industrial users (LADWP, UWMP 2005).

LADWP plans to connect large recycled water customers first, including the Hansen Dam Recreation Area and the Valley Generating Station in the northeast San Fernando Valley, and the Sepulveda Basin and Pierce College in the southwest portion of the San Fernando Valley. Approximately 4,565 afy of irrigation demand and 2,500 afy of industrial demand have been identified, over half of the 10,000 afy target for recycled water use. The identified demand includes 2,000 afy for the Sepulveda Basin Project, 1,000 afy for the South Valley Project, 2,500 AFY for Hansen Area Phase I, and 1,565 AFY for Hansen Area Phase II. The City anticipates all of these projects will be delivering recycled water by 2010. Smaller users in the vicinity of these projects will be identified and connected to close the gap between the major users already identified and LADWP's recycled water supply target for this region (LADWP, UWMP 2005).

In 1999 the City of Los Angeles partnered with the City's Bureau of Sanitation, public stakeholders and other agencies to identify the interrelationship of wastewater, stormwater and water supply; this process will yield an Integrated Resources Plan (IRP). The IRP examines ways to decrease potable water needs by expanding the City's recycled water program and encouraging rainwater harvesting; increase water efficiency by installing smart irrigation devices that reduce irrigation demands; and increase groundwater resources by using wet weather runoff to recharge the aquifer (LADWP, UWMP 2005). The IRP evaluated a broad range of integrated alternatives, initially narrowing them down to 21 and resulting in nine stakeholder-approved alternatives. Today the City has recommended four of these nine that are now undergoing an environmental impact report process. The Los Angeles City Council is scheduled to approve an alternative in October 2006. As of publication, the recommended 'preferred alternative' is Alternative 4.

The East Valley Project was originally designed to deliver tertiary treated water to spreading grounds just below Hansen Dam for groundwater recharge. This is the most economical way to reuse water. It will

filter through the ground to the groundwater basin where it will merge with native waters, and then can be pumped up into the existing water delivery system of the LADWP.

Alternative 4 includes the possibility of using recycled water for recharge in the East Valley, which could include as much as 75,000afy. Roughly 5,000 afy is currently available from the Tillman Treatment Plant, with capability for 5,000 more. A study is currently underway to identify additional users. It would be safe to state that the City of Los Angeles has the potential to produce and utilize at least 100,000afy of recycled water if safety and cost concerns can be addressed.

Alternative Water Supplies

There are several alternative sources identified in the LADWP Urban Watershed Management Plan, some of these include: water transfers (the lease or sale of water or water rights between consenting parties), seawater desalination (the process of desalting seawater to produce potable drinking water), beneficial uses of urban runoff (treating captured runoff for reuse) and greywater (household waters which have not come in contact with toilet waste).

Water Transfers: LADWP is currently in the process of finalizing a four-way agreement between the Department of Water Resources, Metropolitan Water District and Antelope Valley Kern Water Agency that would allow construction of a turn-out to deliver water from the California Aqueduct to the Los Angeles Aqueduct. This turn-out would allow for water transfers of up to 40,000afy. So far, MWD has consented to the water transfer with a stipulated system access charge for utilization of their conveyance and distribution system (LADWP, UWMP 2005).

Seawater Desalination: Desalination is the process of removing salt from seawater either through evaporation or by forcing the salty water through tiny membrane filters (reverse osmosis) in order to make fresh, drinkable water (DRG, 2005). In 2005, LADWP in partnership with Long Beach Water Department (LBWD) and Bureau of Reclamation began a \$15 million research study. This plant currently processes 300,000 gallons per day; the water goes through a desalination process to determine the cost effectiveness and energy consumption of desalination and then reversely through seawater reconstitution tanks before being re-released to the ocean. LADWP are also in the process of investigating the development of a 12 to 25 million gallon-per-day desalination facility at the Scattergood Generating Station near Los Angeles Airport (LADWP, UWMP 2005). Desalination of sea water is much more energy intensive than using the same technology on our wastewater stream which, by law, is already cleaned up to almost potable standards before being discarded via the Los Angeles River to the ocean.

Urban Runoff: Dry weather runoff (e.g., from over irrigation, washing cars) and wet weather runoff (rain falling on impervious surfaces, rooftops, roads, freeways) which usually ends up in our stormwater system and lost to the ocean, has been an untapped alternative source of water supply; specially during seasons of heightened non-potable water demands (e.g., irrigation during the summer). The guiding principle for runoff management in the City of Los Angeles' IRP is to maximize options that offset potable water use, such as: smart irrigation, urban runoff plants, local neighborhood solutions (cisterns, on-site percolation, neighborhood recharge), and non-urban regional recharge. Significant amounts of water can be conserved or captured for re-use through these means. (CoLA, IRP 2006).

Greywater: Household wastewaters that originate from showers, kitchen and bathroom sinks, as well as washing machines end up in the sewage system. These 'greywaters' when diverted to an onsite treatment system instead of entering the sewage system can become a source of water utilized for residential irrigation. In 1994 the City of Los Angeles approved an ordinance that permitted the installation of greywater systems in

residential homes. The Grey Water Systems for Single-Family Residences Act of 1992 legally incorporated the use of greywater as part of the California Plumbing Code (LADWP, UWMP 2005).

Water Storage

Groundwater

Aquifers are not only sources of water but also are storage reservoirs. Spreading grounds allow rainwater to spread over an area of land and facilitate percolation for groundwater recharge. There are five spreading grounds within the Tujunga Watershed. In addition, the County began calculating recharge captured through infiltration via the unlined reaches of Tujunga Wash in water year 2003-2004. These five facilities represented 4.7% (10,065af), 15.3% (113,800af), and 12% (42,091) of the total water conserved in Los Angeles County for the water years 2003-2004, 2004-2005 and 2005-2006, respectively (Table D-5). All spreading ground facilities within the Tujunga Watershed presently utilize only native water for recharge.

Table D-5. Total Water Conserved (Acre-feet)
(Source: LACDPW, 2003-2006)

Spreading Facility	Storage Capacity (Acre Feet)	Percolation Rate (cfs)	2003-2004 Water Year	2004-2005 Water Year	2005-2006 Water Year	Historic Average	Historic High	
							Amount	Water Year
Lopez	27	15	144	940	902	568	1,938	1967-68
Pacoima	440	65	1,731	17,394	7,350	4,956	22,973	1982-83
Branford	137	1	444	1,448	488	400	1,448	2004-05
Hansen	330	150	6,424	33,301	18,559	10,897	35,221	1982-83
Tujunga ¹	100	120	264	21,115	10,759	9,384	42,817	1982-83
Tujunga Wash	n/a	n/a	1,058	39,602	4,033	n/a	n/a	n/a
Total			10,065	113,800	42,091			
LA County Total			227,356	745,468	351,640			

- (1) LADWP in conjunction with LACDPW are presently looking at alternatives for retrofitting Tujunga spreading grounds to incorporate recreational open-space while increasing Tujunga's spreading capacity from 100af to 250af.

Surface Water

Surface water can be stored behind dams forming artificial lakes known as reservoirs. Water can be diverted to a reservoir from rivers or runoff, then stored for irrigation, drinking water, groundwater recharge, or habitat purposes. The Los Angeles Reservoir is within the Upper Los Angeles Area watershed. The Tujunga Watershed encompasses four reservoirs: the Lopez, Pacoima, Big Tujunga and Hansen reservoirs, with a holding storage capacity totaling 39,517 acre-feet (Table D-6). Dam outlet works (gates) can control the flow of water released from a reservoir and are utilized here to optimize groundwater recharge at Hansen Dam and Hansen spreading grounds.

Water Rights

California has the most complex water resource management system in the United States. Several historic decrees have ruled on filed claims to water and the legal rights to these; some of the state and local laws that have influenced and dictated who is entitled to local waters include:

Table D-6. Reservoir Storage Capacity (Acre-feet)
(Sources: LACDPW Dam Safety Section; and USACE Water Resources Division, Michele Chimienti)

Reservoir/ Dam	Storing Capacity (Acre Feet)	Annual Inflow 2002-2003 (Acre Feet)	Annual Outflow 2002-2003 (Acre Feet)	Annual Inflow 2003-2004 (Acre Feet)	Annual Outflow 2003-2004 (Acre Feet)	Annual Inflow 2004-2005 (Acre Feet)	Annual Outflow 2004-2005 (Acre Feet)
Lopez	441						
Pacoima	6,060	3,407	2,437	1,510	1,520	48,550	32,650
Big Tujunga	6,240	7,090	7,031	2,310	2,120	132,800	132,000
Hansen	26,776						
Total	39,517						

1781 – Foundation of the Pueblo. The Pueblo claimed the right to all the waters of the river and all the owners of land on the stream recognized that right. Pueblo Rights: “we hold that, to the extent of the needs of its inhabitants, it has the paramount right to the use of the waters of the river”.

1899 – Los Angeles vs. A.E Pomeroy. The California Supreme Court specifically stated that the City of Los Angeles had rights to “all waters of the San Fernando Valley, except what is lost by evaporation consumed in plant life....either on or beneath the surface”.

1964 – US Supreme Court – Arizona vs. California decree reduced Metropolitan’s dependable supply of Colorado River water to 550,000afy. The reduction in dependability occurred with the commencement of Colorado River water deliveries to the central Arizona project in 1985.

1979 – California Superior Court Judgment. The City of Los Angeles vs. City of San Fernando, “It is appropriate to allow continued limited extraction from the San Fernando Basin... by parties other than the City of Los Angeles, subject to assurance that Los Angeles will be compensated for any cost, expense or loss incurred as a result thereof”, (Rodrigue and Rovai, 1996)

Water Use

According to LADPW, today the average Angeleno uses an average of 155 gallons of water a day compared to 188 in the 1980’s. While in the past LADWP has achieved a water conservation effort of 15%, the 2005 Urban Water Management Plan released by LADWP cites that it has increased its conservation goal to 20%.

Based on population estimates (TWP, 2005) within the watershed and individual average water consumption of Angelenos (LADWP, UWMP 2005); the Tujunga Watershed residents utilize a daily average of 249 acre-feet of water, approximately 81,375,000 gallons a day.

Los Angeles’ Department of Water and Power (LADWP) keeps track of water utilized by each category/customer. Utilizing the City of Los Angeles Integrated Resources Plan land use information for Los Angeles County as reported in the LADWP, Urban Water Management Plan 2005; we were able to compare land use information specific to the Tujunga Watershed (TWP Map, 2005) to produce an approximate number of acre-feet of water utilized by each category within the Tujunga Watershed for the year 2004 (table D-6).

Table D-6. Water Use by Category in Los Angeles and Tujunga Watershed
(Sources: LADWP UWMP 2005, IRP, TWP Land Use Info)

Category	Water Use (Acre Feet) 2004 - Los Angeles (city)	Water Use (Acre Feet) 2004 - Tujunga Watershed
Single-family residential	249,000	31,806
Multi-family residential	190,000	15,566
Commercial	110,000	14,009
Industrial	22,000	2,083
Total	571,000	

Agriculture

There is little agriculture remaining in the watershed. The only agricultural use of water is that used by nurseries growing plants for sale to be used for landscaping.

Water Conservation

Since the five-year drought of 1987 the City of Los Angeles and its residents have adopted water conservation practices due to public awareness programs and education campaigns.

The City of Los Angeles has taken and continues to take steps to conserve water resources. According to the LADWP Urban Watershed Management Plan, the City has produced water conservation figures greater than 15% despite increased demand for this resource. This means that total demand is at least 15% lower than it would be without conservation. The City and its citizens have been implementing permanent conservation since the 1980's.

In 1988, the City adopted a plumbing retrofit ordinance to mandate the installation of conservation devices in all properties and require water-efficient landscaping in new construction. An amendment to the ordinance in 1999 required the installation of ultra-low-flush toilets (ULF) in single-family residences prior to resale (LADWP, UWMP, 2005). In 1993 water rates were restructured to an ascending tier rate system that applies lower rates for water used within a specified allotment and higher rates for billing units exceeding the lower tier allotment.

LADWP reports indicate that the City's water use has been maintained at approximately the same levels as in the mid-1980s due to a combination of hardware-based demand reduction programs, education, and the use of price signals to encourage efficiency.

The California Urban Water Conservation Council was formed in 1991. Their mission is to oversee the implementation of urban water conservation best management practices and to improve the state of the art in water conservation practice and analysis. (CUWCC, 2006) They are also charged with implementing the Memorandum of Understanding Regarding Urban Water Conservation in California (MOU). The MOU is a document signed by over 350 water agencies, public interest groups and interested parties who have pledged to develop and implement 14 Best Management Practices (BMPs) for urban water conservation.

As listed below, the City of Los Angeles currently implements 12 of the 14 BMPs:

- Water survey programs for single-family residential and multi-family residential customers
- Residential plumbing retrofit
- System water audits, leak detention and repair
- Metering with commodity rates for all new connections and retrofit of existing connections
- Large landscape conservation programs and incentives
- High-efficiency clothes washing machine financial incentive programs
- Public information programs
- School education programs
- Conservation programs for commercial, industrial and institutional accounts
- Conservation pricing
- Conservation coordinator water waste prohibition
- ULFT replacement programs

A recent report analyzing the potential for improving the efficiency of urban water use in the State of California concluded that total commercial, industrial, residential, and institutional water use could be cut by as much as 30 percent, cost-effectively, with existing off-the-shelf technologies (Gleick, 2005).

Conclusions

Los Angeles relies on a massive, aging infrastructure system that utilizes 19% of the state's energy to provide the majority of its current water supply. The Tujunga watershed has immense water supply potential but it will need to be more holistically and efficiently managed to meet current and future demands.

The San Fernando and Sylmar Groundwater Basins underlying the Tujunga Watershed have the capacity to provide a significantly greater percentage of local water supplies. Because the lower watershed has been dramatically altered by urbanization and the constrained channel system, current groundwater levels are well beneath capacity. By increasing the amount of stormwater retained and infiltrated into the basin as opposed to being drained out to the Pacific Ocean, Los Angeles can accomplish a meaningful step towards local sustainability and relieve its dependence upon imported water.

However, if the current 'safe yield' determination based on existing conditions remains static, and the system whereby stored water credits are accounted for are not modified accordingly, opportunities to utilize groundwater supplies would remain limited even if groundwater levels were restored to maximum capacity.

Recycled, or reclaimed, water supplies are an underutilized resource. This is attributable in part to public perception and in part to insufficient infrastructure. This resource could meet nearly half the City's industrial demand alone, or could be distributed for groundwater recharge and irrigation of public land.

Studies have proven that water conservation incentives and the use of more water-efficient technologies have thus far enabled Los Angeles' water demand to remain stable despite population increases. While such progress in conservation is laudable, the volumes of potable water being used to support landscape practices demonstrate that efficiencies can still be greatly improved.

Recommendations

The current state of water supply and use in the Tujunga Watershed can be improved through several means: by encouraging the watershed-wide capture and infiltration to groundwater of stormwater that would otherwise be lost to the ocean; by adapting, over time, the legal & policy frameworks that currently disincentivize maximizing native supplies; by facilitating broader utilization of reclaimed water; by utilizing existing technological advancements for more efficient water use; by creating and promoting policies that encourage conservation; and by adopting and fostering a landscape ethic that reduces irrigation demand.

Opportunities to realize watershed-wide capture and infiltration of stormwater can be considered and addressed through four avenues of action. Prioritize investments in large-scale opportunities including: seismically retrofit the Big Tujunga Dam to restore its original capacity (an increase of 300%) to detain larger storm flows; analyze Tujunga, Pacoima, and Branford spreading grounds for potential design modifications to increase their capacity; acquire the Sheldon and Boulevard gravel pits for temporary detention; revise dam operation rules for both Big Tujunga and Hansen Dam in order to facilitate larger volumes of stormwater, including stormwater from events above 3/4', to be diverted to gravel pits for temporary detention and, ultimately, to spreading grounds for infiltration to groundwater.

Pursue options to create medium-sized infiltration basins scaled to handle smaller subwatershed units. These basins can serve to handle runoff while providing recreational benefits and increasing property values in communities. Greenfield areas (e.g. Sylmar and other existing equestrian communities where larger parcels still remain undeveloped), gravel pits, and redevelopment areas have potential to serve this purpose. Retrofitting existing park space and golf courses provide additional opportunities to create such basin areas. The Sun Valley Watershed Management Plan includes projects that take a similar approach. The cities of Fresno and Clovis operate an urban storm drainage system in which they compartmentalize a larger watershed into 160 small urban watersheds, each roughly one square mile, to collect water and filter pollutants. Each watershed has a basin that removes between 50-80% of 15 commonly occurring stormwater pollutants, the water is returned to the groundwater, and the basins double up as parks and recreation areas (League of California Cities, 2006).

Aggressively undertake to reduce impervious surfaces overall. Where larger parcels are not available, creating a large number of smaller basins may be a practical, efficient means for retrofitting neighborhoods to capture and infiltrate minimally the first 3/4' of rainfall in any 24-hour period. Implement a neighborhood pilot program, similar to Seattle's SEA Streets, in which pavement is narrowed, planted area is increased, and runoff is conducted to vegetated swales. Such a program would provide a mechanism for community education, involvement and demonstration. Identify streets that are wider than necessary, and expand the areas of pervious, vegetated medians and parkways.

Utilize public surplus properties and strategic acquisition of 1/4 to 1/2 acre parcels in neighborhoods to capture stormwater and increase accessibility to park-space in underserved communities. Areas as small as 1/10th of an acre can function effectively in aggregate. Take advantage of opportunities such as public rights-of-way, residential developments, and parking lots. In addition, pervious gutters can capture small storm events as well as runoff from over-irrigation. Taking advantage of any practicable means and opportunity to reduce impervious surfaces should become a priority in this watershed.

Capture and infiltrate storm water where it falls in order to cost-effectively increase the amount of clean groundwater available for use. A recent study looking at the potential impacts to groundwater from infiltrating stormwater runoff found no statistically significant degradation of groundwater quality from the infiltration of stormwater-borne constituents as long as site characterization of surface and soil constituents at industrial

sites are conducted prior to implementing infiltration strategies (LASGRWC, 2005).

Larger-scale projects coupled with watershed-wide improvements can, over time, increase the feasibility implementing the fourth avenue of action whereby groundwater recharge can be enhanced. Once significant volumes of stormwater can be captured and infiltrated where it falls, volumes diverted to the stormdrain system, and hence to Tujunga and Pacoima Wash, will be greatly reduced. This will allow greater opportunities for these degraded streams to be rehabilitated. Removing the concrete from these channels will restore surface water and groundwater interaction and allow for stormwater cleansing and recharge.

Public opinion must be changed before the East Valley Water Recycling Project infrastructure can be fully utilized. Investment must be made in a consistent, transparent, education and outreach effort involving regulators, the scientific community and local neighborhood councils in an honest dialogue. Analyze options to develop a network of reclaimed water 'purple pipe' corridors for irrigation and industrial use.

Promote the cost-saving benefits of readily available technologies and encourage their use. Install irrigation sensors on public projects such as parks and transportation rights-of-ways to prevent water wasted by inappropriate irrigation during storm events. Implement other technologies such as automatic faucets and waterless urinals in public projects. Incentivize use of irrigation sensors for homeowners and require it in new developments. Promote and encourage greywater systems and water efficient clothes washers for use by residential customers.

Encourage residents to embrace a native landscape ethic. Target replacing 20% of residential lawns throughout the watershed with native landscaping over the next 10 years. Engage local nurseries in promoting and supporting this transition. Public entities should lead by example, requiring native landscaping on new projects and transitioning landscapes on existing public facilities to a native plant palette over the course of the next 10 years. Public entities should also review existing landscape ordinances regulating private development and revise them to exclude invasive and high water dependent species.

Consider credits to encourage developers to incorporate capture and infiltration of stormwater onsite, purple-pipes, greywater systems, greenroofs, cisterns, weather-sensor irrigation, water-efficient clothes washers and native landscaping in projects. Create a water-efficient seal similar to the energy-efficient seal currently in use to promote the cost-savings that will accrue to residents.

Water Quality

Introduction

Water quality is a critical element of watershed assessment. Impairments to water quality affect our ability to utilize water for drinking supplies, tax the capacity of biotic systems to remediate pollutants, and impact the functioning of water to support aquatic life. In the Tujunga Watershed, a broad range of human activities and natural conditions impact water quality. As settlement of the area has progressed over time, issues associated with human activity have increasingly become cause for concern. The costs associated with rectifying impairments through single-purpose technology can be daunting, and the effectiveness of existing hardware remains unproven. Protecting water quality at its source makes good public health sense, good economic sense, and good environmental sense. Identifying those sources may present challenges, but should be a priority concern. Watershed management seeks to determine the most cost-effective suite of solutions driven by holistic consideration of natural system capacities. The following discussion of water quality includes regulatory background, beneficial uses, water quality, surface water and groundwater quality assessment, and an evaluation of potential pollution sources.

Findings

Regulatory Background

The United States Congress passed the Clean Water Act (CWA) in 1972. In addition to many other provisions, the CWA sets limits on point sources of pollution. Point sources are discrete “end of pipe” discharges of effluent into rivers and waterways from operations such as oil refineries, chemical plants, and wastewater treatment plants. Additionally, the CWA requires each state to identify impaired water bodies within its boundaries that cannot comply with in-stream water quality limits for specific contaminants. These areas are included by each state on a list called the CWA Section 303(d) list, commonly called the 303(d) list. Once these combinations of waterways and contaminants are identified, states or United States Environmental Protection Agency (EPA) must develop limits on how much pollution is allowed to enter the waterway from nonpoint sources. The limit for this nonpoint source pollution combined with the output of all point sources is called a Total Maximum Daily Load, or TMDL. Non-point source pollution, on the other hand, cannot be traced back to a single source and generally encompasses stormwater runoff.

The Dickey Water Pollution Control Act of 1949 passed by the California legislature established a State Water Pollution Control Board (later renamed the State Water Quality Control Board) and nine regional water pollution control boards that roughly corresponded to the major watersheds in the state. The Porter-Cologne Water Quality Control Act of 1969, also passed by the California legislature, conferred broad powers to the State and Regional boards to protect the beneficial uses of water, and established a requirement for water quality control plans (or Basin Plans, which identify beneficial uses for water bodies) for each region.

Primary authority for surface water quality in the Tujunga Watershed rests with the Los Angeles Regional Water Quality Control Board (RWQCB). The RWQCB has the authority to issue permits for point sources and stormwater under the National Pollutant Discharge Elimination System (NPDES). The RWQCB also establishes and oversees enforcement of water quality standards (defined as the combination of beneficial uses and water quality objectives for each waterbody), TMDLs, and any/all changes to the Basin Plan.

In 1998, a coalition of environmental advocacy groups sued the EPA for failure to ensure timely development of TMDLs for each polluted water body in the Los Angeles Region as required by the CWA. The litigation

resulted in a consent decree that establishes a schedule for completing TMDLs for all the polluted waters within 13 years. EPA and RWQCB are working cooperatively to develop TMDLs within the consent decree deadlines.

In December 2002, a joint Draft Strategy for Developing TMDLs and Attaining Water Quality Standards in the Los Angeles Region was publicly circulated for consideration and comment. In the Draft Strategy, the EPA and RWQCB offered interested stakeholders an opportunity to conduct a stakeholder-led TMDL development process. In response, the City of Los Angeles initiated the Cleaner Rivers through Effective Stakeholder-led TMDLs (CREST) program.

Beneficial Uses

Beneficial uses for the Tujunga Wash between Hansen Dam and Los Angeles River include potential beneficial uses for municipal and domestic supply (MUN) (conditional designation which may be considered for exemption at a later date), contact water recreation (REC1) (access prohibited by LACDPW in the concrete channelized area), wildlife habitat (WILD), and warm fresh water habitat (WARM). Intermittent beneficial uses are ground water recharge (GWR) and non-contact water recreation (REC2). Beneficial uses for surface waters in the Tujunga Watershed are presented in Table E-1 and beneficial uses for groundwater are presented in Table E-2. Waterbodies designated as WET may have wetlands habitat associated with only a portion of the waterbody. The beneficial uses affected by nutrients include warm freshwater habitat (WARM), wetland habitat (WET), wildlife habitat (WILD), protection of rare and endangered species (RARE) and, when nutrients lead to nuisance algal blooms, water non-contact recreation (REC2).

Table E-1. Beneficial Uses of Inland Surface Waters in the Tujunga Watershed.
(Source: Los Angeles Regional Control Board)

Waterbody	Beneficial Use & Status									
	MUN	GRW	REC1	REC2	WARM	COLD	WILD	RARE	SPWN	WET
Tujunga Wash	P*	I	P(m)	I	P	P	P			
Hansen Flood Control Basin & Lakes	P*	E	E	E	E	E	E	E		
Lopez Canyon Creek	P*	I	I(m)	I	I		E			
Little Tujunga Canyon Creek	P*	I	I	E	I	I	E	E		
Kagel Canyon Creek	P*	I	I(m)	I	I		E			
Big Tujunga Creek	P*	E	E	E	E	E	E	E	E	E
Upper Big Tujunga Canyon Creek	P*	E	P(m)	E	E		E	E		
Clear Creek	P*	E	E	E	E	E	E			E
Mill Creek	P*	E	E	E	E	E	E			E
Pacoima Wash	P*	E	P(m)	E	E		E	E		
Pacoima Reservoir	P*	E	E	E	E		E			
Pacoima Canyon Creek	P*	E	E	E	E	E	E	E	E	E

E: Existing Beneficial Use

P: Potential Beneficial Use

I: Intermittent Beneficial Use

(m) Access prohibited by the LA County DPW in concrete-channelized areas

*May be considered for exemption at a later date

Table E-2. Beneficial Uses of Groundwater in the Tujunga Watershed.
(Source: Los Angeles Regional Control Board)

Basin	Beneficial Use & Status			
	MUN	IND	PROC	AGR
Sylmar	E	E	E	E
San Fernando Basin, west of Interstate 405	E	E	E	E
Sunland-Tujunga Area	E	E	E	E

E: Existing Beneficial Use

P: Potential Beneficial Use

I: Intermittent Beneficial Use

Nitrite pollution in the groundwater of the Sunland-Tujunga area currently precludes direct MUN uses.

Water Quality Monitoring / Data Availability

Surface water quality data for receiving waters in the Tujunga Watershed is limited. LACDPW does not have any water quality monitoring stations within watershed. RWQCB data available for this report is from a single site located in Tujunga Wash at Laurel Canyon Boulevard. The Southern California Coastal Water Research Project (SCCWRP) conducted two sampling events, which were used for setting the Los Angeles River TMDL for metals and nitrogen compounds. Data were collected along the Tujunga Wash Channel below the Pacoima Drainage Channel confluence for flow, metals, total suspended solids, total organic carbon, biological oxygen demand, ammonia, nitrate/nitrite, organic nitrogen, orthophosphate, and organic phosphorus. Metals analyzed included cadmium, chromium, copper, iron, lead, nickel, mercury, and zinc. The two sampling programs were conducted between September 10 and 11, 2000 (Ackerman et. al. 2003) and July 29 to 30, 2001.

In an attempt to augment the scarce amount of in-stream water quality data available for assessing the Tujunga Watershed, a review of data collected by NPDES stormwater permittees was conducted. This required viewing of archive files kept at the RWQCB's office in downtown Los Angeles.

Surface Water Quality

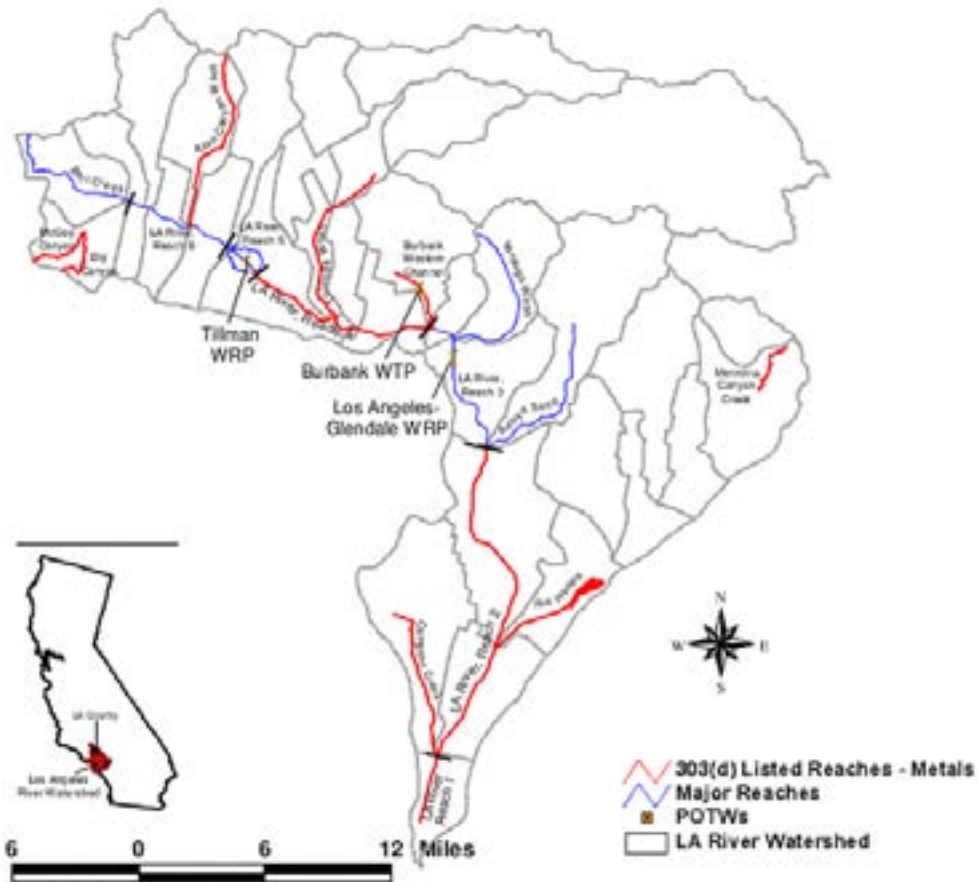
Surface water quality in the Tujunga Watershed is assessed in this section according to 303(d) listed impairments, review of available in-stream data, consideration of NPDES stormwater monitoring data, and a comparison to constituents of concern for other watersheds in the Los Angeles River Basin with similar land use composition.

303 (d) Impairments

One way to characterize water quality in the Tujunga Watershed is to refer to the State of California's 303(d) list. Tujunga Wash from the Los Angeles River to Hansen Dam is included on the 303(d) list for ammonia, copper, bacteria (coliform), odors, scum and trash. Runoff from the Tujunga Watershed eventually discharges into Reach 4 of the Los Angeles River near Colfax Ave and Ventura Blvd, as shown in Figure E-1. Reach 4 of the Los Angeles River is impaired for nitrogen, ammonia, pH, algae, scum, odors, bacteria, trash, and metals.

Nitrogen and ammonia come from human and animal wastes, commercial fertilizers, and landfill leachate. Bacteria come from human and animal wastes, leaky septic tanks or sewer lines, and from decaying organic trash deposited in the water. Copper and other metals come from a variety of industrial sources and auto-related uses.

Figure E-1. 303 (d) Listed Reaches of the Los Angeles River Basin, including Tujunga Wash.
(Source: Los Angeles Regional Water Quality Control Board)

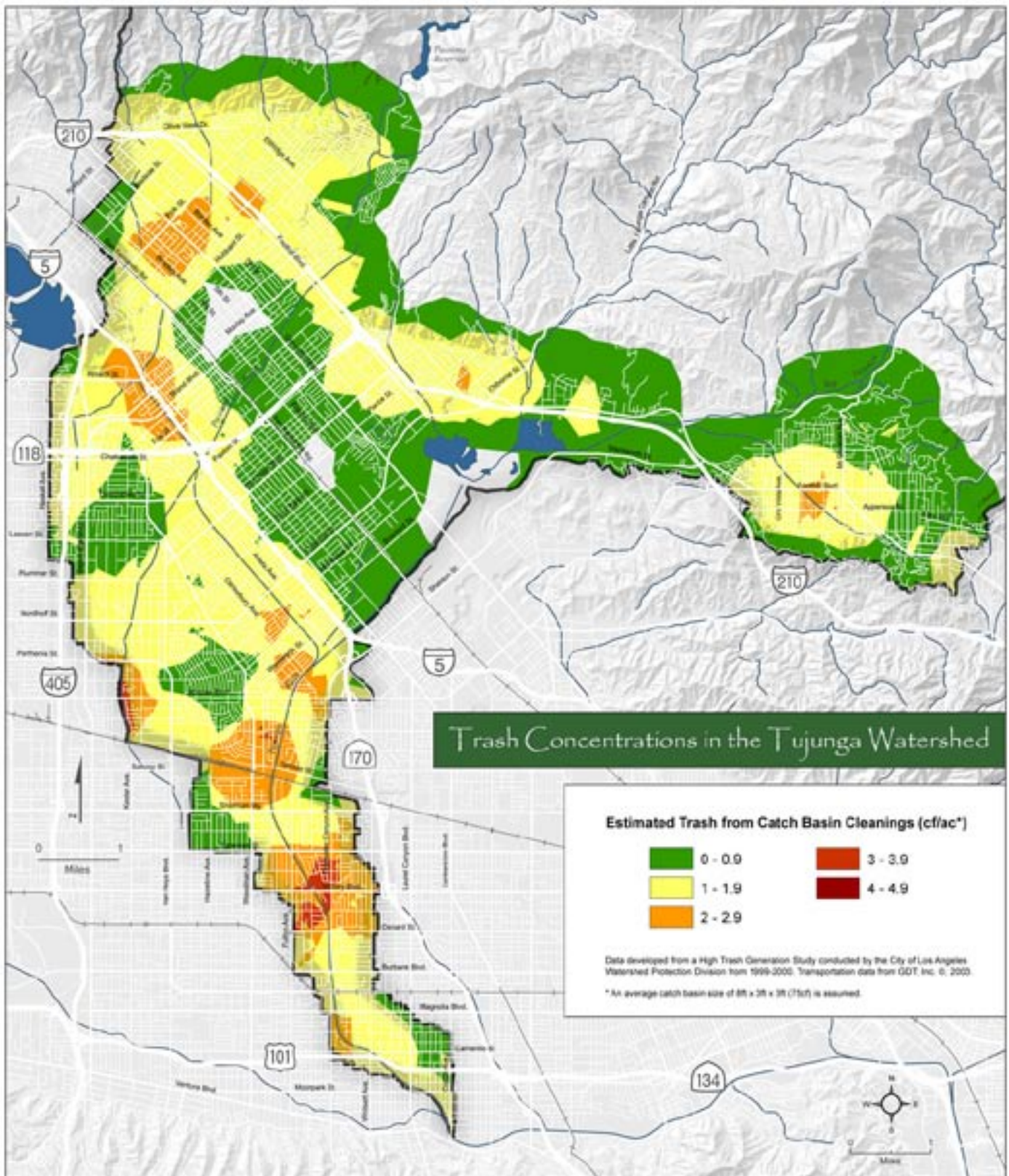


These all find their way into Tujunga Wash via storm drains that pass through urban neighborhoods. In addition, the non-natural condition of many channels in the watershed actually generates pollution. Without the complex biological processes that occur in a river with a natural bottom composed of sediment and plants, algae and other indicators of poor natural function prevail most especially in warm weather. Natural systems filter pollutants from surface waters and provide opportunities for groundwater recharge. Impervious surfaces transport pollutants through storm drains to surface waters without any of the attenuation offered by natural landscapes. There is a direct link between land use, hydromodification, and water quality. For this reason, LARWQCB Resolution number 2005-002 clearly states the will to maintain and restore, where feasible, the physical, chemical and biological integrity of the region's watercourses (LARWQCB, 2005).

While small concentrations of most regulated constituents are naturally present in even the most pristine waterbodies, trash is a purely human-generated pollutant. Data collected for a recent study included a geographical analysis of trash generation (CoLA, 2002). Figure E-2 shows specific areas of concern in the Tujunga Watershed.

None of the organic constituents were detected on the four occasions they were analyzed (10/1986, 3/1990, 5/1991, and 12/1991). None of the organochlorine pesticides or PCBs were detected on the two occasions they were analyzed (10/1996 and 3/1990). However, the detection limits reported for organics,

Figure E-2. Trash Concentrations in the Tujunga Watershed
(source: City of Los Angeles)



Available Water Quality Data from RWQCB

Results of available data from Regional Board water quality monitoring activities mentioned earlier are summarized below, for data collected from the main channel of the Tujunga Wash at Laurel Canyon Boulevard. Samples were collected during 13 different monitoring events between 1986 and 1997, one of which occurred during wet weather. Samples were analyzed for five general classes of constituents: organics, metals, organochlorine pesticides and PCBs, conventional, and bacteria (not all classes were analyzed on all occasions). Table E-3 shows the classes and individual constituents.

Table E-3. Classes of Constituents Analyzed in RWQCB data from Tujunga Wash at Laurel Canyon Blvd.

Class	Individual Constituents
Organics	1,1,1,2-Tetrachloroethane, 1,1,1-Trichloroethane, 1,1,2,2-Tetrachloroethane, 1,1-Dichloroethane, 1,1-Dichloroethylene, 1,1-Dichloropropene, 1,2,3-Trichlorobenzene, 1,2,3-Trichloropropane, 1,2,4-Trichlorobenzene, 1,2,4-Trimethylbenzene, 1,2-Dichlorobenzene, 1,2-Dichloroethane, 1,2-Dichloropropane, 1,3,5-Trimethylbenzene, 1,3-Dichlorobenzene, 1,3-Dichloropropane, 1,3-Dichloropropene, 1,4-Dichlorobenzene, 2,2-Dichloropropane, 2,4,5-TP, 2,4,6-Trichlorophenol, 2,4-Dichlorophenol, 2,4-Dichlorophenoxy-Acetic Acid, 2,4-Dimethylphenol, 2,4-Dinitrophenol, 2,4-Dinitrotoluene, 2,6-Dinitrotoluene, 2-Butanone, 2-Chloroethylvinylether, 2-Chloronaphthalene, 2-Chlorophenol, 2-Chlorotoluene, 2-Hexanone, 2-Methy-4,6-Dinitrophenol, 2-Nitrophenol, 3,3-Dichlorobenzidine, 4-Bromophenyl-Phenyl Ether, 4-Chloro-3-Methylphenol, 4-Chlorophenyl-Phenyl Ether, 4-Chlorotoluene, 4-Nitrophenol, Acenaphthalene, Acrolein, Acrylaldehyde, Acrylonitrile, Anthracene, Benzene, Benzidine, Benzo(A)Anthracene, Benzo(A)Pyrene, Benzo(B)Fluoranthene, Benzo(G,H,I)Perylene, Benzo(K)Fluoranthene, Bis(2-Chloroethoxy)Methane, Bis(2-Chloroethyl)Ether, Bis(2-Chloroisopropyl)Ether, Bis(2-Ethylhexyl)Phthalate, Bromobenzene, Bromochloromethane, Bromodichloromethane, Bromoform, Bromomethane, Butylbenzyl Phthalate, Carbon Tetrachloride, Chlorobenzene, Chloroethane, Chloroform, Chloromethane, Chrysene, Cis-1,2-Dichloroethylene, Dibenz(A,H)Anthracene, Dibromochloromethane, Dichlorodifluoromethane, Dimethyl Phthalate, Di-N-Butylphthalate, Di-N-Octyl Phthalate, Ethylbenzene, Fluoranthene, Fluorene, Fluorotrichloromethane, Hexachlorobenzene, Hexachlorobutadiene, Hexachlorocyclopentadiene, Hexachloroethane, Indeno(1,2,3-C,D)Pyrene, Isophorone, Isopropylbenzene, Methylene Chloride, Naphthalene, N-Butylbenzene, Nitrobenzene, N-Nitrosodi-N-Propylamine, N-Nitrosodiphenylamine, N-Propylbenzene, Pentachlorophenol (Pcp), Phenanthrene, P-Isopropyltoluene, Pyrene, Sec-Butylbenzene, Styrene, Tert-Butylbenzene, Tetrachloroethene, Toluene, Total Petroleum Hydrocarbons, Trans-1,2-Dichloroethylene, Trichloroethylene, Trichlorofluoromethane, Vinyl Chloride, Xylenes, and Total Xylene.
Metals	Arsenic, Barium, Cadmium, Chromium (VI), Total Chromium, Copper, Cyanide, Lead, Manganese, Mercury, Selenium, Silver, and Zinc.
OC Pesticides and PCBs	4,4'-DDD, 4,4'-DDE, 4,4'-DDT, Aldrin, Dieldrin, Endosulfan I, Endosulfan II, Endosulfan Sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1260, Toxaphene, and Gamma-BHC (Lindane)
Conventional	Biochemical Oxygen Demand, Chemical Oxygen Demand, MBAS, Oil and Grease, Phenol, Total Settleable Solids, Dissolved Oxygen, Nitrate (As NO ₃), Ammonia (As Nitrogen), Total Organic Nitrogen, Nitrate (As Nitrogen), Nitrite (As Nitrogen), pH, Phosphate, Total Alkalinity, Hardness (as HCO ₃ and CaCO ₃), Boron, Calcium, Fluoride, Hydroxide (OH), Magnesium, Potassium, Sodium, Sulfate, Total Dissolved Solids, and Chloride.
Bacteria	Total and fecal coliform bacteria.

organochlorine pesticides, and PCBs were relatively high and generally speaking would not be considered environmentally relevant (i.e., detection limits were higher than applicable objectives or effects ranges).

Table E-4 presents summary results for conventional constituents, which provides a general idea of potential issues. The pH data suggest possible exceedances of the Basin Plan objective. However, the objective considers natural conditions and as there is no background data available on natural pH levels it is uncertain whether the data suggests a potential issue or not. Ammonia exceeds the Basin Plan objective in one of eight samples, which would be insufficient for developing a 303(d) listing but is worth noting for future efforts.

Table E-4. Summary of conventional constituents data from Tujunga Wash at Laurel Canyon Blvd.
Average, maximum and minimum values expressed as milligrams per liter (mg/L).

Constituent	Samples Collected	Detected Values	Average	Max	Min	Samples Exceeding Basin Plan Criteria
Dissolved Oxygen	9	9	8.4	9.6	7.3	6
Total Alkalinity	4	4	9.3	11	7	NAC
Bicarbonate	3	3	160.0	240	81	NAC
Biochemical Oxygen Demand 5-Day	2	2	192.7	293	81	NAC
Boron	3	3	15.0	20	10	NAC
Calcium	3	3	0.9	1.9	0.3	NAC
Hardness	4	3	45.7	70	25	NAC
Chemical Oxygen Demand	1	1	186.7	275	79	NAC
Chloride	13	13	---	49	49	NAC
Fluoride	3	3	117.8	339	11	NAC
Hydroxide	3	0	0.9	1.4	0.5	NAC
Magnesium	3	3	---	0	0	NAC
MBAS	1	1	17.7	27	4	NAC
Nitrate (as Nitrogen)	9	4	---	0.1	0.1	NAC
Nitrate (as NO ₃)	3	1	0.3	0.6	0.2	NAC
Nitrite (as Nitrogen)	8	1	---	0.1	0.1	NAC
Ammonia Nitrogen (as Nitrogen)	10	8	---	0.01	0	1
Total Organic Nitrogen	6	6	0.7	2.4	0.1	NAC
Oil and Grease	2	1	1.8	4.7	0.3	NAC
Phenol	2	0	---	16.1	16.1	NAC
Phosphate	2	2	---	0	0	NAC
Potassium	3	3	0.2	0.2	0.2	NAC
Sodium	3	3	---	0	0	NAC
Sulfate	12	12	172.7	340	46	NAC
Total Dissolved Solids	11	11	101.1	280	31	NAC
Total Settleable Solids	1	0	3.2	4	2.6	NAC

NAC = no applicable criteria for the beneficial uses of Tujunga Wash.

Table E-5 presents summary results for metals analysis conducted on four occasions (10/1986, 3/1/1990, 5/15/1991, 12/18/1991). The data provided did not indicate whether metals were measured as a dissolved or total fraction. Generally, criteria are set for the dissolved fraction of metals for the protection of aquatic life. Due to the lack of data and information on whether the results were reported as dissolved or total a simplifying assumption was made that data were reported in the fraction to which the criteria are applicable. The analysis is intended to provide a general idea of potential constituents of concern and would not be appropriate for making 303(d) listing or delisting decisions. Table E-5 indicates that on three of four occasions copper may have exceeded the applicable water quality criteria presented in the California Toxics Rule (CTR) and cadmium may have exceeded on one of four occasions.

Table E-5. Summary of metals data collected from Tujunga Wash at Laurel Canyon Boulevard. Average, maximum and minimum values expressed as micrograms per liter (ug/L).

Constituent	Samples Collected	Detected Values	Average	Max	Min	Samples Exceeding CTR Criteria
Arsenic	4	1	---	21	21	0
Barium	4	3	84.7	136	52	0
Cadmium	4	2	3.5	6	1	1
Chromium (VI)	4	0	---	---	---	---
Total Chromium	4	0	---	---	---	---
Copper	4	4	48.3	101	14	3
Cyanide	1	0	---	---	---	---
Iron	4	2	0.2	0.2	0.2	NAC
Lead	4	0	---	---	---	---
Manganese	4	1	---	0.1	0.1	NAC
Mercury	4	0	---	---	---	---
Selenium	4	0	---	---	---	---
Silver	4	0	---	---	---	---
Zinc	4	2	73.5	97	50	0

NAC = no applicable criteria for the beneficial uses of Tujunga Wash.

Table E-6 presents summary results for bacteria analysis conducted between 1994 and 1997. Both fecal and total coliform bacteria exceeded the Basin Plan objectives for the recreational uses on all but one occasion.

Table E-6. Summary of bacteria data collected from Tujunga Wash at Laurel Canyon Boulevard. Average, maximum and minimum values expressed as colony forming units per 100 milliliters.

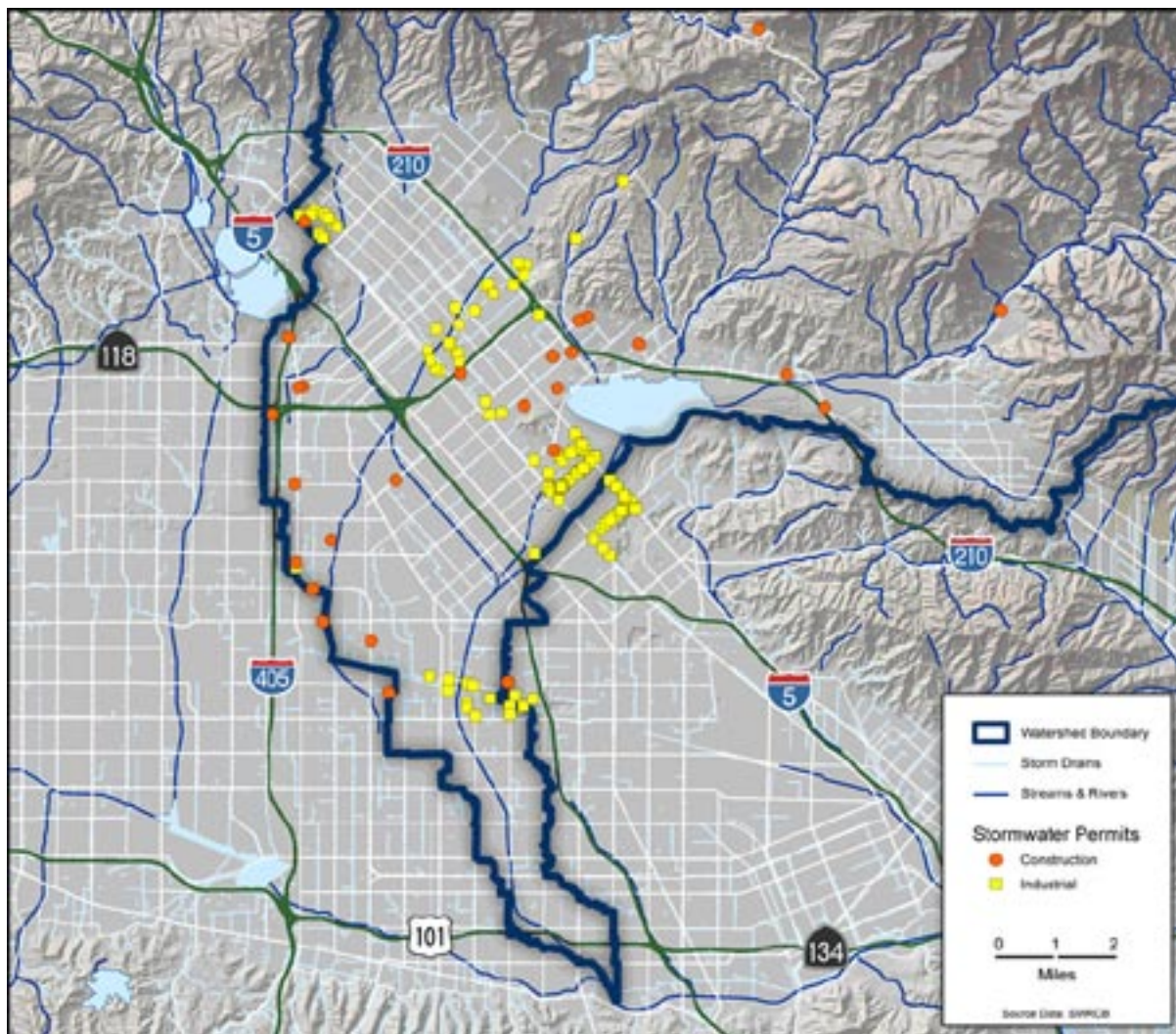
Constituent	Samples Collected	Detected Values	Average	Max	Min	Samples Exceeding Basin Plan Criteria
Fecal Coliform	5	5	1,674	3,000	70	4
Total Coliform	7	7	18,343	98,000	400	6

NPDES Stormwater Monitoring Data

There are many stormwater monitoring reports submitted to the RWQCB. However, because reports are still maintained in hardcopy with little staff resources for integration, follow-up to require improved monitoring, or regional coordination, effectively accessing and analyzing them is remarkably labor intensive. The State has been developing a robust electronic reporting system for NPDES wastewater permits over the past five years and is close to full implementation. A similar system is under development to track sanitary sewer overflows. Systematic electronic submittal of stormwater permits would make assessment simpler and more transparent. Currently, gathering and accurately synthesizing any more than a 'representative sampling' of the copious data would require significant resources beyond the scope of this project.

This section summarizes monitoring data collected by NPDES industrial stormwater permittees in demonstrating compliance with their permits. Construction permits were also reviewed, but found to have little to no worth for water quality assessment due to the very small number of records and lack of meaningful water quality data. Figure E-3 below shows the locations of construction and industrial permits in effect at the end of 2005.

Figure E-3. Locations of construction and industrial permits in and adjacent to the Tujunga Watershed



A three-tiered approach was employed in reviewing the permit program for data. The first tier considered the type of information available about the permittees themselves and how many parties in the watershed have coverage under each kind of permit. The second tier summarized readily available information about a representative subset of dischargers (e.g., type of operation, facility size, location). The third tier delves into the content of the monitoring reports (i.e., water quality information available).

Information available from RWQCB regarding stormwater permittees includes: Status (active, inactive), Permit Type (industrial, construction), Owner/Operator (Name, Location, Phone, Contact Person), Facility (Name, Location, Phone, Contact Person), and Size of Facility. Basic information for a representative set of permittees, for which records were collected, is shown below in Table E-7. In this case the term 'representative' indicates selection of permittees representing the range of activities occurring in the watershed, rather than for a spatially even representation. Additionally, selection of a representative subset of all records was influenced by limited ability to locate those records identified in advance as being representative. The nine permittees for which data were acquired were pulled from an initial set of more than 120 records, many of which were not readily available. Some of the most common types of businesses/activities included in the full set of records are auto dismantling, metal plating, and various manufacturing.

Table E-7. Basic Information for Subset of NPDES Stormwater Permittees Acquired from RWQCB.

Group Name	Operator/Owner Name	Facility Site Name	Facility Size (Acres)	Facility Site (Location City)
California Auto Dismantlers	American Etching & Manufacturing	American Etching & Manufacturing	0.9	Pacoima
Metal Finishing Association Of So CA	Burbank Plating	Burbank Plating	0.8	Pacoima
Metal Finishing Association Of So CA	American Eagle Inc	American Eagle Inc	0.4	Pacoima
Safety-Kleen Corp	Harrys Auto Wrecking	Harry S Auto Wrecking	2.0	Pacoima
Safety-Kleen Corp	Metalite Manufacturing Co	Metalite Manufacturing Co	1.3	Pacoima
PES 5015	American Fruit Processors	American Fruit Processors	2.9	Pacoima
PES 5015	Serena Marble & Granite Inc	Serena Marble & Granite Inc	0.3	Pacoima
Safety-Kleen Corp	Los Angeles City	LA City Lopez Canyon Sanitary	500.0	Sylmar
Building Materials Industry	Aviation Equipment Inc	Aviation Equipment Inc	2.6	North Hollywood

Stormwater permittee records kept by the RWQCB contain a wide range of information pertaining to compliance with permit requirements, including water quality monitoring data. The four parameters most often reported are pH, conductivity, suspended solids, and oil and grease; various other parameters or constituents are reported intermittently (Table E-8). The records also contain information about compliance violations not directly associated with water quality measurements (e.g., failure to file required reports, failure to implement BMPs). Concentrations of copper and zinc exceeded receiving water quality objectives found in the Basin Plan in more than 50% of samples reviewed, however less than ten samples of each were available in the records which were reviewed. Although the monitoring is a snapshot of industrial and

Table E-8. Summary of Water Quality Results from NPDES Stormwater Permittee Monitoring.

Constituent	Number Sampled	Number Detected	Average	Min	Max
Aluminum	5	5	1.67	0.21	4.00
Chemical Oxygen Demand	1	0	-	-	-
Conductivity*	18	17	200	10	1,160
Copper	4	3	0.06	0.05	0.07
Iron	6	5	1.59	0.20	7.05
Nickel	3	3	0.06	0.05	0.08
Nitrate / Nitrite	5	5	8.28	0.10	15.00
Oil and Grease	19	13	18	2	130
pH	17	16	6.73	5.30	8.07
Total Organic Carbon	3	2	26	26	27
Suspended Solids (TSS)	19	17	877	5	11,700
Zinc	6	5	2.08	0.11	8.10
Average, maximum and minimum values expressed as milligrams per liter (mg/L) for all constituents except (*) conductivity, which is expressed as microreciprocal ohms per centimeter (umho/cm).					

construction permittee discharge and not a true measure of the health of the watershed, it can be concluded that these permittees, at least some of the time, are discharging metals.

Sources of Surface Water Pollution

Pollution of water resources in the Tujunga Watershed stems from a range of sources. For modeling purposes, and to confidently support identification of effective projects and programs that can address water quality in the watershed, a deeper analysis of the nature of permittee activity, e.g., looking at flows, frequencies, concentrations, etc., could generate a solid basis for developing pollutant load estimates based on real data. However, as mentioned above, absent an electronic filing system or increased resources, such an effort is outside our current capacity. Instead we are relying on literature land use coefficients and reference areas to develop our findings.

Land Use

One way to assess likely pollutant sources is by considering water quality contributions known to be associated with various types of land use. As shown in Figure G-1 in the Land Use section of this report, and presented below in Table E-9, the lower portions of the Tujunga Watershed are heavily urbanized while the upper portions consist almost completely of open space lying within the Angeles National Forest. Thus most pollutant loading in the watershed likely results from human activities in the lower portion of the watershed. All urban areas contribute trash, bacteria, and copper (as a result of brake pad wear and other uses of copper). Residential areas and golf courses likely contribute relatively larger amounts of nutrients, bacteria, and pesticides. Equestrian facilities contribute nutrients and bacteria. Industrial activities such as metal plating, auto salvage yards, and manufacturing tend to contribute metals and other chemicals associated with those activities. Agricultural lands contribute pesticides, nutrients, and sediment (although agricultural lands represent less than 2% of the total area of the Tujunga Watershed).

Reference Areas

Given the scarcity of data available for assessing water quality conditions in the Tujunga Watershed, a review is included in this section of water quality conditions countywide and for other watersheds in the Los Angeles River Basin with relatively comparable land use composition. This information may offer some insight into probable water quality issues in the Tujunga Watershed, based on the characteristics of encompassing and neighboring areas which are similar and more data-rich.

LACDPW's 1994-2000 Integrated Receiving Water Impacts Report summarized runoff water quality data for Los Angeles County. The report presents results showing that runoff exceeded California Department of Health Services (DHS) bacterial indicator standards at every monitoring station in the county each year. Stormwater results indicate the following constituents might also be of concern countywide: copper, Bis(2-ethylhexyl)phthalate, turbidity, zinc, and lead.

Three other watersheds are considered for comparison to the Tujunga Watershed: Arroyo Seco, Ballona Creek, and Sun Valley. Arroyo Seco land use composition is similar to that of the Tujunga Watershed, having primarily open space in higher reaches and heavily urbanized areas in lower reaches (including parts of Glendale, Pasadena, La Canada, and Los Angeles). Ballona Creek and Sun Valley are generally similar to the lower portion of the Tujunga Watershed, although Ballona is slightly more residential and Sun Valley is more industrial and significantly smaller (all three areas are highly urbanized). The land use composition of the Tujunga Watershed, Lower Tujunga Watershed, Arroyo Seco Watershed, Ballona Creek Watershed, and Sun Valley Watershed are presented below in Table E-9.

Table E-9. Land Use of Tujunga and Other Watersheds in the Los Angeles River Basin.
(Source: North East Trees, 2006; LASGRWC, 2004; LACDPW, 2004).

Land Use	Tujunga (complete)	Lower Tujunga	Arroyo Seco (46.6 sq. mi.)	Ballona Creek (100 sq. mi.)	Sun Valley (4.4 sq. mi.)
Residential	13%	49%	33%	63%	35%
Commercial	2%	9%	3%	8%	6%
Industrial	2%	5%	1%	4%	53%
Open Space	80%	27%	60%	17%	6%
Other	3%	10%	3%	8%	--

Constituents of concern for the Tujunga, Arroyo Seco, Ballona Creek, and Sun Valley Watersheds are presented below in Table E-10. Bacteria and copper are problematic in all four watersheds.

Groundwater Quality

As shown in Figure D-1 of the Water Supply and Use section of this report, the lower watershed primarily overlies the San Fernando Valley Ground Water Basin (SFVGB), with small a portion of the Pacoima Wash Subwatershed above Lopez Dam lying above the Sylmar Ground Water Basin. The 175-mi SFVGB is an important source of drinking water for the Los Angeles metropolitan area.

The designated beneficial uses of groundwater in the SFVGB are municipal and domestic supply, industrial service supply, agricultural supply, and industrial process supply (Table E-2).

Because the SFB is an unconfined aquifer, it has been susceptible to contamination from urban land uses, particularly existing and historical industrial operations. Some contaminants currently affecting the basin's

Table E-10. Constituents of Concern for Other Urban Watersheds in the Los Angeles River Basin.
(Source: 2002 303(d) list; North East Trees, 2006; LASGRWC, 2004; LACDPW, 2004).

Category	Constituent	Watershed			
		Tujunga	Arroyo Seco	Ballona Creek	Sun Valley
Bacteria	Bacteria	X	X	X	X
Metals	Aluminum		X		
Metals	Cadmium			X	
Metals	Copper	X	X	X	X
Metals	Lead		X	X	X
Metals	Metals				X
Metals	Selenium			X	
Metals	Silver			X	
Metals	Zinc		X	X	X
Pesticides/PCBs	Chem-A			X	
Pesticides/PCBs	Chlordane			X	
Pesticides/PCBs	DDT			X	
Pesticides/PCBs	Diazinon		X		
Pesticides/PCBs	Dieldrin			X	
Pesticides/PCBs	PCBs			X	
Other	Ammonia	X			
Other	Chloride		X		
Other	Cyanide		X		
Other	Enteric Viruses			X	
Other	Nitrite		X		
Other	Odors, Scum, Trash	X			
Other	pH			X	
Other	Sediment Toxicity			X	
Other	Toxicity			X	
Other	Turbidity				X

water supply can be traced as far back as the 1940s, when chemical wastes disposal went unregulated throughout the Valley.

In 1980, concentrations of chlorinated volatile organic compounds (VOC), specifically trichloroethylene (TCE) and perchloroethylene (PCE), were found to be above Federal Maximum Contaminant Levels (MCLs) and State Action Levels (SALs) in a number of city production wells. Those solvents were widely used in a number of industries including aerospace and defense manufacturing, machinery degreasing, dry-cleaning, and metal plating (EPA, 2006).

Results of a groundwater monitoring program conducted from 1981 to 1987 revealed over 50 percent of the water supply wells in the eastern portion of the SFVGB were contaminated. TCE and PCE are associated with adverse health effects such as liver problems and increased risk of cancer. Exposure to the VOC contamination can occur through drinking, bathing, or cooking with contaminated groundwater. In response to the public health threat, residents have been provided with alternate drinking water supplies, including imported water or groundwater mixed with imported water. This has resulted not only in the cities turning to

more expensive sources of drinking water, but in the loss of a substantial drinking water source in an area where this resource is already scarce.

In 1986, the San Fernando Valley was listed on the National Priorities List (NPL) under the federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund. The EPA and the RWQCB entered into a Cooperative Agreement to perform an investigation of potential sources of the contamination in the San Fernando Basin. Currently the EPA conducts a quarterly groundwater monitoring program as part of the Remedial Investigation/Feasibility Study (RI/FS) in the San Fernando Valley. The RI monitoring well network consists of 87 RI monitoring wells, 84 of which are currently active (Figures E-3 – E-5). Since the late 1980s, EPA, in cooperation with state and local agencies, has been conducting clean-up by pumping groundwater from a series of wells and treating the water to remove the VOCs. Areas of TCE and PCE contamination in the shallow zone of the groundwater plume (Figures E-3 and E-4) are located largely outside the watershed boundary.

In 1998, The Upper Los Angeles River Area (ULARA) Watermaster notified the USEPA and SWRCB that hexavalent chromium (CR) was being detected in SFV wells (Figure E-5). Since then, an inter-agency committee, the Chromium Task Force, has met quarterly to share information and focus its attention on understanding the nature of the problem. The RWQCB has been charged by the USEPA with the task of locating the sources of hexavalent chromium contamination in the soil and groundwater. The EPA also requires monitoring for methyl tertiary butyl ether (MTBE) and perchlorate in the SFVGB to determine if they are of concern and whether clean-up action is required (EPA, 2006).

Figure E-3. San Fernando Basin TCE Contamination Plume in Shallow Zone.
(Source: LADWP)

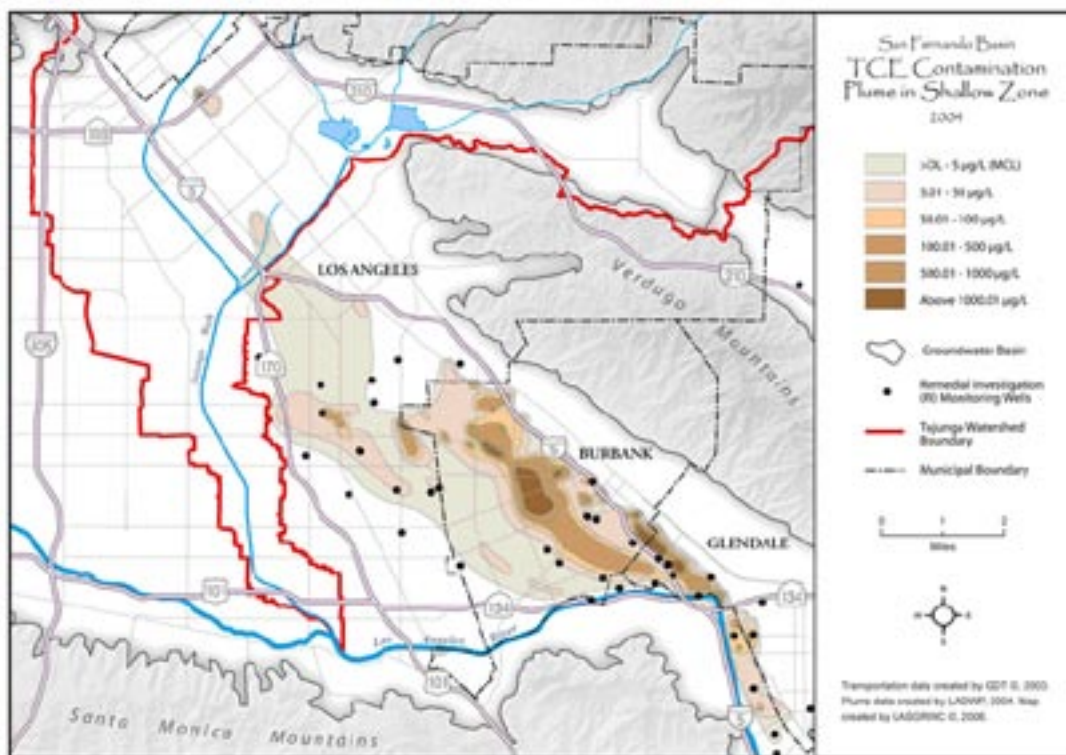


Figure E-4. San Fernando Basin PCE Contamination Plume in Shallow Zone.
(Source: LADWP)

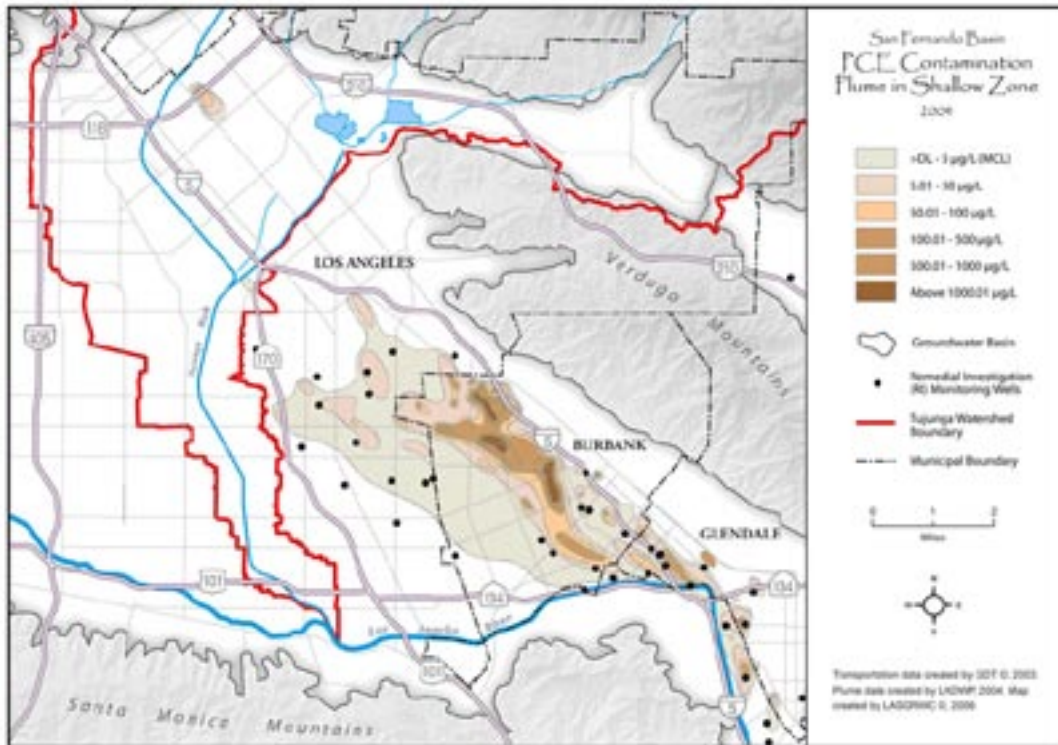
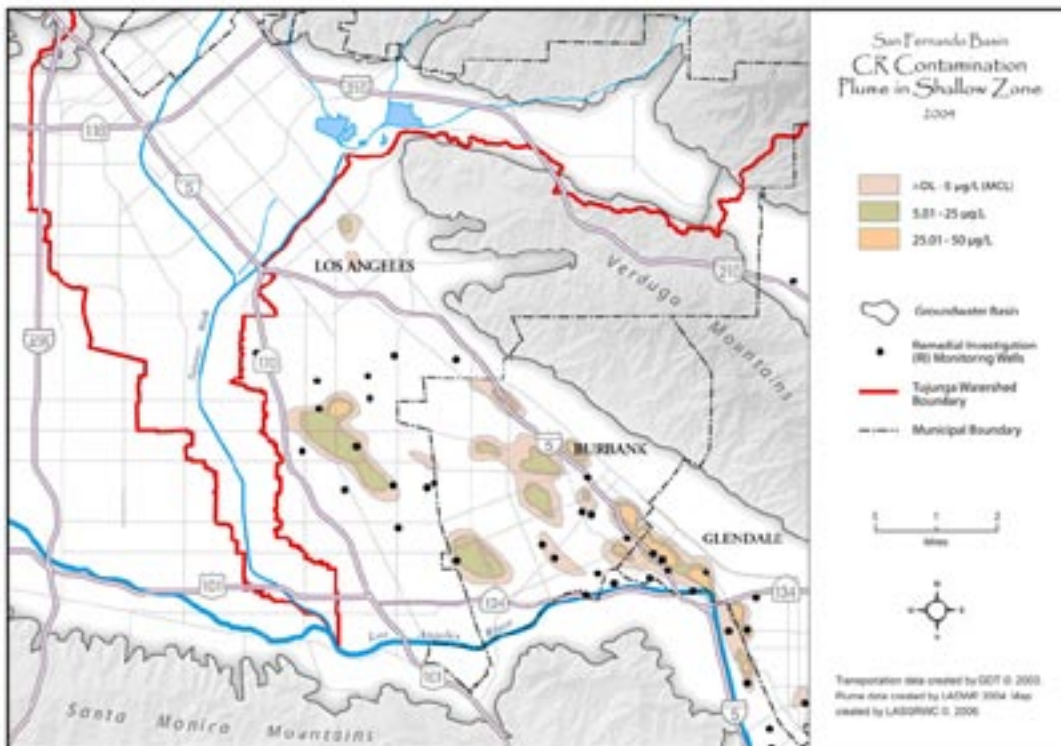


Figure E-5. San Fernando Basin CR Contamination Plume in Shallow Zone.
(Source: LADWP)



Conclusions

Current sampling of surface waters in the Tujunga Watershed is limited, making it difficult to make informed decisions about how and where to address water quality problems in the watershed. Despite the fact that the Tujunga Watershed is the largest tributary to the Los Angeles River, receiving waters for the entire watershed are generally sampled annually at one monitoring site just upstream of the confluence of Tujunga Wash and the Los Angeles River. However, the limited data does identify trash, copper and total and fecal coliform as constituents of concern, particularly as the Los Angeles River has TMDLs in place for trash, metals and bacteria.

Likely sources of metals highlighted by analysis of a representative sampling of NPDES permits include auto dismantlers, who comprise twenty percent of permittees in the watershed. These facilities, along with salvage yards, metal plating facilities, and other industrial uses are concentrated in close proximity to waterbodies and spreading grounds. Likely sources of bacteria highlighted by a cursory land use analysis include a golf course within Big Tujunga Wash and numerous equestrian facilities in the upper watershed.

City of LA data identifies 10 high-concentration trash sites in the watershed, with the highest concentration site located in the community of Valley Glen.

It is clear that we will need better source characterization if we are to address water quality degradation effectively. While NPDES permits can yield more thorough information, an electronic filing system is needed in order to utilize the data cost effectively.

There is no single solution and no formula for achieving clean water. Given the specific opportunities presented by the unique soil characteristics and presence of the SFV Groundwater basin, the most appropriate and effective mix of solutions for the Tujunga Watershed will likely differ from solutions for the watersheds we are currently using as reference for TMDL development.

Current implementation plans for the three existing TMDLs appear to rely exclusively on retrofitted engineering solutions, such as trash screens, CDS interceptors, low-flow diversions, sand filters and infiltration trenches. Given the role that impervious surfaces and hardened stream channels play in water quality degradation, it seems clear that solving the water quality problems in the watershed will entail substantive changes to existing infrastructure. These changes will have to go beyond retrofits. Some single-purpose water quality BMPs such as catch basin screens for trash are necessary. But in the context of watershed planning, priority must be given and the balance of investment weighted to projects that deliver more benefits and promote holistic solutions.

TMDL implementation plans can do more to guide development and redevelopment by encouraging municipalities to consider non-structural means of attaining water quality standards such as source control, outreach, education, and ordinances that support increased pervious surfaces and restored fluvial processes throughout the watershed. The RWQCB cannot dictate land use, but with the right tools, it can incentivize land use that is protective of water quality by stating up front what kind of credit can be granted to communities that take an integrated approach.

Recommendations

Expand the number of official monitoring sites within the watershed. Active RWQCB monitoring locations should include several within the lower Tujunga and Pacoima Wash in areas most impacted by urbanization and immediately upstream of Hansen and Lopez Dams to provide information on background water quality.

Chemical analysis, at minimum, should include metals, nutrients, bacteria, pesticides currently used in the urban environment, suspended solids, and general water quality parameters (flow, pH, dissolved oxygen, and conductivity). Water from the Tujunga Watershed has an impact on the water quality in the Los Angeles River. As such, any monitoring program established for TMDLs on the Los Angeles River should include several sites on the both Tujunga and Pacoima Wash.

Establish a volunteer monitoring program in partnership with the two community colleges in the watershed and engage other residents through Neighborhood Councils or high schools. Such a program can raise awareness and augment official data.

Implement an electronic filing system for NPDES permittees in order to facilitate development of pollutant load estimates for sub-basins within the watershed that are based on real data, instead of relying on reference watersheds and literature land use coefficients.

Develop a source control program for trash. Keeping trash and other contaminants out of waterways and groundwater will, to a large extent, be more cost effective than removing them after the fact. An effective source control program needs to begin with source characterization and an assessment of achievable source control benefits. Next, a source control strategy including pilot programs for strategic placement of trash receptacles, frequent collection and street sweeping in targeted commercial and high-density areas, and other identified measures. A wider program of incentives and disincentives, perhaps including new regulations and fees, could be developed for targeted sources, such as fast food outlets, grocery markets and the plastics industry.

Implement pilot programs for trash. Targeting installation of trash screens for catch basins within the 10 areas identified by the city of Los Angeles and select sites in the City of San Fernando could intercept a large percentage of the trash. Pilots should include community outreach and be followed by assessment of their effectiveness and adjustment of the next steps.

Scale-up the use of any single-purpose hardware BMPs, so that with the benefit of experience, assessment and feedback, midcourse corrections can be made to the mix of remedies to be deployed.

Limit the use of pesticides and fertilizers on golf courses within the historic floodplain. Encourage use of alternative grass species and native plants that do not require pesticides and fertilizers, and irrigation sensors to reduce runoff from over-watering.

Develop outreach materials for the equestrian community outlining benefits of water quality management measures, including water collection and drainage systems, vegetative buffer strips, waste containment measures, composting or other manure disposal systems.

Develop programs that encourage homeowners to reduce lawn coverage, to landscape with native plants that do not require pesticides and fertilizers, and to utilize irrigation sensors to reduce runoff from over-watering.

Identify multi-benefit sites for detention basins capable of handling wet-weather runoff at key locations to allow treatment of a portion of bacteria concentrations in runoff at off-peak hours.

Prioritize use of public Right of Ways (ROWs) such as transmission line corridors to detain, infiltrate and remediate stormwater, while increasing habitat and creating trail networks. Work with Caltrans to identify and implement multi-benefit BMPs along the freeways corridors and interchanges.

Install pervious gutters along streets where soils and depth to groundwater present favorable conditions to remediate metals. RWQCB metals TMDL suggests filtration through sand media as an implementation strategy. Given the sandy soils characterizing the watershed, copper and other metals coming from cars can be mitigated through utilization of pervious gutters on major streets.

TMDL implementation plans should motivate and reward proactive efforts by giving credit for successful projects and programs undertaken ahead of the TMDL adoption, to reward and incentivize pro-active communities.

Enable increasing pervious surfaces and restoring fluvial processes as valid TMDL implementation actions by developing a model to translate those actions into load reductions. The first step for the translation would be development of a conceptual model to help the community understand the linkage between functioning ecosystems and water quality.

Develop a quantitative numeric model to forecast the water quality benefits of pervious surfaces and functional streams. That model needs to help quantify load reductions attained by the full range of alternatives, not just sand filters and infiltration trenches. It needs to tell people “if you capture and infiltrate X acre-feet of water, you will get Y pounds of credit towards the load allocation; if you make X acres of land pervious, you will get Y pounds per year credit; if you restore X miles of stream to natural condition, you will get Y pounds per year of credit.” The third step would involve testing of the model through pilot projects and monitoring. This could be done as a special study through the City of Los Angeles’ CREST effort, in partnership with watershed stakeholders.

Exercise the intent of the RWQCB 2005-002 Hydromodification resolution to maintain the functional integrity of all remaining natural watercourses. This is most critical in this watershed where numerous blue line streams in the urban fringe are threatened with encroaching development. Actively support efforts to restore the physical, chemical and biological integrity of modified watercourses.

Use revenue from MS4 permit fees, which recently went up ten-fold, to fund staff time to develop and implement the MS4 permit. A significant percentage of those fees should be used to fund staff to do the important work of translating wasteload allocations, which are theoretical constructs, into meaningful actions.

Habitat

Introduction

A habitat is the environment where a plant or animal species population lives. An ecological niche for a specific organism is provided by a particular set of environmental parameters. Nearly imperceptible variations between seemingly identical locales are essential for adaptation and speciation to occur and biodiversity to flourish. Many species tolerate a range of conditions along several gradients (e.g., temperature, light intensity, or moisture) and consequently may be common and/or widespread. Rare species may have limited abundance and/or distribution for multiple reasons, both natural and human-caused. An endemic species is restricted to a particular habitat or locale which can be any size geographic area. Endemics are most likely to be threatened by change to natural conditions (Allen et al 1995; Meffe & Carroll 1997; Krebs 2000; Stein et al 2000; Ornduff et al 2003).

Extensive discussions about the diverse physical environment of the Tujunga Watershed precede this section; climate, hydrology, and geology influence biology and determine the existence of potential habitat. Animal habitats are associated with vegetation and other resources present. Structure and type of vegetation are correlated with many physical factors, including overall topography, elevation, slope steepness, the aspect or geographic orientation of the slope (south-facing slopes are warmer and drier than north-facing slopes), soil conditions, rainfall patterns, proximity to permanent water, and natural disturbance regimes. Watershed flora may be organized by native vegetation type or plant community, further subdivided into associations and alliances (Schoenherr 1992; CNPS 2000; CDFG 2003; Ornduff et al 2003; USFS 2005a). However, categories are human constructs, not natural laws. Nature is resilient, adaptable and variable, with transitional regions and uncertainties expected.

Various methods are used to record and explain distribution and abundance of living things. Surveys note presence of plants or animals in a particular region. Biogeographical absence data are difficult to obtain, yet what is not present in a given environment often is significant. Precise data include geographic coordinates but general location within a habitat zone is often indicated instead. It may not be desirable to indicate the exact sites of sensitive species. Knowledge of patterns and controlling processes allows occurrences in non-sampled locations to be predicted. Habitat assessments consider environmental conditions as they affect patterns of presence and absence in specific areas.

Biological data are inherently complex and investigative detail varies by taxonomic group and habitat. This is evident when synthesizing available data for a large region with extreme topographic variation and numerous microhabitats. Data acquisition and their organizational refinement are continual so an assessment uses "snapshots." Among many excellent sources, comprehensive data from the Forest Service (e.g., USFS 1987; Stephenson & Calcarone 1999; USFS 2005a, 2005b, 2005c), the California Native Plant Society (CNPS 2000, 2006) and the California Natural Biodiversity Database (CDFG 2006) supplied information for representative habitats and documented species within in the watershed. Environmental histories (e.g., Lockmann 1981) and the analysis of historical ecosystems (e.g., Schiffman 2005) provide critical guidelines for responsibly planning successful ecological restoration and habitat improvement (FISWRG 1999; Egan & Howell 2001; Palmer et al 2005).

One approach for an assessment would be to use the presence or absence of individual species to define or assess environmental conditions. This "target species" option is suitable for reserve design or when formulating stand-alone biodiversity or ecological restoration plans that require further monitoring, but may not provide the broad habitat assessment needed to inform a multiple-objective watershed management

plan where habitat restoration is only one of several diverse and ambitious goals; for the TWP we seek “[t]o revitalize the Tujunga Watershed, balancing water supply, water quality, community open space needs, environmental protection and restoration, and public safety.”

Ecologists, naturalists, and others often consider particular plant and/or animal associations indicative of a given climate, soil type, and/or geographical area. Several types of focal species have been defined; these may serve as surrogates for others that prefer a similar habitat. Indicator species may determine environmental composition or assess environmental conditions; some categories include biodiversity, ecological, environmental, connectivity, and fragmentation indicators. Flagship, umbrella, and keystone species are widely used concepts; simply put, flagship or charismatic species have high profiles thus may inspire conservation action; umbrella species require a large geographic range, so ensuring their survival would likely preserve many others; and keystone species are those whose removal from the system would produce a disproportionate impact. Categories vary in subjectivity and are not mutually exclusive. Some species are described by these terms where appropriate (for further discussion see, e.g., Meffe & Carroll 1997; Krebs 2000; Ornduff et al 2003; Martino et al 2005).

Instead, a holistic method which considered the natural community composition and ecosystems of the Tujunga Watershed was implemented for this assessment. This landscape-level approach is closely aligned with watershed-based management and habitat-based conservation (Noss et al 1997) and is adopted by conservation biologists and others who seek to “shift conservation emphasis from a single species approach to a landscape approach that encompasses groups of species, plant communities, and ecosystems while continuing to incorporate the need for rare and endangered species conservation and management” (CNPS 2000).

Subdivisions of three general ecosystems are described: aquatic (or wetland), riparian, and terrestrial (or upland) habitats. Important floristic groups and the wildlife found within associated habitats are explored to qualitatively assess biodiversity under existing conditions. Listed threatened, endangered, or sensitive (TES) species and vegetation types of special concern are characterized; these are biota identified as having high conservation value. Natural and altered disturbance regimes affecting ecosystem functions are incorporated in the discussion and present-day environments are directly compared with evolving and historical conditions within corresponding habitats. These capture change over time. Conclusions are drawn about the condition of watershed habitats by synthesizing available information. Based on habitat-related Goals, Subgoals & Objectives devised for the TWP, recommendations are made which may guide future action. References follow.

Findings

Classification of California Habitats and their Flora and Fauna

Habitat data encompass a multitude of different types of information about the environment that are multidisciplinary in scope, drawn from biology, ecology, geography, geology, synthetic scientific disciplines, and other sources. Climatic, geologic, and hydrologic processes control the physical environment of a region; this landscape ultimately influences the biological environment, including the physiognomic structure, distribution, abundance, and species composition of native vegetation. Wildlife habitat is primarily determined by the type of vegetation, but individual species may also have suites of other essential resources which must be present for the habitat to be considered suitable.

Factors that combine in only five locations worldwide result in our mediterranean climate. Defined by climate, the Californian Floristic Province (CFP) is the smallest North American floristic province, but the

largest in California; it comprises the roughly 70% of the state west of the Sierra Nevada crest and Mojave Desert called “cismontane”. The local subdivisions, San Gabriel Mountains and South Coast, conveniently correspond to upper and lower watershed. The CFP includes such distinct vegetation types as chaparral, coastal sage scrub, and oak woodland. Ecotones between are speciation opportunities. High species richness - number of species, and high endemism - species found nowhere else, are mediterranean climate hallmarks (Schoenherr 1992; Hickman 1993; CNPS 2000).

Since 1925, the *Jepson Manual* has been the technical reference to classify California plants. Using a dichotomous (yes/no) key, and working through distinguishing characteristics, ideally identification is made at some taxonomic level, or perhaps a new species has been found – not that uncommon an event. The most current version (Hickman 1993) includes 7000 vascular plant taxa outside cultivation; of these, 5862 are natives. Of the natives, 4693 are separate species, while 1169 are subspecies or varieties. Using different criteria, the CNPS *Inventory of Rare and Endangered Plants* (2000, 2006) estimated 6300 native plants. Either number is impressively large. Debate over what is or is not a genetically distinct species has conservation implications and is a global phenomenon engaged in for all manner of living things. In this assessment, common and scientific names (*Genus species*) are given for first usage; subsequent references may use just the common name; ‘spp.’ refers to multiple species; ‘taxon’ (plural: taxa) may indicate any taxonomic level (e.g., family, genus, species).

California genera with highest endemism are *Mimulus* (monkeyflowers), *Astragalus* (locoweeds), *Lupinus* (lupines), *Eriogonum* (wild buckwheats), *Arctostaphylos* (manzanitas), and *Ceanothus* (wild lilacs). Most rare plants are neoendemics, new species, or paleoendemics, relict species once more widely distributed which retreated to their present range in response to changing climate (Ornduff et al 2003; also see discussion of pre-historical conditions). As described by CNPS (2000): “Widely contrasting habitat conditions closely juxtaposed produce ample opportunities for genetic isolation and speciation. The result has been impressive adaptive radiations within such groups as *Arctostaphylos*, *Astragalus*, *Castilleja*, *Eriogonum*, *Lupinus*, *Mimulus*, and many genera in the *Asteraceae*, to name only a few. Indeed, most of our rare plants are specialists adapted to a particular combination of climate and substrate and many are members of one of these recently diverging groups.” New species require time to develop the genetic variability to allow them to expand their range; as suitable habitat becomes unavailable, many new species will never do so. All taxa listed above have representatives in the Tujunga Watershed; most have several. Some are widely distributed; others are on the regularly updated TES list. Table F-1 lists TES animal and plant species.

California vegetation classification schemes have adopted different approaches over the century that flora has been described systematically. Native plants that occur together under similar conditions are “natural communities” (Holland 1986; CDFG 2003, 2006), “vegetation types” (see Ornduff et al 2003); coarser and finer-level “series” (CalVeg 1980; CNPS 2000, 2006), or an “association” or “alliance” (see CDFG 2003). Different systems are in use simultaneously; most note the predominant plant species but names, methodology, levels of detail, smallest patch size, and other features vary. “Crosswalks” relate one system to another. The CNDDDB has instituted a work-in-progress to integrate systems - past, present, and future - without losing any detail; new “natural communities” are identified by a three part 7-digit code (CDFG 2003). Intensive field surveys are required to gather the most accurate and precise data, and to validate remotely-sensed data, but increasingly finer-scale digital format data has the advantage of being easily updated and quickly disseminated. This report makes references to several types of classifications as required. TES communities or ecosystems are listed in Table F-2.

Wildlife-habitat relationships (WHR) place animal species within their preferred plant communities. In this sense, a habitat is species-specific. This works well but animals did not devise the system; although many species have exact requirements, generalists may occur across several vegetation types. For WHR, plant

species are grouped into broad vegetation communities which form habitat for wildlife, e.g., montane riparian forest or chamise chaparral. The CWHR (California WHR) habitat classification scheme was developed to support the CWHR System, a wildlife information system for California's regularly-occurring birds, mammals, reptiles and amphibians (Mayer & Laudenslayer 1988). The original method has evolved into its eighth version (available from CDFG) integrated with a geographic information system package. The method has many applications, including inferring species presence in unsampled locations by predictive modeling for habitat suitability and GAP analysis for conservation planning. A crosswalk between CWHR Wildlife Habitats and CNPS Vegetation Classifications (CDFG 2005) was extracted for the Tujunga Watershed (Table F-3).

Table F-1. Threatened and Endangered Species potentially in the Tujunga Watershed
(CDFG [CNDDDB 8-2006]; CNPS 2006; Long 2006)

Animals

E = Endangered

T = Threatened

FSC/CSC = Federal/California Species of Concern

Species Name	Common Name	Federal Status	State Status
Amphibians			
<i>Taricha torosa torosa</i>	Coast Range newt	None	CSC
<i>Bufo californicus</i>	Arroyo toad	E	CSC
<i>Spea (=Scaphiopus) hammondi</i>	Western spadefoot	None	CSC
<i>Rana aurora draytonii</i>	California red-legged frog	T	CSC
<i>Rana muscosa</i>	Mountain yellow-legged frog	E	CSC
Reptiles			
<i>Clemmys marmorata pallida</i>	Southwestern pond turtle	FSC	CSC
<i>Anniella pulchra pulchra</i>	Silvery legless lizard	None	CSC
<i>Phrynosoma coronatum blainvillei</i>	San Diego horned lizard	FSC	CSC
<i>Aspidoscelis hyperythrus</i>	Orange-throated whiptail	None	CSC
<i>Aspidoscelis tigris stejnegeri</i>	Coastal western whiptail	FSC	None
<i>Lampropeltis zonata pulchra</i>	San Diego mountain kingsnake	FSC	CSC
<i>Salvadora hexalepis virgultea</i>	Coast patch-nosed snake	FSC	CSC
<i>Thamnophis hammondi</i>	Two-striped garter snake	None	CSC
Fish			
<i>Gila orcutti</i>	Arroyo chub	FSC	CSC
<i>Rhinichthys osculus ssp. 3</i>	Santa Ana speckled dace	FSC	CSC
<i>Catostomus santaanae</i>	Santa Ana sucker	T	CSC
<i>Gasterosteus aculeatus williamsonii</i> [most sources indicate sp. is extirpated; one (Long 2006) indicates presence.]	Unarmored threespined stickleback	E	E

Table F-1 (Continued) – Threatened and Endangered Species potentially in the Tujunga Watershed

Species Name	Common Name	Federal Status	State Status
Birds			
<i>Gymnogyps californianus</i>	California condor	E	E
<i>Aquila chrysaetos</i>	Golden eagle	None	CSC
<i>Haliaeetus leucocephalus</i>	Bald eagle	T	E
<i>Falco mexicanus</i>	Prairie falcon	None	CSC
<i>Falco peregrinus</i>	Peregrine falcon	delisted	E
<i>Athene cunicularia</i>	Burrowing owl	None	CSC
<i>Coccyzus americanus occidentale</i>	Western yellow-billed cuckoo	Candidate	E
<i>Contopus cooperi</i>	Olive-sided flycatcher	FSC	None
<i>Empidonax traillii extimus</i>	Southwestern willow flycatcher	E	E
<i>Poliophtila californica californica</i>	Coastal California gnatcatcher	T	CSC
<i>Vireo bellii pusillus</i>	Least Bell's vireo	E	E
<i>Lanius ludovicianua</i>	Loggerhead shrike	FSC	CSC
<i>Agelaius tricolor</i>	Tricolored blackbird	FSC	CSC
<i>Aimophila ruficeps canescens</i>	Ashy rufous-crowned sparrow	FSC	CSC
<i>Amphispiza belli belli</i>	Bell's sage sparrow	FSC	None
Mammals			
<i>Myotis volans</i>	Long-legged myotis	None	None
<i>Nyctinomops macrotis</i>	Big free-tailed bat	None	CSC
<i>Lepus californicus bennettii</i>	San Diego black-tailed jackrabbit	FSC	CSC
<i>Neotoma lepida intermedia</i>	San Diego desert woodrat	FSC	CSC
<i>Onychomys torridus ramona</i>	Southern grasshopper mouse	None	CSC
<i>Taxidea taxus</i>	American badger	None	CSC

Table F-1 (Continued) – Threatened and Endangered Species potentially in the Tujunga Watershed

Plants

CNPS plant listings

1B = rare/endangered in California

4 = plants of limited distribution

Species Name	Common Name	Federal Status	State Status	CNPS
<i>Oreonana vestita</i>	Wooly mountain-parsley	None	None	1B
<i>Aster greatae</i>	Greata's aster	None	None	1B
<i>Hemizonia parryi australis</i>				
(<i>Centromadia</i>)	Southern tarplant	None	None	1B
<i>Stylocline masonii</i>	Mason's neststraw	None	None	1B
<i>Berberis nevinii</i>	Nevin's barberry	E	E	1B
<i>Opuntia basilaris brachyclada</i>	Short-joint beavertail	None	None	1B
<i>Atriplex parishii</i>	Parish's brittle scale	None	None	1B
<i>Dudleya multicaulis</i>	Many-stemmed dudleya	None	None	1B
<i>Arctostaphylos gabrielensis</i>	San Gabriel manzanita	None	None	1B
<i>Lupinus peirsonii</i>	Peirson's lupine	None	None	1B
<i>Malacothamnus davidsonii</i>	Davidson's bush mallow	None	None	1B
<i>Chorizanthe parryi fernandina</i>	San Fernando Valley spineflower	Candidate	E	1B
<i>Dodecahema leptoceras</i>	Slender-horned spineflower	E	E	1B
<i>Linanthus concinnus</i>	San Gabriel linanthus	None	None	1B
<i>Horkelia cuneata puberula</i>	Mesa horkelia	None	None	1B
<i>Castilleja gleasonii</i>	Mt. Gleason Indian paintbrush	None	Rare	1B
<i>Mimulus johnstonii</i>	Johnston's monkeyflower	None	None	4
<i>Calochortus clavatus gracilis</i>	Slender mariposa lily	None	None	1B
<i>Calochortus palmeri palmeri</i>	Palmer's mariposa lily	None	None	1B
<i>Calochortus plummerae</i>	Plummer's mariposa lily	None	None	1B
<i>Calochortus striatus</i>	Alkali mariposa lily	None	None	1B
<i>Lilium parryi</i>	Lemon lily	None	None	1B
<i>Orcuttia californica</i>	California Orcutt grass	E	E	1B

Table F-2 Ecosystems Listed as of Special Concern in the Tujunga Watershed (CDFG 2006)

Ecosystem or Plant Community Name:	USGS 7.5 minute quad locations in watershed:
Southern California Arroyo Chub Santa Ana Sucker Stream (Figure F-1)	Condor Peak; Sunland
Riversidian Alluvial Fan Sage Scrub (Figure F-2)	San Fernando; Sunland; Van Nuys
Southern Coast Live Oak Riparian Forest	Burbank; Condor Peak; San Fernando; Sunland
Southern Cottonwood Willow Riparian Forest	Burbank; Chilao Flat; Condor Peak; Pacifico Mountain; San Fernando; Sunland
Southern Mixed Riparian Forest	Condor Peak; Sunland
Southern Sycamore Alder Riparian Woodland	Burbank; Chilao Flat; Condor Peak; Pacifico Mountain; San Fernando; Sunland
California Walnut Woodland	Burbank; Van Nuys

Figure F-1. Typical aquatic, riparian, and terrestrial habitats for Arroyo Chub and Santa Ana Sucker Stream; Southern Mixed Riparian Forest; Mixed Chaparral. Upper Big Tujunga Creek (MacDonald 2005)



Table F-3 – Tujunga CWHR Wildlife Habitats Crosswalked with CNPS Vegetation Classifications
(CDFG 2005; ranges crosschecked with Hickman 1993; CNPS 2000)

Tujunga CWHR Habitats	CWHR Code	Important CNPS Vegetation Series
Coastal Oak Woodland [minor but important occurrences]	COW	Coast Live Oak Forest and Woodland Englemann Oak Woodland
Closed-Cone Pine-Cypress [minor occurrences, E watershed]	CPC	Knobcone Pine Woodland
Chamise-Redshank Chaparral [overlap with MCH]	CRC	Chamise-Bigberry Manzanita Chaparral Chamise-Bigpod, Ceanothus Chaparral Chamise-Black Sage Chamise-Eastwood Manzanita Chaparral Chamise-Hoaryleaf Ceanothus Chaparral Chamise-White Sage Chaparral Chamise Chaparral
Coastal Scrub	CSC	Birchleaf Mountain Mahogany-California Buckwheat Broom Scrub California Buckwheat-Black Sage California Buckwheat-White Sage Scrub California Sagebrush-Black Sage California Sagebrush-California Buckwheat Chaparral Yucca-California Buckwheat
Jeffrey Pine [overlap with SMC]	JPN	Jeffrey Pine Forest and Woodland
Mixed Chaparral [overlap with CRC]	MCH	Birchleaf Mountain Mahogany Scrub Chaparral Whitethorn Chaparral Hoaryleaf Ceanothus Chaparral Interior Live Oak-Canyon Live Oak Chaparral Interior Live Oak-Chaparral Whitethorn Chaparral Interior Live Oak-Birchleaf Mountain Mahogany Interior Live Oak-Scrub Oak Chaparral Scrub Oak-Chamise Chaparral Scrub Oak-Birchleaf Mountain Mahogany Chaparral Scrub Oak Chaparral-Whitethorn Chaparral Woolyleaf Manzanita Chaparral
Montane Hardwood	MHW	Canyon Live Oak Forest Interior Live Oak Woodland
Montane Hardwood-Conifer	MHC	Bigcone Douglas-Fir –Canyon Live Oak Forest Coulter Pine-Canyon Live Oak Woodland
Montane Riparian [some willows extend to VRI]	MRI	Black Cottonwood Riparian Forests and Woodlands Red Willow Riparian Forests White Alder Forest and Woodland
Ponderosa Pine [overlap with JPN]	PPN	Ponderosa Pine Forest
Sierran Mixed Conifer [overlap with JPN, PPN]	SMC	Bigcone Douglas-Fir Forest Coulter Pine Woodland Jeffrey Pine-Ponderosa Pine Forest and Woodland Mixed Conifer Ponderosa Pine-Incense Cedar Forest White Fir-Sugar Pine Forest
Urban [entire lower watershed]	URB	No corresponding type
Valley-Foothill Riparian [some willows extend to MRI]	VRI	Arroyo Willow Black Willow Temp-Flooded Woodland California Sycamore Fremont Cottonwood Riparian Forests and Woodland Mulefat Scrub

Tujunga Watershed Habitats

The Tujunga Watershed represents an exceptional section of an incomparable state; it contains numerous California vegetation types and wildlife habitats. Extreme topographic diversity and an elevation range from about 170 to 2170 meters (562 to 7128 feet) (USGS 2006) has allowed many distinct yet intergrading ecological zones and microhabitats to form within an intricate mosaic of vegetation that exploits the unique climate, geology and natural disturbance regimes of the region (Map, Figure F-3). Major vegetation communities are aligned in altitudinal bands, with variations in species composition between north and south-facing slopes, which reflect differences in microclimate. Progressing inland, coastal influence gradually gives way to greater desert influence. Very generally, ascending from the south, alluvial fan and coastal sage scrub of the lower alluvial basin segues into a wide band of lower chaparral and a narrower zone of upper chaparral. Mixed oak-conifer woodlands and forests grade into higher altitude coniferous forests with varied compositions. Riparian and aquatic vegetation are also classified by elevation. Vegetation is typically described first, followed by wildlife.

From an ecological perspective, the vegetation, habitat, wildlife, and physical processes of the upper and lower Tujunga watershed regions are quite distinct. For the three basic habitat types considered here, aquatic (or wetland), riparian, and terrestrial (or upland) environments, there is little overlap between habitats found within the two regions. Numerous niche environments exist within the topographically complex mountain drainage basins that form the relatively natural upper watershed, most of which is on the Angeles National Forest. Species richness is high. In the densely populated lower section, most of the alluvial fan lies beneath asphalt and concrete and flood control channels have replaced natural stream courses. Some native birds, insects, reptiles and mammals live in the urban habitat. Well-planned, well-executed, and well-maintained multiple-use restoration projects can potentially increase native flora and fauna in the urban habitat by orders of magnitude.

Figure F-2 – Riversidian Alluvial Fan Sage Scrub, Big Tujunga Wash (Winter, 1998)



Aquatic Habitats

Habitat characteristics include the water flow rate and flow patterns, the benthic substrate, in-stream vegetation, water quality, interactions between compartments (e.g., between waterway and the surrounding riparian habitat or benthos and water column), plus other inputs. Leaf litter and debris washed off the land or dropped from riparian trees represent the greatest amount of input to aquatic systems. When white alders (*Alnus rhombifolia*) are part of the riparian community, as they are in the upper watershed, about a third of the biomass in the adjacent aquatic habitat is leaf litter. Aquatic and amphibious organisms are very sensitive to change and rely on ranges of aquatic conditions staying within specific limits for survival and reproduction in order to persist as populations in individual waterways. Conditions and characteristics can be measured individually or as suites of indicators (Schoenherr 1992; DiTomaso & Healy 2003; Shilling et al 2004).

The lower concrete-lined Washes are devoid of natural habitat and may only serve as temporary habitat for certain organisms. Unlike the Los Angeles River, there are no natural-bottom sections of the Washes. Habitat conditions are subject to a combination of human activities (e.g., storm-water management) and natural climatic events (e.g., storms or heat-waves).

Upper Watershed Aquatic Habitat

Aquatic and riparian habitats under natural conditions in the Tujunga Watershed are influenced by the flashy hydrologic regime which periodically scours substrate and channel, removing in-stream and adjacent vegetation, rearranging and altering the habitat while depositing alluvial materials downstream. Reaches downstream of the major dams may lack sediment transport, flows, and other conditions during certain times of the year. Usually, rate of flow or stream current determines the aquatic species present. Additionally, among other habitat variables, flow rate affects sediment size, the accumulation of algae, and the presence of dead leaves and fallen branches. Flow is slower along stream banks, along the bottom, through living vegetation, and in areas protected by rocks, large woody debris and other plant materials, so microhabitats are created within stream reaches. Natural disturbance and renewal are important features (Schoenherr 1992; Garrett 1993a).

In-stream plants include algae, *Elodea* spp., pondweed (*Potamogeton* spp.), sedges (*Cyperus* spp.), bulrushes (*Scirpus* spp.), cattails (*Typha* spp.), horsetails (*Equisetum* spp.), and adjacent riparian species like willows (*Salix* spp.), mulefat (*Baccharis salicifolia*), and blackberries (*Rubus* spp.).

The greatest biomass in aquatic communities is microscopic algae or bacteria. Benthic organisms, primarily arthropods, make up the rest of the majority of stream inhabitants. Aquatic animals are ecologically classified by feeding behavior: shredders shred leaf litter; grazers scrape algae off rocks; collectors gather plankton and other floating matter; and predators eat the others. Amphipods and isopods are crustacean zooplankton; important members of stream-bottom habitats, both are shredders that accelerate decomposition of organic material. Gastropods (snails) are a large, little-known, highly endemic group of freshwater invertebrates. Aquatic insects that spend most of their lives in the water before metamorphosing into adults (and becoming both more visible and part of a different habitat) are an additional animal component of aquatic ecosystems; these include larvae such as those of Dipterans (true flies) and Trichoptera (caddisflies); and nymphs or naiads of Ephemeroptera (Mayflies) and Odonata (dragonflies). Some Hemipterans (true bugs) and Coleopterans (beetles) also spend part of their adult lives as aquatic forms: water bugs and water beetles. Upper watershed invertebrates have high species richness. These organisms are food sources for birds, fish and amphibians (Laurel & Woodley 1975; Schoenherr 1992; Garrett 1993a; Hogue 1993).

California native freshwater fishes almost all belong to one of three families: minnows (*Cyprinidae*), suckers (*Catostomidae*), or trout (*Salmonidae*). Three native Los Angeles Basin freshwater fish species remain in the Tujunga Watershed: Santa Ana sucker (*Catostomus santaanae*), and two minnows, arroyo chub (*Gila orcutti*), and Santa Ana speckled dace (*Rhinichthys osculus*). All have special conservation status (Schoenherr 1992; Swift & Seigel 1993; Drill 2004).

Arroyo chub are generally restricted to the Lower Tujunga Wash and the lower reaches of the three major creeks. Arroyo chub are small chunky minnows found in slow moving sections of mud or sandy-bottom streams. They feed on algae and small invertebrates picked off vegetation or the stream bottom. They are threatened by habitat modification and competition with introduced minnows such as red shiners (Drill 2004). Santa Ana sucker and Santa Ana speckled dace are found in main channels of Pacoima and Big and Little Tujunga Creeks and also in tributary mountain streams. Speckled dace inhabit a variety of stream and channel types in intermittent streams and large rivers but prefer fast-moving tributaries with riffles on rocky bottoms and abundant cover. Persistence of the Tujunga Watershed speckled dace population has been questioned; it may be extirpated (Stephenson & Calcarone 1999; USFS 2005b). Santa Ana suckers have large lips covered with taste buds, which they use to find prey in the substrate. They are medium sized fish found in small to medium sized streams with permanent water and rocky bottoms with good algae cover. They prefer clear water, and cannot survive in reservoirs. They were historically found throughout the Los Angeles River drainage, but are now restricted to sections of Tujunga Wash with year-round water between Big Tujunga and Hansen Dams (Drill 2004; USFS 2005b).

Most aquatic natives are TES species. Amphibians are most sensitive to any environmental change. California red-legged frog (*Rana aurora draytonii*) and mountain yellow-legged frog (*R. muscosa*) rely entirely upon this ecosystem; foothill yellow-legged frog (*R. boylei*) was historically present but has been extirpated. Most Southern California native frog habitat has been destroyed (Stephenson & Calcarone 1999). Some TES aquatic species require additional territory during their life cycle. Coast Range newt (*Taricha torosa torosa*) returns to water to breed, but inhabits oak forests and chaparral during other times of the year. Endangered arroyo toad (*Bufo californicus*) habitat includes aquatic, riparian and upland components. Toads reproduce in shallow, sandy pools in low-gradient streams, forage in any upland watershed habitat, and overwinter in streamside terrace sands. Southwestern pond turtle (*Clemmys marmorata pallida*) occupies a wide variety of aquatic environments but moves onto land to reproduce and overwinter. Garter snakes swim well, feed on most other animals, and attract few predators; nevertheless, two-striped garter snakes (*Thamnopsis hammondi*) are declining. Destruction of aquatic and riparian habitat has seriously impacted both reptiles. Non-TES herpetofauna include Pacific Treefrog (*Pseudacris regilla*) and California Treefrog (*Hyla cadaverina*); these treefrogs are sympatric only in the western San Gabriel and Santa Susana Mountains. The largest frog in California is here: the introduced bullfrog (*R. catesbeiana*); highly predatory, it eats frogs, fish, and snakes. Introduced fauna and flora threaten most watershed ecosystems (USFS 1987; Schoenherr 1992; Stephens & Calcarone 1999; USFS 2005b, 2005c; USFWS 2005a).

Big Tujunga Creek was previously identified as a 'high ecological significance' area by USFS (Stephenson & Calcarone 1999). Although dammed at approximately 732 m (2400 ft) elevation, the authors noted 'important riparian and aquatic habitat both upstream and downstream of the reservoir' and cited persistence of arroyo chub, Santa Ana sucker, pond turtle, and arroyo toad, even though proximity to the reservoir increased the impact of non-native aquatic species (primarily introduced fish); the dam releases were 'variable and sometimes extreme'; and recreation use had resulted in habitat degradation. When considering vegetation and invertebrates, Big and Little Tujunga and Pacoima Creeks and their tributaries have largely intact aquatic habitats, except where invasive non-native species, physical barriers, stream crossings, water diversions, or consequences of increased sedimentation because of the altered natural fire regime have modified stream conditions. Unfortunately for native fishes, amphibians and reptiles, the present situation is discouraging.

Riparian Habitats

Riparian communities are a transitional zone between aquatic and terrestrial ecosystems; water is a requirement. Like other ecotones where habitats and ecological processes intergrade, biodiversity is high because the region shares characteristics and resources of adjacent environments. Ecotones between contiguous systems may also create unique conditions that support distinct animal and plant communities. For example, marshy areas along the edge of a stream that are habitat for frogs and turtles, cattails and sedges differ from many aquatic or riparian ecosystems. Alluvial fan sage scrub within Big Tujunga Wash is its own vegetation type that exists under specific environmental conditions, but it also represents an ecotone between coastal sage scrub, chaparral, and riparian plant communities and is a fuzzy boundary between riparian and terrestrial ecosystems.

Riparian zones are comparatively narrow corridors between the stream channel and the floodplain or uplands. Landscape forms occur along a gradient, from a restricted riparian zone in a steep canyon where the stream crosses bedrock, to a flat alluvial floodplain with traversing braided channels which may have a wide riparian zone indistinguishable from floodplain vegetation and nearby uplands. Edges of a community are typically more diverse than the core, and these corridors have significant amounts of "edge". Rivers are the most sensitive component of the landscape; they rapidly react to change and adjust to fluctuations in hydrology and sediment load. In response, riparian habitats are highly dynamic; the continually shifting environment creates a complex and variable vegetation structure. Riparian communities are very productive; most wildlife depends directly or indirectly on riparian communities for survival, whether for water, food sources, shelter, shade, or a protected wildlife corridor for larger animals to move between adjacent habitats. For multiple reasons, biodiversity and abundance within riparian habitats are greater than in any other California vegetation community (USFS 1987; Schoenherr 1992; Nebel & Wright 2000; Krebs 2001; Ornduff et al 2003).

Vegetation structure and dominant trees differ along perennial and ephemeral streams. Biodiversity is higher and trees are usually larger with constant above-ground water. Interrupted, not intermittent, tributaries have subsurface flow year-round. Willows (*Salix* spp.) or other moisture-obligate species indicate permanent water. Fault planes dissecting mountains trap water; perched water allows riparian vegetation along the fault scarp to survive summer. Drought in headwaters creeks precludes riparian flora; water must be present in the soil. Most riparian trees are broad-leaved, winter-deciduous, and wind-pollinated; all are adaptations for this environment. In the watershed, as throughout California, willows grow along all riparian corridors and mixed tree and shrub communities are found along streams. Vegetation categorized as montane or valley riparian habitat occurs on an elevational gradient without sharp boundaries (Holland 1986; Mayer & Laudenslayer 1988; Schoenherr 1992).

Physical (e.g., micro-climate, hydrologic connectivity), chemical (e.g., water quality), and biological (e.g., presence of amphibians and songbirds) characteristics indicate riparian zone conditions. As the interface between aquatic and terrestrial ecosystems, riparian habitat has high ecological significance. Riparian trees reduce erosion and stabilize stream channels. Fast-growing, with extensive root systems, they hold alluvial soils and stream banks in place and allow flowing water to recharge groundwater. Plants re-establish quickly after natural disturbance, and are usually present in sizes ranging from seedlings and saplings to large trees. Catastrophic loss of riparian vegetation quickly leads to increased storm runoff and erosion rates. When combined with chaparral destruction on slopes above streams, as in the case of fire, major sedimentation and debris flows can occur in heavy rainfall years. Unlike fire-adapted chaparral, riparian vegetation does not burn well because rivers are topographic low points and plants also maintain high moisture levels (Rundel & Gustafson 2005).

Montane Riparian Habitat

Montane riparian vegetation occurs at higher elevations in fairly narrow zones within moderately steep to very steep-walled canyons. Well-established riparian corridors exist along upper Pacoima and Big Tujunga Creeks and along larger upper tributary streams. White alder (*Alnus rhombifolia*), black cottonwood (*Populus trichocarpa*) and big-leaf maple (*Acer macrophyllum*) are the predominant large trees. Alder and cottonwood are more abundant and usually occur in groups of the same species rather than mixed together. White alder is the only Southern California native alder, and can occur from low valleys up into mountain canyons. More common at medium to high elevations, it always indicates permanent fresh water. The smooth, straight gray-brown trunk has distinctive v-shaped marks where branches attach; leaves have saw-toothed edges. Long, golden catkins emerge in late winter when the tree is leafless; clusters of small reddish cones appear at the ends of branches. Big-leaf maple is California's largest maple; its winged fruits are called samaras. In northern California, it is a forest species; here it is almost always associated with white alder. Black cottonwood has finely serrated dark green leaves with a silvery reverse that vary from heart-shaped at low elevations to lance-shaped higher in the mountains; it also requires permanent water.

Willows (*Salix* spp.), are the predominant riparian plant genera, and can be identified by their simple, elongated leaves. Multiple species and interspecific hybrids overlap in variable altitudinal bands. Red willow (*S. laevigata*) is the most abundant; it and Pacific willow (*S. lasiandra*) become tree-sized, about one-third the size of the larger riparian trees. Lemmon (*S. lemmonii*), Scouler's (*S. scouleriana*), yellow (*S. lutea*), narrow-leaved or sandbar (*S. hindsiana*), and the less-common dusky (*S. melanopsis*) willow are shrubs (Schoenherr 1992; Hickman 1993; CNPS 2000; CDFG 2006).

Valley Riparian Habitat

Valley riparian plant communities exist along lower-gradient and frequently larger creeks on wider floodplains, and usually extend farther from the edge of the stream into adjacent upland habitat (Holland 1986). On lower reaches and tributaries of Big and Little Tujunga and Pacoima Creeks, predominant large trees are Fremont cottonwood (*Populus fremontii*) and Western or California sycamore (*Plantanus racemosa*). Both generally grow in same-species groups, intermixed with shorter trees and shrubs, with cottonwood more abundant at lower elevations. Fremont cottonwood also grows only where soils are permanently wet. It is fast-growing but not long-lived; triangular leaves turn yellow in the fall and brownish fruits split to expose cottony seeds. California sycamore tolerates slightly drier conditions but prefers wet stream banks in valleys, foothills and lower mountains and may occur with white alder at higher elevations. Wide-spreading trees become massive. Tree bark is distinctive, flaking and mottled when young, then dark gray with age. Large light green lobed leaves are fuzzy on undersides, and turn brown in mid to late summer; ball-like fruits hang in long clusters.

As in montane regions, willows are a major component of the valley riparian habitat. Red, Pacific, and sandbar willows extend their distribution to lower elevation stream banks, but primary species here are shrub to small-tree-sized Arroyo (*S. lasiolepis*) and Black (*S. gooddingii*) willows. Mulefat (*Baccharis salicifolia*), which resembles the shrubby willows, is the other predominant riparian species. Mugwort (*Artemesia douglasiana*), California blackberries (*Rubus californica*), California wild roses (*Rosa californica*), and poison oak (*Toxicodendron diversiloba*) are common understory plants.

Less-common riparian communities grow along intermittent streams. Two have evergreen oaks as dominant trees: Coast live oak (*Quercus agrifolia*) is found occasionally at low elevations of the southern upper watershed; Canyon live oak (*Q. chrysolepis*) extends downslope from woodlands to streams in the northern upper section of the watershed. California black walnut (*Juglans californica*) also has a limited southern distribution (Schoenherr 1992; Hickman 1993; CNPS 2000; CDFG 2006).

All riparian habitats are important for birds. Regardless of their diet, very large numbers of resident and migrant species are associated with this habitat type because the vegetation structure is complex and so many resources are available, including fruits, seeds, insects, fish, amphibians, and small mammals. Some species which use riparian habitat may range across several habitat types with their distribution dependent on particular resource availability. Each habitat is utilized differently by various species and bird communities. In general, a given species can usually be classified as more typically found within a particular vegetation type (Grinnell & Miller 1944; Garrett & Dunn 1981; Schoenherr 1992; Stephenson & Calcarone 1999; Evens & Tait 2005; USFS 2005b).

Riparian-dependent montane birds include Hermit Thrush (*Catharus guttatus*), MacGillivray's Warbler (*Oporornis tolmiei*), Wilson's Warbler (*Wilsonia pusilla*); and Western Screech-Owl (*Otus kennicottii*) (Garrett & Dunn 1981; USFS 1987; Garrett 1993b; USFS 2005b). A recent survey in the Upper Tujunga Watershed along Big Tujunga Creek and its tributary streams described avian species occurrence within the montane riparian corridor, classified by affinity for the adjacent upland vegetation type (e.g., chaparral or mixed coniferous forest) (Garrett 1993b). Prevalent species and a selection of others are listed under chaparral, oak woodland, and coniferous forest habitat sections. Some species require multi-layered willow-dominated thickets or gallery forests with dense understory vegetation; low-elevation riparian-obligate species of concern include Southwestern Willow Flycatcher (*Empidonax traillii extimus*), Least Bell's Vireo (*Vireo belli pusillus*), Warbling Vireo (*Vireo gilvus*), Yellow-breasted Chat (*Icteria virens auricollis*), Yellow Warbler (*Dendroica petechia brewsteri*), and Swainson's Thrush (*Catharus ustulatus oedicus*). Song Sparrow (*Melospiza melodia*) is widespread throughout California and is a permanent riparian thicket resident; it is a proposed Forest Service indicator species. Black-chinned Hummingbird (*Archilochus alexandre*), Redwinged Blackbird (*Agelaius phoeniceus*), Tricolored Blackbird (*A. tricolor*), Western Yellow-Billed Cuckoo (*Coccyzus americanus occidentalis*), Swainson's Hawk (*Buteo swainsoni*), and Red-shouldered Hawk (*Buteo lineatus*) are present in cottonwood and willow lowland forests. Nest parasitism by Brown-headed Cowbird (*Molothrus ater*) is a major problem (Garrett 1993b; Evens & Tait 2005; USFS 2005b).

Small mammals include bats, numerous rodents, opossum (*Didelphis virginiana*), raccoon (*Procyon lotor*), and Western gray squirrel (*Sciurus griseus*). Mule deer (*Odocoileus hemionus*) are present. Long-tailed weasel (*Mustela frenata*), coyote (*Canis latrans*), grey fox (*Urocyon cinereoargenteus*), mountain lion (*Puma concolor*), black bear (*Ursus americanus*), and an occasional American badger (*Taxidea taxus*) come to riparian habitat for water and to take advantage of the plentiful food sources available (Bakker 1984; USFS 1987; Schoenherr 1992; Stephenson & Calcarone 1999; USFS 2005b). Amphibians listed above, plus several lizards and snakes are present (USFS 1987, 2005b).

Dragonflies, damselflies, and other riparian insect species are numerous. Butterflies commonly feed on riparian plants. Some butterfly larvae are restricted to only one food plant; usually adults are less specialized but may also be associated with one particular species for the nectar they require. Large colorful butterflies characteristic of low to mid-elevation riparian woodlands include Lorquin's admiral (*Basilarchia lorquini*), Western tiger swallowtail (*Papilio rutulus*), and Mourning Cloak (*Nymphalis antopa*); their food plants include willow, cottonwood, alder, and sycamore. Pale swallowtail (*P. eurymedon*) and Satyr anglewing (*Polygonia satyrus satyrus*) are seen at mid to high elevations. Butterflies are among the best studied insects and many formerly common riparian butterflies have become rare or been extirpated, including various hairstreak, checkerspot, blue, copper, sootywing, and admiral species (Mattoni 1990; Garrett 1993a; Hogue 1993; Stephenson & Calcarone 1999).

Lower Watershed Riparian Habitat

Lower Tujunga and Pacoima Washes and their storm drain tributaries have no native riparian plant communities. The areas adjacent to the water are concrete and if there is any vegetation nearby it is typically heavily managed non-native grass or landscaped areas. Some partially native plantings exist.

Alluvial Fan Riparian Habitat

Near Hansen Dam, remnant portions of wetland floodplain forest and freshwater marsh that were historically present on the Tujunga Wash alluvial fan near confluences of the major creeks still exist. Vegetation is primarily a dense thicket of willows, with some Fremont cottonwoods (Garrett 1993a). Other areas are weedy scrubland. A large lake no longer exists, as it did decades ago, but heavy rainfall fills additional portions of the basin and also floods downstream spreading grounds and gravel pits, which creates additional wetland habitat.

Avian biodiversity is extremely high. Present-day surveys have recorded nearly three hundred bird species in Big Tujunga Wash/Hansen Dam; they include resident riparian species, diverse passerine migrants that make the willow forest a major migration stopover, and numerous waterbirds, waterfowl, and shorebirds attracted to mudflats, marsh, and wetland environments (Garrett 1993b). Presumably, to sustain this ecosystem, invertebrate biodiversity is also high and water quality is good.

Important riparian specialists noted during a six-year breeding bird survey included Green Heron (*Butorides virescens*), Belted Kingfisher (*Ceryle alcyon*), Downy Woodpecker (*Picoides pubescens*), Yellow Warbler, Yellow-breasted Chat, and Blue Grosbeak (*Guiraca caerulea*) (Garrett 1993b). Marsh songbirds at include Western Yellow-Billed Cuckoo and Common Yellowthroat (*Geothlypis trichas*) (USFS 2005b). Black-crowned Night-Heron (*Nyctanassa violacea*), Spotted Sandpiper (*Actitis macularia*), Western Bluebird (*Sialia mexicana*), Cooper's Hawk (*Accipter cooperii*), Loggerhead Shrike (*Lanius ludovicianus*), Chipping Sparrow (*Spizella passerina*), Greater Roadrunner (*Geococcyx californianus*), and Solitary Vireo (*Vireo solitarius*) were other species breeding in the Hansen Dam basin. Waterbird diversity was very high: five grebe species; nine heron species, ten species of terns and gulls; 22 waterfowl species; and 22 shorebird species were counted (Garrett 1993b).

Alluvial Fan Sage Scrub

Distinctive alluvial fan scrub vegetation, called Riversidian alluvial fan sage scrub or "riparian coastal scrub," originally developed at canyon mouths along the entire southern face of the San Gabriel Mountains. Broad, gently-sloping alluvial fans were deposited as rivers and streams exited the fast-rising mountains. The Tujunga fan is an enormous landform that begins as a boulder and cobble floodplain within Big Tujunga Canyon and extends across the eastern San Fernando Valley. Prior to channelization for flood control, low-gradient braided streams usually crossed the Tujunga fan to their confluence with the Los Angeles River (USGS 1902, 1911; Hegelson 1993).

However, this is naturally a dynamic landscape. Wash vegetation is dependent upon natural disturbance to regenerate and sustain the plant community. Typically dry large washes intermittently flood and scour the terrain, eroding and depositing large amounts of sediment. Anastomosing stream courses occasionally shift in response to the hydrologic regime. Seasonal floods eradicate old vegetation, and then pioneer plants colonize the area. Riparian corridors and gallery forests adjacent to deeper, semi-permanent streams include fast-growing species which re-establish rapidly. On the rest of the fan, mature vegetation developed gradually into complex habitat. All phases of vegetative development occurred simultaneously within the larger ecosystem. As a consequence, to maintain the ecosystem, alluvial sage scrub habitats must remain

large enough to support all processes, and cannot survive further fragmentation (Scott 1973; Hegelson 1993; Woods 2000). Alluvial fan sage scrub in Southern California has almost been entirely eradicated by urbanization, other development, and flood control projects (Scott 1973; Hanes et al 1989; Myers 1995; Woods 2000). "The alluvial scrub habitats of Big Tujunga Wash form an exceptionally and critically important remnant of this beleaguered habitat" (Garrett 1993a).

This vegetation community within and along infrequently inundated alluvial fans and floodplains is adapted to very specialized conditions. Boulders, cobbles, and gravels that flood at irregular intervals support an assemblage of deciduous, evergreen, coniferous, sclerophyllous, drought-deciduous, and succulent shrubs, herbaceous perennials, bulbs, and annuals (Hegelson 1993; Garrett 1993a; CNPS 2000; Woods 2000; CDFG 2006).

Alluvial fan sage scrub has characteristic plants, including Chaparral Yucca (*Yucca whipplei*) which occurs at all watershed elevations, but is most prevalent in the Wash. The dominant indicator plant is scalebroom (*Lepidospartum squamatum*); other principal species include white sage (*Salvia apiana*), mulefat (*Baccharis salicifolia*), California buckwheat (*Eriogonum fasciculatum*), Coast Goldenbush (*Isocoma menziesii*), mugwort, California juniper (*Juniperus californica*), cholla and prickly pear (*Opuntia* spp.). TES species include endangered San Fernando Valley spineflower (*Chorizanthe parryi*), slender-horned spineflower (*Dodecahema leptoceras*), and Nevin's barberry (*Mahonia nevinii*), many-stemmed dudleya (*Dudleya multicaulis*), and Davidson's bush mallow (*Malacothamnus davidsonii*) (Hegelson 1993; Woods 2000; CDFG 2006).

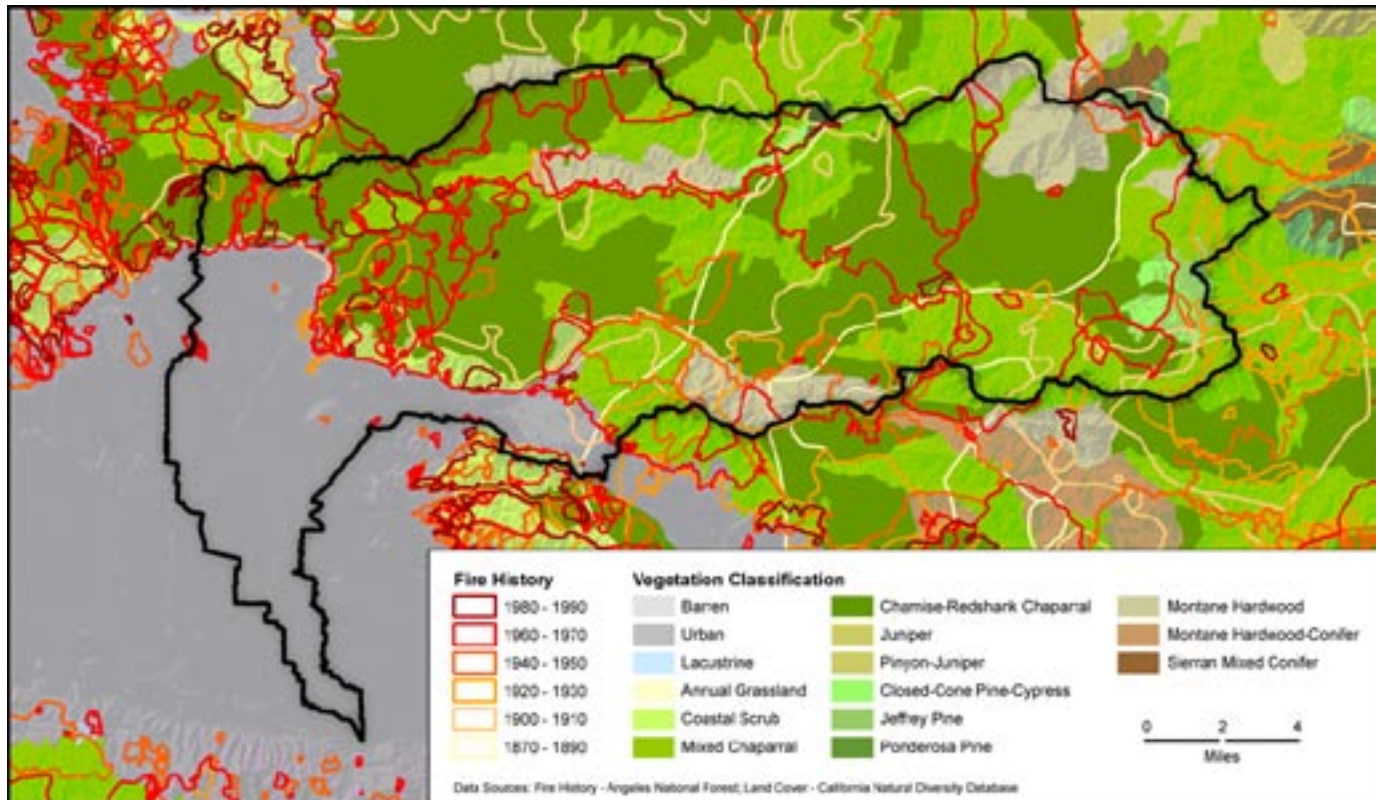
This vegetation community is allied to and combines plant associations from riparian, coastal sage, chaparral, woodland, and desert communities. Riparian species include white alder, arroyo willow, black willow, California sycamore, Fremont cottonwood, elderberry (*Sambucus mexicana*), mulefat, rushes, cattails, and sedges. California buckwheat and white sage are typical coastal sage species and laurel sumac (*Malosma laurina*) and lemonade berry (*Rhus integrifolia*) are found in chaparral associations. Coast live oak (*Quercus agrifolia*), Engelmann oak (*Q. engelmannii*), and California black walnut (*Juglans californica*) are woodland species. California juniper and opuntia species grow in desert habitats (Schoenherr 1992; Woods 2000; CDFG 2006).

The fauna are as diverse as the flora, and some are as imperiled. As described in the aquatic section, the three native freshwater fish in Big Tujunga Wash are Santa Ana sucker, Santa Ana speckled dace, and arroyo chub, all TES species. Threatened Coastal California Gnatcatcher (*Polioptila californica californica*) and species of concern Burrowing Owl (*Athene cunicularia*) may still be present (USFS 2005b; CDFG 2006). Cactus Wren (*Campylorhynchus brunneicapillus*) was formerly widespread in the alluvial fan habitat; egg sets were historically taken from much of eastern San Fernando Valley but few birds are left. Rock Wren (*Salpinctes obsoletus*), Costa's Hummingbird (*Calypte costae*), Lesser Nighthawk (*Chordeiles acutipennis*), Common Poorwill (*Phalaenoptilus nuttallii*), Killdeer (*Charadrius vociferous*), Spotted Sandpiper, Sage Thrasher (*Oreoscoptes montanus*), Phainopepla (*Phainopepla nitens*), California Quail (*Callipepla californica*), Greater Roadrunner, Common Barn Owl (*Tyto alba*), Greater Horned Owl (*Bubo virginianus*), American kestrel (*Falco sparverius*), Red-shouldered Hawk (*Buteo lineatus*), and Turkey Vulture (*Cathartes aura*) currently use this habitat (Garrett 1993b; Woods 2000; Evens & Tait 2005).

California horned lizards (*Phrynosoma coronatum blainvillii*) are endemic to California and prey on non-native ants, but will also eat beetles (Stephenson & Calcarone 1999; USFS 2005b). They occur in chamise chaparral, riparian woodlands, and grasslands, but are a TES species most abundant on old alluvial fans, preferring open areas with limited overstory for basking. Southwestern arroyo toad and Western spadefoot toad (*Spea hammondi*), also TES species, utilize alluvial fan sage scrub.

Mammals include southern grasshopper mouse (*Onychomys torridus ramona*), California mouse (*Peromyscus californicus*), deer mouse (*P. maniculatus*), kangaroo rats (*Dipodomys* spp.), woodrats (*Neotoma* spp.) and other rodents, California ground squirrels (*Spermophilus beecheyi*), black-tailed jackrabbit (*Lepus californicus*), coyote (*Canis latrans*), and bobcat (*Felis rufus*). Butterflies include Variable Checkerspot (*Euphydryas chalcedona*), Gray Hairstreak (*Strymon mellinus*), Painted Lady (*Vanessa cardui*), West Coast Lady (*V. anabella*), and Large White Skipper (*Heliopetes ericetorum*) (USFS 1987; Mattoni 1990; Schoenherr 1992; Stephenson & Calcarone 1999; CDFG 2006).

Figure F-3 – Generalized Terrestrial Habitats of the Tujunga Watershed with Fire History [IEI map – J. Casanova]



Terrestrial or Upland Habitats

The terrestrial part of a watershed (uplands) composes the majority of the watershed by area, but may receive much less attention than the waterways. It is the part of the watershed on which precipitation falls and water originates for streams and rivers; in the Tujunga Watershed, the predominant vegetation type is chaparral. Activities and conditions in the upland plant communities can determine water quality, water supply and timing, and many aspects of “watershed health.” Wildlife use of these communities and of the riparian zone near waterways is an important indication of the health of an ecosystem and its component watersheds (Shilling et al 2004; CDFG 2006).

Urban habitat

Due to alignment of canyons, this habitat receives some coastal influence, even inland, thus is a desirable locale for human habitation. The original habitats, alluvial fan sage scrub, coastal sage scrub, perennial grasslands, prairie, oak woodlands, riparian corridors, and wetlands disappeared as the region urbanized.

Any remnant communities are highly modified or threatened by habitat destruction. Native and introduced species that live here can occur almost everywhere in the watershed: non-domesticated mammals include raccoon, opossum, coyote, striped skunks (*Mephitis mephitis*), house mouse (*Mus musculus*), Norway rat (*Rattus norvegicus*), roof rats (*Rattus rattus*), and fox squirrels (*Sciurus niger*). Among many others, urban birds include Northern mockingbird (*Mimus polyglottus*), Mourning Dove (*Zenaida macroura*), rock dove or pigeon (*Columba livia*), American Crow (*Corvus brachyrhynchos*), House Finch (*Carpodacus mexicanus*), Black Phoebe (*Sayornis nigricans*), Anna's Hummingbird (*Calypte anna*), Sharp-shinned Hawk (*Accipiter striatus velox*), Cooper's Hawk, Red-tailed Hawk (*Buteo jamaicensis*), Peregrine falcon (*Falco peregrinus*) and Turkey Vulture (*Cathartes aura*). All have larger ranges, but find abundant food sources here.

Coastal sage scrub

Above the valleys, below the chaparral zones, coastal sage scrub or 'soft chaparral' covers dry, rocky steep lower slopes. This vegetation community is composed entirely of shallow-rooted small shrubs (to 2 m; about 6 ft.), usually drought-deciduous or summer-dormant species, with foliage that is often highly aromatic. Some species are succulent. It is not frost-tolerant, thus occurs at lowest elevations. Several coastal sage scrub plant alliances are prevalent on the low south-facing (coastal influence) slopes of the San Gabriel Mountains, and in the adjacent Verdugo Mountains (Ornduff et al 2003; CDFG 2006). CNPS (2000) refers to coastal scrub as a 'collection of series' (Table F-3). Coastal sage scrub has components which form common associations. Classifying by the CNDDDB system, more-mesic Venturan Sage Scrub grows in the western watershed and near the Verdugos; more-xeric Riversidian Sage Scrub grows on lower slopes between Little and Big Tujunga Canyons and grades into remnant Big Tujunga Wash Riversidian alluvial fan sage scrub (Holland 1986; CDFG 2006).

California sagebrush (*Artemisia californica*) is a general indicator plant for Coastal Sage Scrub. It is in the sunflower family, and not a "true" sage. Finely divided blue-gray leaves have a distinctive, pleasantly strong aroma. It leafs out with the first fall rains. California buckwheat (*Eriogonum fasciculatum*) is a typical scrub and chaparral plant, with tiny waxy leaves; tightly packed clusters of pink flowers on long stalks bloom from April through October and the dry flower clusters hold on the plant for months. 'True' sages (*Salvia* spp.) include black sage (*S. mellifera*), commonest in the watershed, purple (*S. leucophylla*), and white (*S. apiana*) sage. Coyote brush (*Baccharis pilularis*), California encelia (*Encelia californica*), and monkeyflowers are typical coastal sage components.

The coastal sage vegetation community is comparatively limited in the watershed overall, but extends to the valley floors in the northwestern watershed, intergrades with alluvial fan sage scrub, and also mixes with chaparral at higher elevations. North-facing coastal sage slopes have a different species composition adapted to the cooler, moister conditions. Plants are evergreen rather than summer-deciduous and have larger leaves. Such species as toyon (*Heteromeles arbutifolia*), laurel sumac (*Malosma laurina*), sugar bush (*Rhus ovata*), lemonade berry (*Rhus integrifolia*), and currant (*Ribes* spp.) occur here, and are present in some chaparral associations. Ecotones between coastal sage scrub and chaparral tend to be fuzzy in the San Gabriel Mountains (Ornduff et al 2003; Rundel & Gustafson 2005; CDFG 2006).

Formerly extensive in coastal southern California, all coastal sage communities are highly threatened by habitat destruction. It has been the fastest disappearing major habitat as the region urbanizes. Fire is a natural disturbance in coastal sage scrub communities, but the response of shrubs is different than in the chaparral, which is denser fire-obligate vegetation. Drought-deciduous species such as the sages, California sagebrush, and California buckwheat regenerate from wind-dispersed seed. After a fire, sage scrub seedlings often infiltrate the higher-elevation chaparral shrubs. Chaparral shrubs resprout more slowly, but eventually shade out most coastal sage components. Black sage is an exception in that stands

appear to be able to compete well and remain indefinitely as long as it is not limited by cold temperatures. Most evergreen species like toyon resprout from their crown, although sumac will both crown-sprout and regenerate from seeds (Bakker 1984; Schoenherr 1992; Stein et al 2000; Rundel & Gustafson 2005).

About 100 plants and animals are endemic to this habitat. Predators operating here include golden eagle (*Aquila chrysaetos*), California condor (*Gymnogyps californianus*), prairie falcon (*Falco mexicanus*), other raptors, several owls, coyote and bobcat. American badger (*Taxidea taxus*) will utilize coastal sage scrub habitat if it is not too densely vegetated. All have ranges that extend into other habitats, but small animals available here are excellent food sources. Mammals include bats (*Myotis* spp.), mice, rats, ground squirrels, voles, striped skunk, Western spotted skunk (*Spilogale putorius*), black-tailed jackrabbits, and desert cottontail (*Sylvilagus audubonii*). Various salamanders occur here and at higher elevations. Lizards include common western fence lizard (*Sceloporus occidentalis*); TES species silvery legless lizard (*Aniella pulchra pulchra*), orange whiptail (*Aspidoscelis hyperthyrus*) and coastal western whiptail (*A. tigris stejnegeri*). Another TES species, coast patch-nosed snake (*Salvadora hexalepis virgulata*) and coastal rosy boa (*Lichanura trivirgata roseofusca*) have a generalist diets which include birds, rodents and lizards (USFS 1987; Schoenherr 1992; Faber et al 1993; USFS 2005b).

Typical coastal sage scrub birds include Anna's Hummingbird and Costa's Hummingbird (*Calypte costae*), as well as typical chaparral species such as California Quail (*Callipepla californica*), Bushtit (*Psaltiriparus minimus*), California Towhee (*Pipilo crissalis*), Spotted (Rufous-sided) Towhee (*Pipilo erythrophthalmus*), and Wrentit (*Chamaea fasciata*). Desert species whose range extends towards the coast into coastal sage scrub include Greater Roadrunner, Gambel's Quail (*C. gambelii*), Cactus Wren, and Burrowing Owl. Many birds prefer ecotones where habitats overlap; examples are Western Scrub-Jay (*Apelocoma coerulescens*), and House Finch. Others, including Bell's sage sparrow (*Amphispiza belli belli*), Black-throated Sparrow (*A. bilineata*), Rufous-crowned Sparrow (*Aimophila ruficeps canescens*), and Black-chinned Sparrow (*Spizella atrogularis*) avoid "edges" and remain within the core of the coastal sage habitat (Garrett & Dunn 1981; Garrett 1993b; Evens & Tait 2005).

Butterflies are common in coastal sage scrub. Dusky metalmark (*Calephelis nemesis*) feeds on *Encelia* and mulefat; California and other buckwheats are food plants for Behr's metalmark (*Apodemia mormo virgulti*) and Variable checkerspot (*Euphydryas chalcedona*), which also utilizes sticky monkeyflower (*Mimulus longiflorus*) (Mattoni 1990; TPF 1995).

Chaparral

By area, the watershed is predominantly chaparral vegetation. It occurs throughout the Upper Big Tujunga drainage and elsewhere up to an elevation of 1500 m (~5000 ft.). Chaparral communities are highly drought-tolerant, with sclerophyllous or hard-leaved, tough waxy evergreen foliage on plants which grow to about 1 – 3 m (3 – 10 ft) in height. Plants tolerate dry, rocky soil and have an extensive root system. As a further climate adaptation, species which favor south-facing slopes tend to have smaller leaves which transpire less water than larger-leaved plants on north-facing slopes. Mature stands become dense, impenetrable thickets. The natural structure is single layered, lacking herbaceous ground cover or overstory tree canopy. Fire occurs regularly and influences vegetation structure and consequently habitat (Ornduff et al 2003; Rundel & Gustafson 2005; CDFG 2006).

Chaparral vegetation is fire-obligate, meaning it has coevolved with and requires fire. Many species have specific adaptations to either encourage fire, such as volatile oils; to withstand fire, such as thick, fireproof bark; and to recover after a burn, including shrubs which sprout from a seemingly-dead crown, serotinous closed-cone pine cones which will not open to release seeds until they experience extreme

temperatures, or herbaceous plants which may require high heat or a layer of ash upon the soil for their seeds to germinate.

Fires burn at varying intensities, related to such physical factors as humidity, temperature, wind speed and direction, as well as biological factors like foliage and stem moisture content and age of the stand of vegetation. Fire intensity can be gauged by the size of the smallest branches remaining; shrubs may or may not be killed to the ground. Vegetation mosaics are formed according to fire intensity, burn pattern, and recovery succession. In general, although the actual composition of plant species may vary, the vegetation structure is the same in a given location. Interruption of the natural fire regime through fire suppression and the consequent lack of multiple age-cohort mosaics plus build-up of excess brush are major problems in chaparral (Holland 1986; Mayer & Laudenslayer 1988; Rundel & Gustafson 2005; USFS 2005d).

Chaparral fire ecology is complex. In the first year following a fire, annual flowers that only appear after a fire carpet bare slopes. Their seeds remain viable for decades in soil seed banks. Many have very showy blossoms, including numerous members of the poppy (*Papaveraceae*), phacelia (*Hydrophyllaceae*) and figwort (*Scrophulariaceae*) families. Short-lived perennials and subshrubs, such as California buckwheat and deerweed (*Lotus scoparius*) then become dominant for two to five years. Insects are very common in chaparral and both buckwheat and deerweed are important nectar plants for insect species, including Funereal Duskywing (*Erynnis funeralis*) and Orange Sulfur (*Colius eurytheme*) butterflies. Deerweed fixes nitrogen, is high in protein and provides excellent forage for animals like mule deer (*Odocoileus hemionus*), while the original woody species become reestablished (Mattoni 1990; Ornduff et al 2003; Rundel & Gustafson 2005; TPF 2005).

Most chaparral shrubs reestablish either by resprouting from woody root crowns or by germination of generally long-lived seeds. Chamise (*Adenostoma fasciculatum*) is the major exception; it regenerates both from stump sprouts and from numerous seeds it produces. Some seeds require heat to germinate; others do not, but seeds do not remain viable as long as those of other genera. It is the classic example of fire-adaptation: it bursts into flame at high temperatures in a fire. As medium-lived shrubs like ceanothus (*Ceanothus* spp.) grow back, herbs disappear. After 10 to 30 years, ceanothus decline and die out. As habitat matures height and coverage of vegetation increases and species diversity declines. Chamise is the longest-lived of chaparral shrubs, thus many slopes are entirely chamise, including broad expanses of slopes above the drainages of Little and Big Tujunga Creeks, Upper Big Tujunga and its tributaries, and south-facing slopes of Upper Pacoima Creek (Stephenson & Calcarone 1999; Ornduff et al 2003; Rundel & Gustafson 2005; CDFG 2006; CNPS 2006).

Multiple chaparral plant alliances are recognized (Table F-3; CDFG 2003; CNPS 2006); 'chamise chaparral' and 'mixed chaparral' are distinctions generally synonymous with the terms 'low' and 'high' chaparral. Chamise chaparral occurs at generally lower elevations than mixed chaparral, but often forms an ecotone with coniferous forest above as well as broad mosaics and complex gradations with lower-elevation coastal sage scrub, particularly the sages and California buckwheat. Chamise occurs alone and with ceanothus (*Ceanothus*) and manzanita (*Arctostaphylos*) species. Birchleaf mountain-mahogany (*Cercocarpus betuloides*) is another widespread chaparral species; it is an important browse for deer and bighorn sheep. Scrub oaks (*Quercus berberidifolia*) are common in Little Tujunga and lower Pacoima and Big Tujunga Canyons, especially on north-facing slopes and canyon bottoms; shrubby forms of canyon (*Q. chrysolepis*) and interior live oak (*Q. wislizenii*) are also key members of chaparral alliances. Endemic leather oak (*Q. durata gabrielensis*) is similar to scrub oak. Hundreds of other plant species occur here, including toyon, laurel sumac, sugar bush, lemonade berry, currants, and the watershed's distinctive yucca (Schoenherr 1992; Hickman 1993; Ornduff et al 2003; CDFG 2006; CNPS 2006).

At least eight *Ceanothus* spp. are here, on both north and south-facing slopes; blue or white flowers cover hillsides. Hoaryleaf ceanothus (*C. crassifolius*) and chaparral whitethorn (*C. leucodermis*) are prevalent throughout the central watershed except for high peaks; buck brush (*C. cuneatus*) and deer brush (*C. integerrimus*) are less abundant with similar distributions; desert ceanothus (*C. greggii*) occurs on dry south-facing slopes of upper Pacoima Canyon; mountain whitethorn (*C. cordatus*) prefers eastern high elevations; and hairy (*C. oliganthus*) and bigpod ceanothus (*C. megacarpus*) prefer coastal-influenced lower western slopes. Manzanita species richness is also high: woolyleaf manzanita (*A. tomentosa*) is abundant; coyotes and bears eat the 'little apples' of bigberry manzanita (*A. glauca*); Eastwood manzanita (*A. glandulosa*) is common in the eastern watershed; restricted-range endemic San Gabriel manzanita (*A. gabrielensis*) grows at Mill Creek Summit; and high-elevation species include *A. parryana* and *A. patula* (Schoenherr 1992; Hickman 1993; CDFG 2006). Many other wildflowers are associated with chaparral in addition to the fire-followers. Locally endemic TES species include Greata's aster (*Aster greatae*), Mount Gleason Indian paintbrush (*Castilleja gleasonii*), San Gabriel linanthus (*Linanthus concinnus*), Johnston's monkeyflower (*Mimulus johnstonii*), and Palmer's, Plummer's, slender, and alkali mariposa lilies (*Calochortus* spp.) (Allen et al 1995; CNPS 2000, 2006; CDFG 2006).

Chaparral provides excellent cover for wildlife. Smaller mammals present in riparian communities adjacent to chaparral uplands, including mice, kangaroo rats, woodrats, bats and skunks, extend their range deep into the chaparral. Although little is known about migratory patterns and home ranges of most large watershed mammals, predators include mountain lion, coyote, bobcat, and gray fox. Mule deer are abundant. Bighorn sheep, *Ovis canadensis nelsonii*, are present in isolated locations in mixed but not chamise chaparral, although most of their recent range is outside the watershed (USFS 1987; Schoenherr 1992; Stephenson & Calcarone 1999; Holl 2004; USFS 2005b; CDFG 2006). Most-common birds recorded in Upper Big Tujunga chaparral vegetation by the 1986-1992 Breeding Bird Surveys were: Spotted (Rufous-sided) Towhee, Wrentit, Western Scrub Jay, Ash-throated flycatcher (*Myiarchus tyrannulus*), Western Wood-Pewee (*Contopus sordidulus*), Black-chinned Sparrow, California Towhee, Plain Titmouse (*Parus inornatus*), and Lesser Goldfinch (*Carduelis lawrencei*) (Garrett 1993b). Additional chaparral birds include Lazuli Bunting (*Passerina amoena*), California Thrasher (*Toxostoma redivivum*), and Mountain Quail (*Oreortyx pictus*). Toyon berries attract Hermit Thrush (*Catharus guttatus*) and American Robin (*Turdus migratorius*). Golden eagle and California condor are present in high chaparral along the northern edge of the watershed (USFS 1987; Garrett 1993b; Evens & Tait 2005; USFS 2005b). Hairstreaks (*Satyrium* spp.) are common chaparral butterflies that feed on scrub oaks, mountain-mahogany, and ceanothus; California tortoises (*Nymphalis californica*) feed on ceanothus; checkerspots (*Euphydryas* and *Melitaea* spp.) prefer wildflowers, including asters, monkeyflowers, and Indian paintbrush (Mattoni 1990).

Forests and Woodlands

Coastal Oak and Walnut Woodlands

Remnant California black walnut (*Juglans californica*) woodlands grow in Big Tujunga Wash. Coast live oak (*Quercus agrifolia*) occurs in lower sections of all three major canyons, on some lower south-facing slopes with coastal sage, and along Big Tujunga Wash. Coast live oak attains the largest size of the watershed oaks. After hundreds of years, the slow-growing hardwoods may reach 25 m (75 ft) in height with a 30 m (100 ft) spread, with trunks exceeding 3 m (10 ft) in diameter. Thick bark protects them from fire, and leathery leaves and an enormous root system help them to withstand drought. Thin, long, pointed acorns were those preferred to grind into meal. Valley oak (*Q. lobata*) sometimes occurs with coast live oak. Englemann oak (*Q. englemanni*) is present in Tujunga Wash.

Montane Hardwoods

The distinction between “woodland” and “forest” is that tree canopies touch in the forest, whereas trees are spaced in woodlands, often within a matrix of other vegetation. Ascending to higher elevations, ecotones are present between chaparral and the three montane vegetation types: oak woodlands, oak-conifer forests, and coniferous forests. Oak woodlands and forests occur throughout Pacoima Canyon on canyon slopes and may extend downwards to the riparian zone; grow above the chaparral zone in Big Tujunga Canyon, typically on north-facing slopes and in shaded canyons; and may also be at the tops of ridges. Oaks have an altitudinal zonation that is less sharp than conifers, and species adapted to slightly different conditions also hybridize, making identification of some trees problematic. Shrubby scrub oak and leather oak are present in the chaparral. Deciduous, large California black oak (*Q. kelloggii*) is easy to identify. All three may be present in higher-elevation oak woodlands. Nevertheless, within all upper watershed hardwood communities, Canyon live oak (*Q. chrysolepis*) is most abundant. It may grow alone, with other oaks, or with conifers; widely scattered in woodlands or closely spaced in forests; and as a shrub or large tree, 6-30 m (20-100 ft) tall with an equal spread. Leaves and acorns are extremely variable. Always evergreen, leaves are cupped, spiny and shiny dark green above with yellowish hairs on the underside, but may have smooth edges and be gray underneath. Egg-shaped acorns have a thick scaly cup with golden hairs. Interior live oak (*Q. wislizenii*) is prevalent in mid-to-upper Pacoima and Big Tujunga Canyons and occurs with Canyon live oak. Interior live oak grows as a tree 10-20 m (30-70 ft) tall with a short, stout trunk, and also as a much shorter shrub. Evergreen, thick, leathery leaves are usually spiny and shiny, dark green above, lighter green beneath, without hairs. Acorns are long and pointed with a deep cup. Interior live oak can be differentiated from scrub oak because scrub oak leaves may be spiny or smooth but are dark green with short hairs on the underside, and small lobes on the edge; acorns are pointed but shorter (Schoenherr 1992; USFS 2005c; CDFG 2006).

Mixed Oak-Conifer Forests

Moisture-holding north-facing slopes within mixed oak-conifer forests often include canyon and interior live oaks and two endemic conifers, which generally do not occur together: big-cone Douglas-fir (*Pseudotsuga macrocarpa*) and Coulter pine (*Pinus coulteri*). These two are among the most easily identifiable watershed conifers. Big-cone Douglas-fir has distinctive foliage and much larger cones than regular Douglas-fir, while Coulter pine has extremely long needles and enormous cones with heavy outward-curving spines. Endemic big-cone Douglas-fir is not abundant, but is found in all three major canyons; it is restricted to Southern California. Seeds germinate well after fires, and trees may resprout along their branches if the fire is not too intense. Less drought-tolerant than many conifers, Coulter pine will grow at most elevations on north-facing slopes (Schoenherr 1992; CDFG 2006).

Coniferous Forests

At higher elevations, along the northern ridge and eastern boundary, coniferous forests include mixed conifer groups and stands of individual species with elevational and moisture preferences. Incense-cedars (*Calocedrus decurrens*) mix with Coulter pine. These are joined by Jeffrey pine (*P. jeffreyi*), which then predominates at higher elevations, and Ponderosa pine (*P. ponderosa*). These are sometimes referred to as Yellow Pine forests. A tall, straight pine to 40 m (130 ft) in height, Jeffrey pine most resembles Ponderosa pine. They are distinguished by their cones; Jeffrey cones are larger and less prickly. Both grow at higher elevations than Coulter pine and have shorter needles. Jeffrey pine bark often has a strong scent of vanilla. In moist locations, sugar pine (*P. lambertiana*) and white fir (*Abies concolor*) are main conifers. The largest pine, sugar pine may exceed 50 m (160 ft) feet in height, with a straight unbranched trunk. Cones are extremely long but slender, and needles are in groups of five. Coulter, Jeffrey, and ponderosa pines have needles in threes. The southernmost extent of sugar pine is southern California. Its seeds, like those of

all local pines, were gathered for food. White fir is a very tall narrow tree that grows to 45 m (150 ft) and needs moist soil. True fir cones grow upwards at branch ends; Douglas-fir and pine cones hang down. Firs have short, stiff, upward curving needles distributed along horizontal branches instead of needles grouped in bundles like pines. Small sections of the northeast watershed have planted knobcone pine (*P. attenuata*). Close to the boundary with desert-influenced habitats, California juniper is present (Schoenherr 1992; CNPS 2000; CDFG 2006).

Birds fill diverse niches in mountain habitats. American Bald Eagle (*Haliaeetus leucocephalus*) winters in southern California and utilize many watershed habitats where food is abundant. Eagles tend to use large trees near water in coniferous forest but may also use chaparral or riparian habitat with oaks or sycamores (USFS 2005b). Small Flammulated Owl (*Otus flammeolus*) prefers pine-oak woods; Northern Pygmy Owl (*Glaucidium gnoma*) is restricted to Pacoima Canyon but found in all montane forests; Northern Saw-Whet Owl (*Aegolius acadicus*) is also small, and its range overlaps the other two in oak-conifer and coniferous forests. Only slightly larger, Western Screech Owl is an oak woodland species. Large, rare California spotted owl (*Strix occidentalis occidentalis*) occurs within Canyon live oak/bigcone Douglas-fir habitat and less abundantly in mixed conifer forest. It requires large-diameter trees and a complex multilayered canopy; it was noted that the apparent high quality of the oak-conifer habitat explains continued species persistence (Evens & Tait; USFS 2005b).

A breeding bird survey of the Upper Tujunga drainage indicated abundant higher-elevation birds were Acorn (*Melanerpes formicivorus*), Nuttall's (*Picoides nuttallii*), and White-headed (*P. albolarvatus gravirostris*) Woodpeckers, Steller's Jay (*Cyanositta stelleri*), Mountain Chickadee (*Parus gambeli*), White-breasted (*Sitta carolinensis*) and Pygmy Nuthatch (*S. pygmaea*), Western Bluebird (*Sialia mexicana*), Western Tanager (*Piranga ludoviciana*), Black-headed Grosbeak (*Pheucticus melanocephalus*), Dark-eyed Junco (*Junco hyemalis*), and Purple Finch (*Carpodacus purpureus*) (Garrett 1993b). Cassin's Vireo (*Vireo cassinii*), Loggerhead Shrike, Olive-sided flycatcher (*Contopus cooperi*), Golden- (Regulus satrapa) and Ruby-crowned kinglet (*R. calendula*), Hairy Woodpecker (*P. villosus*), Mountain Quail, and Band-tailed Pigeon (*Columba fasciata*), the California native pigeon, are common (Schoenherr 1992; Garrett 1993b; Evens & Tait 2005).

Most reptiles and amphibians are distributed across several habitats over a wide elevation range. California mountain kingsnake (*Lampropeltis zonata*) is an exception. Present only in montane terrestrial habitats - oak woodlands, and mixed hardwood-conifer and coniferous forests - it eats insects, birds, eggs, lizards, and small mammals, including shrews, mice, dusky-footed woodrats, and moles. Other mammals within montane habitats include bats, chipmunks, squirrels, raccoon but not ringtail, long-tailed weasel, gray fox, porcupine (*Erethizon dorsatum*), black bear, mountain lion, coyote, mule deer, and possibly bighorn sheep in the eastern watershed (USFS 1987; Schoenherr 1992; Stephenson & Calcarone 1999; USFS 2005b; CDFG 2006).

Historical Conditions

The Pre-historic Era

Like most of their features, present-day habitats of the Upper and the Lower Tujunga Watersheds are very different. Historic conditions were similarly distinct. Nonetheless, geologic and climatic conditions which preceded these were regional phenomena thus events can be described together through the Pleistocene "Ice Age" which ended roughly 10 Ka (geologic time scale, Table B-1). During glacial episodes, extensive ice sheets covered large sections of the northern hemisphere, which profoundly affected global, regional, and local climates. Glaciers were not a major feature of the San Gabriel Mountains, however, unlike the Sierra Nevada (Norris & Webb 1990; Schoenherr 1992). The study of pollen assemblages, palynology, is

often used to provide detailed information on past ecosystems because pollen grains for individual genera are highly distinctive; climate patterns are reconstructed using characteristic vegetation suites identified by pollen, cones, and other techniques (Davis 2001).

While the incipient Transverse Ranges rotated to their present alignment, before recent uplift, about 16-12 Ma, higher elevations of the southern California coastal region were dominated by mixed pine, oak and palm (*Palmae*) forests. Diverse woodlands clothed the rest of the landscape, including regions that are now deserts. Woodland species composition was apparently similar to present-day chaparral and oak woodland communities, and included toyon, sumac, chamise, California lilac, manzanita, and currant (Hickman 1993; Ornduff et al 2003). When intense uplift of local mountains began about 5 Ma with a shift to transpressional tectonic plate motion, inland areas became progressively drier as effects of Pacific storms were moderated by the changing topography. North-facing slopes and their adjacent valleys began to experience rain shadow effects of orographic precipitation, which became more evident as rapidly rising mountains captured more rainfall. North-south differentiation in interspersed woodland and scrubland plant communities developed based on new moisture patterns. This remains an essential feature of vegetation alliances found on mountain slopes today. The biota responds to gradual change by adaptation, which may result in speciation. Many locally abundant genera (e.g., *Pinus*, *Quercus*, *Ceanothus*, *Salvia*) adapted to different microclimates and developed new species. During this relatively cool time period, what we consider typical California vegetation zones were shifted southward and occurred at lower elevations; Sierran forests extended into the mountains of southern California (Schoenherr 1992; Hickman 1993).

By about 3 Ma, warm interglacial periods began to punctuate cool conditions; only then did our characteristic mediterranean climate develop. Climate shift in conjunction with the rapidly rising terrain created new landscapes. As glaciers retreated, scrub/shrubland ranges expanded both northward and upslope and chaparral vegetation became predominant; lower slopes developed coastal sage scrub alliances. Forests experienced a change in species composition as cold-intolerant palms retreated to desert locales and coniferous forests were restricted to cooler, moister high mountains; pines, firs, and other conifers were distributed based on moisture and temperature gradients over an extended elevational range of great topographic complexity. Oaks had a similar altitudinal zonation; they overlapped the lower-elevation conifers and extended to the foothills. California black oak, California scrub oak, and canyon and interior live oaks were each adapted to slightly different conditions. Widely-spaced coast live oak dominated woodlands and was interspersed in grasslands from the foothills through the valleys (Schoenherr 1992; Hickman 1993; Ornduff et al 2003; Schiffman 2005). Like north-south differentiation due to topography, climate-driven patterns initiated several millennia ago persist. Climate warming now would likely produce a similar habitat shift, forcing forest species to retreat upward. Especially if change were rapid, some conifers and associated wildlife might disappear entirely from the watershed because cool-climate high-elevation refugia would not exist.

As climatic shifts and a changing hydrologic regime due to tectonic uplift altered established river patterns, high-velocity streams within narrow, deep canyons became a feature of upper elevations. Riparian corridor vegetation also changed to resemble present-day landscapes. Like the vegetation communities of the expanded uplands, montane and foothill riparian species began to show altitudinal distributions because of the greater range of elevations to occupy. Some distributions were generic replacements: white alder was common at medium to high watershed elevations, but likely not present along lowest elevation riparian corridors where California sycamore was dominant. Speciation occurred: black cottonwood was found at higher elevations, while Fremont cottonwood grew at lower elevations. Willows (*Salix* spp.) are the classic example; they were as common then as they are now along watershed streams. Multiple distinct species and their interspecific hybrids overlapped in altitudinal bands: Pacific, arroyo, red and black willows were among several watershed willows; their ranges intergraded along highest to lowest elevation streams (Schoenherr 1992; Hickman 1993).

As flowing water transported increased sediments from rising mountains, greater alluvial deposition occurred at lower elevations. The gently sloping Tujunga Wash Alluvial Fan developed as major watershed streams exiting the mountains reached lower gradients and deposited generally unsorted boulders, cobbles, gravels, and sands at canyon mouths and across the Tujunga and San Fernando Valleys. Distinctive alluvial fan scrub vegetation developed where broad dry washes intermittently flooded and scoured the landscape; adapted to these specialized conditions, it combined plant associations from chaparral, coastal sage, and riparian communities. Riparian corridors and gallery forests adjacent to deeper, semi-permanent streams included fast-growing species which re-established rapidly as anastomosing stream courses occasionally shifted in response to the hydrologic regime. Flat lower valley locations farther away from streams were dominated by perennial grass savanna interspersed with oaks and pines; on clay soils found in the north lower watershed, prairie vegetation included vast fields of annual and perennial wildflowers and bulbs (Dunn et al 1921; Schoenherr 1992; Hickman 1993; Schiffman 2005).

The Historic Era

Although pollen analysis and dendrochronology (tree ring studies) are effective techniques to recreate past landscapes, “history” requires records. Early human inhabitants of the Tujunga Watershed, like those in the rest of the Los Angeles region, had an oral tradition of transmitting information, so human habitation preceded written documentation by possibly thousands of years. Indigenous people did establish organized villages and manipulated the environment to meet their needs, often through intentional fires set to encourage or discourage particular species, thus they did have a significant ecological impact. Acorns, seeds, bulbs, berries and other fruits were major food sources; however, they fully utilized local biodiversity for food, drink, medicine, shelter, basket materials, fiber, dyes, clothing, tools, snares and other weapons, toys, and other cultural requirements.

An inventory of natural resources used by early residents includes plants and animals from throughout the watershed. A partial list of commonly used plant materials includes various species of oak, willow, pine, cottonwood, manzanita, California lilac, sumac, and sage; white alder, California juniper, yucca, toyon, elderberry, prickly pear and other opuntia, poison oak, rushes, grasses, and numerous bulbs. Animals hunted for food, skins, and other purposes included birds and their eggs; various fishes; snakes, lizards, turtles, and frogs; larger insects, particularly grasshoppers, and insect larvae; mice and other small rodents, squirrels, hares, rabbits, mule deer, and pronghorn antelope (*Antilocapra americana*) (Balls 1963; DeWitt & Woodley 1975; Raven 1986; Schiffman 2005). The impact or ‘ecological footprint’ of these Americans was limited compared to what rapidly occurred after first European settlement. Upper and lower watersheds then began to be affected differently by human activity. A more natural environment would remain in the upper watershed in contrast to the severely fragmented and virtually non-existent remnant habitats of the lower watershed.

Historic Lower Tujunga Watershed

Earliest written descriptions of local landscapes were provided by the Spanish, in diaries and journals of soldiers and priests who established the chain of missions that would begin the transformation of California. A member of the Portola Expedition described the Los Angeles River just downstream from its confluence with the Tujunga Wash as a “beautiful river” within a valley “well grown with cottonwoods and alders”; nearby were California wild roses, grapevines, and willows. “Vast numbers of antelope” were seen, a fact corroborated by others, and it was noted that “in the mountain range running along on the north, there [were] a great many bears” (Crespí 1769 [2001]; Schiffman 2005).

The mountain range was the San Gabriel Mountains; the bears were grizzlies (*Ursus arctos horribilis*), memorialized on our State flag but extirpated in California [extinct in that portion of their range]. A skull from a grizzly killed at San Fernando Mission in 1875 is at the Smithsonian Institution. Just north of Sunland, a “huge cinnamon bear” was shot in Big Tujunga Canyon in 1916; she was the last grizzly known in southern California (Barkley 1993). Unlike the smaller woodland and forest-dwelling black bears now established in the watershed, which were relocated from the Sierra Nevada long after the grizzly was gone, grizzlies preferred broad, open lower watershed valleys for their abundant food sources, including mice, voles, ground squirrels, gophers, and various other rodents, insect grubs, roots and bulbs. Most were dug from the soil with their huge claws; this natural disturbance favored short-lived plant species that set seed or produced bulbs quickly to regenerate (Schiffman 2005). Fish and amphibians, some also now extirpated, provided additional food sources. Other lower watershed predators exploiting the region were coyote, bobcat, grey fox, mountain lion, badger, weasel, golden eagle, bald eagle, and numerous hawks, falcons, owls, and other birds of prey. California condors and turkey vultures were local scavengers (Schoenherr 1992; Barkley 1993; Garrett 1993a; USFS 2005b).

Braided and anastomosing stream channels are shifting entities; older Tujunga Wash stream courses across the alluvial fan are evident on maps (Figures B-2 & B-3; USGS 1902, 1911; USDA 1917). Riparian vegetation corridors immediately adjacent to deeper flowing water became established, were scoured and shifted in response to flooding, and re-established rapidly. The San Fernando Valley aquifer near the surface was continually recharged, and during droughts some water still flowed. The vegetation was likely similar to the associations on lower reaches of the three major upper watershed creeks today, with willows, sycamore, mulefat, and cottonwood predominant, and coast live oak woodlands upland from the streams. Southern California black walnut woodlands were present in the north and south lower watershed (Schoenherr 1992; Garrett 1993a; Rundel & Gustafson 2005; Schiffman 2005). Fresh water, fast-growing vegetation, and an abundance of insects, seeds, and forage adjacent to other habitat types made these valley riparian forests among the richest habitats for resident and migratory birds. Several hundreds of resident and migrant species would have been encountered amid multilayered thickets and trees, including riparian specialists (Grinnell & Miller 1944; Garrett & Dunn 1981; Garrett 1993b; Evens & Tait 2005; USFS 2005b).

All seven native Los Angeles Basin freshwater fish species were likely present in the Lower Tujunga Wash until 1940s flood control projects led to the extirpation of four of them in the Los Angeles River. The remaining three, Santa Ana sucker, arroyo chub and Santa Ana speckled dace, have special conservation status. Southern steelhead trout (*Oncorhynchus mykiss*) and Pacific lamprey (*Lampetra tridentata*) migrated from the ocean and ascended large streams with heavy rains in mid-winter, then returned to the sea one or two years later; both required similar habitats. Pacific brook lamprey (*Lampetra pacifica*), unarmored threespined stickleback (*Gasterosteus aculeatus williamsoni*), and arroyo chub were generally restricted to the Lower Tujunga Wash and the lower reaches of the three major creeks. Santa Ana sucker and Santa Ana speckled dace were found in the main channels and also in tributary mountain streams (Swift & Seigel 1993; Drill 2004). Native aquatic species composition, including in-stream vegetation and invertebrates was presumably consistent with what could be expected in southern California stream systems (Schoenherr 1992; Garrett 1993a).

Various amphibians and reptiles now either restricted to the upper watershed or extirpated were presumably abundant, including lizards, salamanders, snakes, mountain and foothill yellow-legged frogs, California red-legged frog, and the endangered arroyo toad, which specifically requires riparian habitats that are disturbed by flooding on a regular basis, like the natural Lower Tujunga Wash. Butterflies, moths, flies, and other riparian insect species were more numerous. Butterflies are among the best studied insects, and many formerly common butterflies have become rare or been extirpated; these include various hairstreak, checkerspot, blue, copper, sootywing, and admiral species (Mattoni 1990; Garrett 1993a; Hogue 1993;

Stephenson & Calcarone 1999; USFS 2005b).

Present-day surveys have recorded nearly three hundred bird species at Hansen Dam, including riparian-obligate species, diverse passerine migrants, waterbirds, waterfowl, and some shorebirds. Historic species richness and abundance within the lower watershed apparently was much higher. Numerous common resident, wintering and breeding birds are now scarce or absent (Garrett 1993b).

Small portions of the alluvial fan, particularly near confluences of major creeks (e.g., near what is now Hansen Dam) were wetland floodplain forest and freshwater marsh of willow and cottonwood with a dense understory of California wild roses, wild grapes, blackberries and other vines. Most of the upper fan resembled remnant areas that persist along Big Tujunga Wash, with the distinctive Riversidian alluvial fan sage scrub or riparian coastal scrub vegetation association that also occurred on alluvial fans and in washes along the entire south face of the San Gabriel Mountains. Boulders, cobbles, and gravels that intermittently flooded supported a mixture of chaparral, coastal sage scrub, evergreen shrubs and annuals. Historic plant species composition was probably very similar to the remaining habitat nearly eliminated by effects of urbanization and flood control measures, and included scalebroom, white sage, mulefat, mugwort, yucca, California buckwheat, California juniper, cholla and spineflowers (Hanes et al 1989; Garrett 1993a; Hegelson 1993; Myers 1995; Woods 2000).

“Upland” habitat, as defined, did not exist in much of the Lower Tujunga Watershed. Most historic vegetation would be considered riparian, including dominant alluvial fan sage scrub, riparian corridors postulated to have existed on the more permanent braided channels, and the freshwater marsh and floodplain forest at major stream confluences (Garrett 1993a). A small section of prairie grassland with bulbs and wildflowers existed in the upper section of the lower watershed (Schiffman 2005); prairie vernal pools that supported endangered California orcutt grass (*Orcuttia californica*) and ephemeral flowers may have existed. Small California black walnut woodlands were present, both in Big Tujunga Wash and nearer the confluence of the Lower Tujunga Wash with the Los Angeles River.

Coastal sage scrub covered dry, rocky slopes above the valleys, below the elevation of chaparral zones. Several sage scrub alliances were prevalent on the low south-facing slopes of the San Gabriel Mountains, and in the Verdugo Mountains. This vegetation community likely extended onto the alluvial fan and intergraded with allied alluvial fan sage scrub. Dominant plants were drought-deciduous, soft-leaved plants that included California sagebrush, black sage, California buckwheat, and coyote brush. Formerly extensive in coastal southern California, this plant association is also one of the most endangered in the U.S.; urbanization has eradicated coastal sage throughout its range. Roughly 10% of its historic extent remains (Mattoni 1990; Schoenherr 1992; Stein et al 2000; Ornduff et al 2003).

Once San Fernando Mission was established, livestock grazing was the dominant agricultural activity, and prairies and grasslands were transformed. Crops were planted regularly and were grown in the San Fernando and Tujunga Valleys after mission influence faded. To facilitate expanding agriculture and cattle to supply Gold Rush markets, and then to accommodate new southern California settlers, remaining marshes were drained and riparian corridors disappeared. The impact of a hundred years of grazing by unfenced cattle and sheep irreparably decimated the landscape. Drought year grazing was very destructive. Further alterations accompanied the railroad, which continually replaced bridges swept away by Tujunga Wash (Reagan 1915; Lynch 1931; Gumprecht 1999; Schiffman 2005).

A “massive biological invasion” (Schiffman 2005) occurred when plants introduced to the region added a new dimension to the disturbance caused by European settlement and livestock. Although different species, most invasives were from the Mediterranean region, thus were pre-adapted to our climate. Yellow

mustards (*Brassica nigra*) were conspicuous non-natives that arrived with the missions; travelers noted mustard 'forests' in 1827-28 (Gumprecht 1999). Probably the worst exotics were annual grasses brought for feed, including barley (*Hordeum murinum*), several bromes (*Bromus madritensis*; *B. diandrus*; *B. hordeaceus*) and wild oats (*Avena barbata*; *A. fatua*). Facilitated by grazing, and certainly adapted to it, they have overtaken woodlands and eradicated native perennial grasses (Schoenherr 1992; Schiffman 2005). Invasions continue; exotics are an extreme threat (Garrett 1993a; Stein et al 2000; DiTomaso & Healy 2003; USFS 2005d; Cal-IPC 2006).

The concept of natural variability of lower watershed habitat is supported by interviews with long-time residents after 1914 Los Angeles floods and photographs from many sources, including one entitled "Rabbit-hunting in Tujunga." Mr. Wilson, from San Fernando, indicated the Los Angeles River was "practically in the same place as at present [1914]," but Tujunga Wash joined it downstream at a different location when he first saw it in 1871. San Fernando and Pacoima Creeks flowed in the same place but Pacoima Creek was about one-third its width. "Tujunga Wash country" was "covered with juniper and elders and some oak trees. The Juniper [were] big clumps, and some 30 or 40 feet high, and the trees and brush [ran] down to about where the good roads are between Burbank and Lankershim, and there were few washes in that section; what there were were narrow and deep; there were no great wide stretches. Over on the Pacoima side [...] it was a large cacti patch." He noted flood magnitudes (1884 was the "big flood"); the amount of sand and gravel (about 30%) carried by flood-stage streams; and the response of channels: "big washes [...] only carry water in very heavy floods" (Reagan, 1915; for local flood history, see van Wormer 1971; Gumprecht 1999; Orsi 2004).

Historic Upper Tujunga Watershed

The majority of the upper watershed is on the Angeles National Forest and under US Forest Service jurisdiction. Multiple-use National Forests plans are updated regularly; a new Land Use Plan for the Angeles was recently issued after extensive public comment (USFS 2005d, 2005e; ANF 2006). Angeles National Forest has a long, distinguished conservation history, and was first set aside in 1892 as San Gabriel Timberland Reserve prior to establishment of the Forest Service. This action was intended primarily to protect the watershed. It was the first forest set aside in California, and the second in the U.S., after Yellowstone, to receive federal protection (Lockmann 1981).

The entire watershed was included in regional surveys completed by the U.S. Army. Corps of Engineers Geographical Surveys West of the 100th Meridian; expeditions were in 1871, 1875-76 and 1878. Detailed early surveys indicate historic vegetation conditions in the upper watershed were similar in most respects to present-day conditions. A land-use classification map delineates few "open coniferous forests" and significant amounts of "brush" or "scrub" (chaparral) in the rest of the mountainous regions. "Grazing land" is at low elevations. The "Gulch of Tejungo Creek" runs along the eastern "San Fernando Plains," which are indicated "agricultural land with irrigation" (Wheeler 1881). Surveys of water resources were made at about the same time to plan for irrigation (Hall 1888).

Judicious conservation measures, unusually rough terrain, and impenetrable vegetation contributed to the protection of the upper watershed. Like the forest, it was mainly dense chaparral. John Muir, who preferred "true" Sierra forests, visited in 1877 and noted that chaparral "slopes are exceptionally steep and insecure to the foot [...] covered with horny bushes" (1898). A description equally valid today, Muir's assessment was echoed by a soil scientist working years later: "the mountains are rough and broken, the most rugged mountainous section in southern California [...] slopes are extremely steep and very stony, [with] many sharp ridges and bare granite peaks, with intervening V-shaped canyons [that] contrast strongly with [...] the highly developed agricultural valley region" (Dunn et al 1921).

Chaparral remains thorny and virtually impassable; California lilacs are still the thorniest shrubs. Numerous wild lilac and manzanita species, plus chamise, scrub oaks, and mountain-mahogany, sometimes one species alone, or in mixtures or alliances of several species, are the major chaparral components today. The hundreds of other plant species that may occur in this vegetation type now existed there historically. The 1921 soil survey described mountains "covered with brush"; specific observations included ceanothus, chamisal (chamise), manzanita, and scrub oak; with pines, cedar, and bigcone spruce at higher elevations (Dunn et al).

Historic habitat conditions in the chaparral, by far the predominant watershed vegetation community, would seem to have been almost identical to present-day conditions. Nevertheless, they were not. Chaparral requires regular fire for renewal. Fires naturally burn at varying intensities related to numerous physical and biological factors, including slope, humidity, and plant moisture levels, but also to the age of the stand and the amount of fuel or dead brush built up. Historic fires would have burned this way, killing some plants in some areas entirely, but not others. A natural mosaic of vegetation patches of similarly aged plants developed through varying fire intensity and because fires affect different areas with varying frequency. When killed to the ground, chaparral shrubs regenerated by resprouting or by germination of long-lived seeds. Seeds germinated triggered by the heat of the fire and by the ash. While original species reestablished, fire-following annual flowers and then short-lived shrubs and subshrubs dominated for a few years.

Interruption of the natural fire regime through fire suppression has destroyed the age-cohort mosaic. Now, when an inevitable high-intensity fire burns through, fueled by excess brush, it kills a large region to the ground. Moisture-resistant soil layers may also develop. The altered fire regime may be the only reason why upper watershed chaparral is not identical to historic vegetation (Stephenson & Calcarone 1999; Ornduff et al 2003; Rundel & Gustafson 2005; USFS 2005d; CNPS 2006).

As compared to the lower watershed riparian corridors or gallery forests, now non-existent, larger yet less-accessible upper watershed streams such as Alder, Upper Big Tujunga and Upper Pacoima Creeks resemble their historic state, and frequently appear to be some of the watershed ecosystems least disturbed by recent human impact. Smaller tributaries, although certainly not untouched, may look much as they did two hundred years ago, partially because aquatic systems are dynamic and riparian vegetation is fast growing. Riparian habitats extend through foothill and mountain canyons adjacent to the aquatic habitat within streams. The vegetation alliances vary with altitude, stream slope and distance into the mountains; however, tree species associations historically prominent remain so: alder-willow at higher elevations, and sycamore-cottonwood-willow along lower-elevation creeks. Mulefat, mugwort, and various understory vines were present at most elevations.

Faunal species richness and abundance were likely higher than at present in historic montane riparian habitat, because it was less disturbed. Most fauna present in a region are attracted by the plant or animal food sources within riparian corridors and also by the edges or ecotones formed by adjacent vegetation types. Almost any animal encountered in the watershed could have potentially been found here, including bighorn sheep, bobcat, western spotted skunk, striped skunk, ringtail, raccoon, long-tailed weasel, porcupine, bats, plus almost all other mammals previously mentioned, including mountain lion and gray fox, other than the grizzly bear, black-tailed hare, and small rodents which preferred open coastal sage or grassland habitats (USFS 1987; Mayer & Laudenslayer 1988; Faber et al 1989; Schoenherr 1992; Stephenson & Calcarone 1999; Holl 2004; CDFG 2006).

Historic invertebrate distribution is not well-documented. It is inferred that butterflies, dragonflies, and other insects were probably more abundant in upper watershed habitats, and some species may now be

extirpated or extinct. It is likely that because most resources are extant (e.g., plant species, aquatic or riparian habitat), species persistence rates are higher for upper watershed habitats than for low-elevation insects dependent upon almost-eradicated sage scrub (Mattoni 1990; Hogue 1993).

Very large numbers of bird species were associated with riparian habitat because of the complex vegetation structure and plentiful resources. Although birds are extremely adaptable, it is assumed that declining population trends noted for lower watershed birds apply, to a lesser extent, to those in the upper watershed. Nest predation by Brown-headed Cowbird over the past century in all riparian habitats was facilitated as land cleared for agriculture became cowbird habitat. Historical records exist for the lower watershed and Los Angeles River drainage; few exist for any upper watershed locations. It is likely that where habitat is least-disturbed, conditions more approximate the historic environment. A recent breeding bird survey in the Upper Tujunga Watershed along Big Tujunga Creek and its tributary streams gave an idea of the potential for very high historical avian species richness within the montane riparian corridor, adjacent chaparral and mixed coniferous forest (Grinnell & Miller 1944; Garrett & Dunn 1981; Garrett 1993b; Stephenson & Calcarone 1999; Evens & Tait 2005; Dowd [n.d.]).

Historic aquatic habitats in the upper watershed are inferred to have been relatively undisturbed, but conditions for native taxa are likely to have declined as new types of human disturbance became prevalent, beginning with 19th century livestock grazing in accessible, low-gradient streams. Habitat and water quality were degraded by mining along Big and Little Tujunga Creeks and their tributaries, including Gold and Mill Creeks, and on Upper Pacoima Creek. Recreational activity, the effects of flood control projects, including water releases from dams, and intentional or unintended introduction of exotic species starting in the early 20th century also altered habitat. Algae, bacteria, and microscopic benthic arthropods were the majority of stream inhabitants; amphipods and isopods were crustacean members of stream-bottom habitats. Invertebrates likely had high species richness but are not well studied; historic extinctions of freshwater crayfish occurred nearby and may have occurred here with minor declines in water quality. These smaller organisms, along with insect larvae, were food sources for fish and amphibians; it is likely they were more abundant (Laurel & Woodley 1975; Hogue 1993). Native upper watershed freshwater fish included Santa Ana sucker and Santa Ana speckled dace, found in main stream channels and also in tributary mountain streams (Swift & Seigel 1993; Drill 2004). Both were adversely affected by habitat degradation and impacted by the presence of introduced species (Garrett 1993a; Stephenson & Calcarone 1999; Drill 2004; USFWS 2005a).

The number of TES amphibian and reptile species today that need aquatic habitat is high. Foothill yellow-legged frogs (*Rana boylei*) were extirpated; and two other frogs, California red-legged frog and mountain yellow-legged frog, are threatened and endangered, respectively. Arroyo toad and southwestern pond turtle require aquatic, riparian and upland habitats during various parts of their life cycles, thus the species have been negatively impacted by all types of human activity. The population declines of these species support the presumption that historic habitat quality was higher for all aquatic species (Stephenson & Calcarone 1999; USFWS 2005b).

Above the wide chaparral zone, mixed hardwood-conifer forests and more-widely-spaced woodlands with similar species associations occurred on upper canyon slopes, typically north-facing, and also in narrow shaded canyons. Tree species included canyon and interior live oaks interspersed with small stands of big-cone Douglas-fir. Black oak was present in some areas. These habitats have remained fairly inaccessible thus they are relatively undisturbed. We can infer that historic habitats were probably similar to present-day conditions (Schoenherr 1992; Garrett 1993a; CDFG 2006).

A mixed conifer habitat on drier slopes was dominated by Coulter pine, with Bigcone Douglas-fir, incense-

cedar and some canyon live oaks present in various associations. These forests were also primarily on very steep slopes and fairly inaccessible, so historic and present-day forests were likely similar. At high elevations along the northeastern perimeter, coniferous forests included variable mixed conifer groups as well as large stands of individual species. Jeffrey pine predominated, with Ponderosa pine, sugar pine and white fir (Schoenherr 1992). This section of watershed forest was historically much more pristine than it is today, because the region is along main forest roads and continues to be heavily used (Garrett 1993a; USFS 2005d).

Conclusions

The Upper and Lower Tujunga Watersheds are naturally interconnected yet dissimilar environments. Our goal of restoring functionality to the watershed thus means addressing needs of the comparatively natural upper watershed as well as the densely settled, urbanized lower watershed. The lower watershed is an entirely different place than it was historically. Nevertheless, because we have the ability to identify old stream courses and infer species composition of historical ecosystems, the opportunities for successful natural restoration of lower watershed habitats are greatly enhanced. The alluvial fan and its highly permeable soil are still there, able to capture stormwater and recharge the aquifer; we now have ecologically and technologically superior methods to ensure public safety.

The grizzly bear, a keystone species, will never return, nor will pronghorn antelope. Anadromous fish such as southern steelhead would need considerable accommodations made to be able to ascend the Los Angeles River from the sea and enter Tujunga Wash, but many other faunal and floral components of the historic lower watershed can be reestablished, given access to suitable habitat. Habitat for wildlife along riparian corridors connecting the mountains and the washes can be integrated with multiple-use parkland for people. Permanent protection as undevelopable open space is warranted where any remnant functional habitat remains, such as the alluvial fan sage scrub and coastal sage scrub along Big Tujunga Wash and other areas above Hansen Dam, and any riparian corridors, which also provide crucial connectivity for the rest of the watershed.

In the upper watershed many aspects of upland, riparian, and aquatic habitats are very different from historic conditions. Nevertheless, with exception of the major impact of human alteration of natural fire ecology, habitat conditions within the chaparral vegetation, which is the overwhelmingly predominant plant association; the mixed hardwood-conifer forests and woodlands; and the riparian corridors of the uppermost watershed are relatively high-quality, and remarkably similar to habitat which existed before European settlement of California. Aquatic habitat is less intact and many native species are imperiled or extirpated. Introduction of exotic species, and overuse of some regions have produced additional impacts upon the upper watershed habitat and these conditions are being addressed.

Recommendations

Watershed protection was the primary rationale for Forest conservation in 1892. Sustained protection of existing resources is crucial. To maintain existing conditions, protect sensitive species, and make future restoration projects in the upper watershed successful where feasible, strong support for and involvement with local and regional Forest Service conservation and planning efforts should continue.

The most extreme departure from historic conditions has been alteration of natural fire regimes, which would normally result in natural regeneration and a mosaic of habitat patches of varying ages. Our ecosystems are dynamic; in particular, chaparral requires periodic burning to ensure the health of the ecosystem. Chaparral communities are critical for managing watershed health and riparian habitats (Stephenson & Calcarone

1999; USFS 2005a). Coniferous and mixed hardwood-conifer forests have also suffered; lack of periodic small fires has allowed the forest to become thick with undergrowth. Crowded stands of trees make it more difficult for the forest to withstand stressors such as drought, insect infestations, and ozone damage. The eventual build-up of fuel guarantees that when the forest does burn, it becomes a conflagration. Intense fires can remove the vegetation from entire subwatersheds. This further impacts systems, as sediment from barren slopes becomes debris flows that fill streams. Recent plans address these issues (USFS 2005e; ANF 2006) and should be implemented and supported, ensuring the public understands why these actions are necessary.

Although mountain slopes are still steep and thorny, they are no longer entirely “rigidly inaccessible” (Muir 1898). Major and minor paved roads cross the upper watershed, and forest roads and trails (Robinson & Christiansen 2005) add to the network. Another of Muir’s remarks is the prime reason why things have changed: over a century ago, he referred to these forests as the “best appreciated” in the West; in 2005, Angeles National Forest was the most heavily used U.S. National Forest. Given its location next to metropolitan Los Angeles, where it is the ‘backyard’ for 20 million people (USFS 2005d; ANF 2006), it is unsurprising that forest use by human visitors and encroachment by settlement has led to numerous forms of disturbance which have affected habitat quality.

Trash regularly left by visitors from local communities negatively affects water quality in riparian corridors and seriously degrades habitat overall. This is a major issue throughout Upper Tujunga Watershed, but is especially apparent along major roads, including Angeles Crest Highway; at Chilao Flat; at several Mill Creek sites along Angeles Forest Highway; and along Lower Big Tujunga. This is a complex issue that requires encouraging wise stewardship while teaching diverse forest users about their responsibilities. Education of people in the watershed about the natural treasures of their environment is critical here. This is not necessarily a problem that should be solved by an understaffed Forest Service. Educating kids is an effective approach, but it’s never too late to learn.

Habitat for species of concern should generally be off-limits, whether it is officially designated critical habitat or not. Naturally, this is difficult in such a heavily used environment. Nevertheless, methods to encourage users to seek a spot elsewhere for recreational use, such as parking restrictions in place along Upper Big Tujunga seem effective and should be expanded if conditions merit this approach. Issues related to the needs of the adjacent Los Angeles metropolitan area and its requirements for dams, flood protection, and other infrastructure may impact the survival of species and habitats. Alternatives to established or planned procedures may need to be carefully considered; mitigation for loss of irreplaceable habitat may not be an acceptable option.

Big Tujunga Creek was identified as an area of high ecological significance by USFS in 1999 (Stephenson & Calcarone). Authors noted “important riparian and aquatic habitat both upstream and downstream of the reservoir” and cited the persistence of arroyo chub, Santa Ana sucker, pond turtle, and arroyo toad, even though the close proximity to the reservoir increased the impact of non-native aquatic species; the dam releases were “variable and sometimes extreme”; and recreation use had resulted in habitat degradation. In the recent ANF Plan (USFS 2005d), problems within “Big Tujunga Canyon Place” and solutions were discussed in detail; desired conditions included “habitat conditions for threatened, endangered, proposed, candidate, and sensitive species are improving over time”. Since 1999, gradual use-restrictions on Upper Big Tujunga were implemented, and other measures were likely taken. Given the importance of this locale, if quantitative assessment or monitoring is being done to evaluate ongoing habitat improvement, it would be useful for the TWP to view that data.

Critical habitat designation under the Endangered Species Act exists in the watershed only for the Santa

Ana sucker, not for other TES species (table 1). USFWS (2005) has repeatedly noted that “the Service has found that the designation of statutory critical habitat provides little additional protection to most listed species, while consuming significant amounts of available conservation resources. The Service’s present system for designating critical habitat has evolved since its original statutory prescription into a process that provides little real conservation benefit, is driven by litigation and the courts rather than biology, limits our ability to fully evaluate the science involved, consumes enormous agency resources, and imposes huge social and economic costs. The Service believes that additional agency discretion would allow our focus to return to those actions that provide the greatest benefit to the species most in need of protection.” For TES species protection, perhaps this should be implemented. Several years of litigation over arroyo toad critical habitat designation in parts of Big Tujunga, Mill and Alder Creeks led to exclusion of all essential lands for economic reasons.

Exotic species began their assault years ago. Invasive annual grasses (e.g. brome, wild oats) from livestock grazing days ascended hillsides followed by ornamentals and weeds from Los Angeles County. Profusely reseeding perennial ornamental grasses (e.g., *Cordateria* spp.; *Pennisetum* spp.) may prove just as bad as the grass imported to feed cattle. World-class endemic wildflowers (Allen et al 1995) must compete with exotic mustards and brooms (*Cytisus*; *Genista*; *Spartium* spp.), and star-thistle (*Centaurea* spp.) is encroaching (Cal-IPC 2006). Eradication efforts and targeted education for individuals who plant noxious weeds or other potential escapees as ornamentals should continue (Osborn et al 2002). Native plant landscaping alternatives should be encouraged by all methods: e.g., websites, partnerships with CNPS, nurseries, botanical gardens, and other willing organizations, school and demonstration gardens, and tours of successful projects. Impact of exotic species is second only to habitat loss and degradation as a cause for biodiversity loss (Stein et al 2000).

In riparian corridors, giant reed (*Arundo donax*) threatens lower-elevation streams in the watershed (Cal-IPC 2006). Eradication efforts take time and caution (Neill 2002). Intentionally planted in southern California for erosion control on banks and for windbreaks in the late 18th and early 19th centuries, now it displaces native vegetation and diminishes wildlife habitat – and it is adapted to fire. A full-blown tamarisk (*Tamarix* spp.) invasion is not far off; it is prevalent in the Santa Clara watershed to the north and has several nasty habits which give it an advantage. Unlike willows and cottonwoods which compete with it, tamarisk draws water from saturated and unsaturated soils; seriously reduces underground water; and extracts salts from the soil, which it excretes in its leaves, which drop and increase the surface soil salinity, which inhibits the growth of desirable vegetation (DiTomaso & Healy 2003). Reconnaissance of extent, thorough eradication, and follow up procedures are needed.

The remnant alluvial fan sage scrub ecosystem of Big Tujunga Wash is unique, highly endangered and about the last of its kind (Woods, 2000). Governmental acknowledgements of its significance and public outcry have failed to protect this ecosystem. Restoration would be ideal; further development is unacceptable to maintain this habitat. Due to the dynamic nature of the Wash ecosystem, periodic natural disturbance from flooding is required to regenerate the ecosystem.

Although found throughout coastal southern California, unlike alluvial fan sage scrub, coastal sage scrub is also an important habitat that is highly threatened; 95% has been eradicated. In the watershed, it is restricted to south-facing slopes above the Tujunga and San Fernando Valleys. Furthermore, all watershed riparian associations listed by the CNDDB (2006; see table F-3) are special – and unprotected.

Habitat connectivity is crucial to maintain viable wildlife populations; linkages should be maintained or restored across areas of remaining open space (Martino et al 2005). Potential open space should be acquired whenever possible and stringently protected. In-holdings on Angeles National Forest that may

become available for sale present prime opportunities to protect additional watershed land.

Important natural wildlife corridors between the San Gabriel and Verdugo Mountains naturally cross Big Tujunga Wash. The wash itself is critically important habitat, and is the connection to remnant freshwater marsh/floodplain forest habitat in Hansen Dam Basin. Hansen Dam is renowned for avian biodiversity, and can provide linkages to restored wetlands and water recharge projects in spreading grounds. These can be the major links to riparian corridors with gallery forest buffer zones through neighborhoods along the length of the Washes, following historical and present-day stream channels.

Restored streams with erosion control using fast-growing native riparian species (e.g., willows) along re-graded bioengineered banks will provide for public safety during natural flood events while facilitating a functional hydrologic system that allows for natural recharge of the underground aquifer and thus less dependence on imported water.

As compared to the upper watershed, it may not be easy for some to envision what historic conditions were like or to plan a valid habitat restoration in a totally urbanized environment. Providing connectivity for humans is perhaps the best method to encourage conservation and stewardship. It is a conservationist's saying that people love what they know and protect what they love. Habitat connectivity from the Angeles National Forest through the Tujunga and Pacoima Washes through the urbanized Lower Watershed provides a multitude of neighborhood-specific opportunities for human use of the natural system.

It is critical to continually educate watershed residents and other stakeholders about the special nature of this environment and its significance as a sustainable habitat for plants, wildlife, and people, and encourage their participation in outreach and habitat restoration projects. Ideally, K-12 schools in the watershed will permanently incorporate the TWP watershed-specific grade-level curricula into their educational programs, and community colleges will continue to encourage students to pursue local site-specific watershed-based science that is relevant to them and to their community.

Land Use & Open Space

Introduction

The Tujunga Watershed exhibits a dichotomous character, with approximately one-quarter of the land being a highly developed urban grid while a majority of the land remains natural undeveloped open space. The watershed, similar to the rest of the City of Los Angeles, suffers from insufficient public open space in the poorest and most developed areas, yet is adjacent to the Angeles National Forest. Although the Tujunga Watershed has been compromised by some planning decisions, opportunities exist to this day for the betterment of the land, natural systems, and public health.

Findings

During the latter half of the 19th century, land-use in the Tujunga Watershed was characterized by few “open coniferous forests” and significant amounts of chaparral (i.e. brush, scrub) throughout the upper watershed. Lower elevations within the San Fernando Valley, or what was then deemed the “San Fernando Plains”, were designated for ranching (grazing) and agricultural purposes (orchards and vineyards) (Wheeler 1881). Populations spiked as additional settlers were drawn to the region as a result of small mining ventures designed to capitalize on a minor gold rush in Little Tujunga, Big Tujunga, Gold Creek, Alder Creek, and Mill Creek (Robinson 1991). Prior to the establishment of the U.S. Forest Service in 1905, the land now covering the Angeles National Forest received federal protection in 1892 as the San Gabriel Timberland Reserve as a primary step to protect the water supply (Lockmann 1981).

Today, the upper watershed is still predominantly composed of undeveloped land (~80%), primarily due to the presence of the Angeles National Forest (which covers approximately three-fourths of the watershed). The lower, urbanized¹ portion of the watershed is dominated by residential use, although there still is a sizeable percentage of vacant land just below the Forest jurisdiction (within the unincorporated portions of Los County and along the City of Los Angeles’ northern fringe). While there are pockets of high-density residences located in the neighborhoods of Panorama City and Valley Village as well as areas along the 210 freeway corridor in Sylmar, most residential areas within the watershed are currently occupied by single-family homes (Tables G-1 through G-4).

Industrial uses, including manufacturing, warehousing, and mining, comprise 5% of the lower watershed and cluster within three regions: (a) along the San Fernando Road corridor (through Pacoima, San Fernando, Sylmar, and Sun Valley), (b) adjacent to Pacoima Wash starting from San Fernando Road on northward to the 210 freeway, (c) and lastly, along the Union Pacific Railroad corridor (between Panorama City and Van Nuys). Commercial use in the watershed encompasses large retail shopping centers (including the Panorama Mall in Panorama City) and major strip mall developments along main thoroughfares (Figure G-1).

There is mounting concern among many of the foothill equestrian communities that single-family residences located in Sylmar, Lake View Terrace, Sunland, and Tujunga are being bought up by developers and transformed into high-density housing. This concept of “infilling” not only puts further strain on infrastructure and public facilities, but horse riders lose valuable open space to store horses and have access to the mountains. Approximately 1200 new homes are in the planning or construction phases in the Sylmar area alone as well as 450 new condos along Foothill Blvd in the same vicinity (Covarrubias, 2006). In addition, some of the last remaining undeveloped hillsides are facing the threat of development. One prime example

(1) The upper portion of the watershed is geographically designated as the region within the Angeles National Forest boundary. The lower watershed is designated by all areas below the Angeles National Forest jurisdiction.

includes the Canyon Hills Project just south of the watershed in Tujunga. 221 luxury homes are slated to be built on approximately 280 acres of existing animal habitat in the Verdugo Mountains.

Table G-1. Existing Land Use for the Entire Watershed

Land Use	Acreage	Sq Mi	Percent
Multi-Family Residential	1921.45	3.00	1.34
Mixed Residential	392.73	0.61	0.27
Single-Family Residential	15988.07	24.98	11.12
Commercial and Service	3283.87	5.13	2.28
Industrial	1736.15	2.71	1.21
Communication and Utilities	1476.25	2.31	1.03
Transportation	1270.63	1.99	0.88
Hydrology	1629.05	2.55	1.13
Agriculture	567.27	0.89	0.39
Vacant	113776.94	177.78	79.11
Open Space & Recreation	1551.26	2.42	1.08
Other	228.40	0.36	0.16
Total	143822.08	224.72	100.00

Table G-2. Existing Land Use for the Lower (urbanized) Watershed

Land Use	Acreage	Sq Mi	Percent
Multi-Family Residential	1921.45	3.00	5.24
Mixed Residential	392.73	0.61	1.07
Single-Family Residential	15746.02	24.60	42.93
Commercial and Service	3176.18	4.96	8.66
Industrial	1736.15	2.71	4.73
Communication and Utilities	475.17	0.74	1.30
Transportation	1265.63	1.98	3.45
Hydrology	1528.62	2.39	4.17
Agriculture	546.56	0.85	1.49
Vacant	8669.30	13.55	23.63
Open Space & Recreation	994.12	1.55	2.71
Other	228.40	0.36	0.62
Total	36680.33	57.31	100.00

Table G-3. Existing Open Space for the Entire Watershed

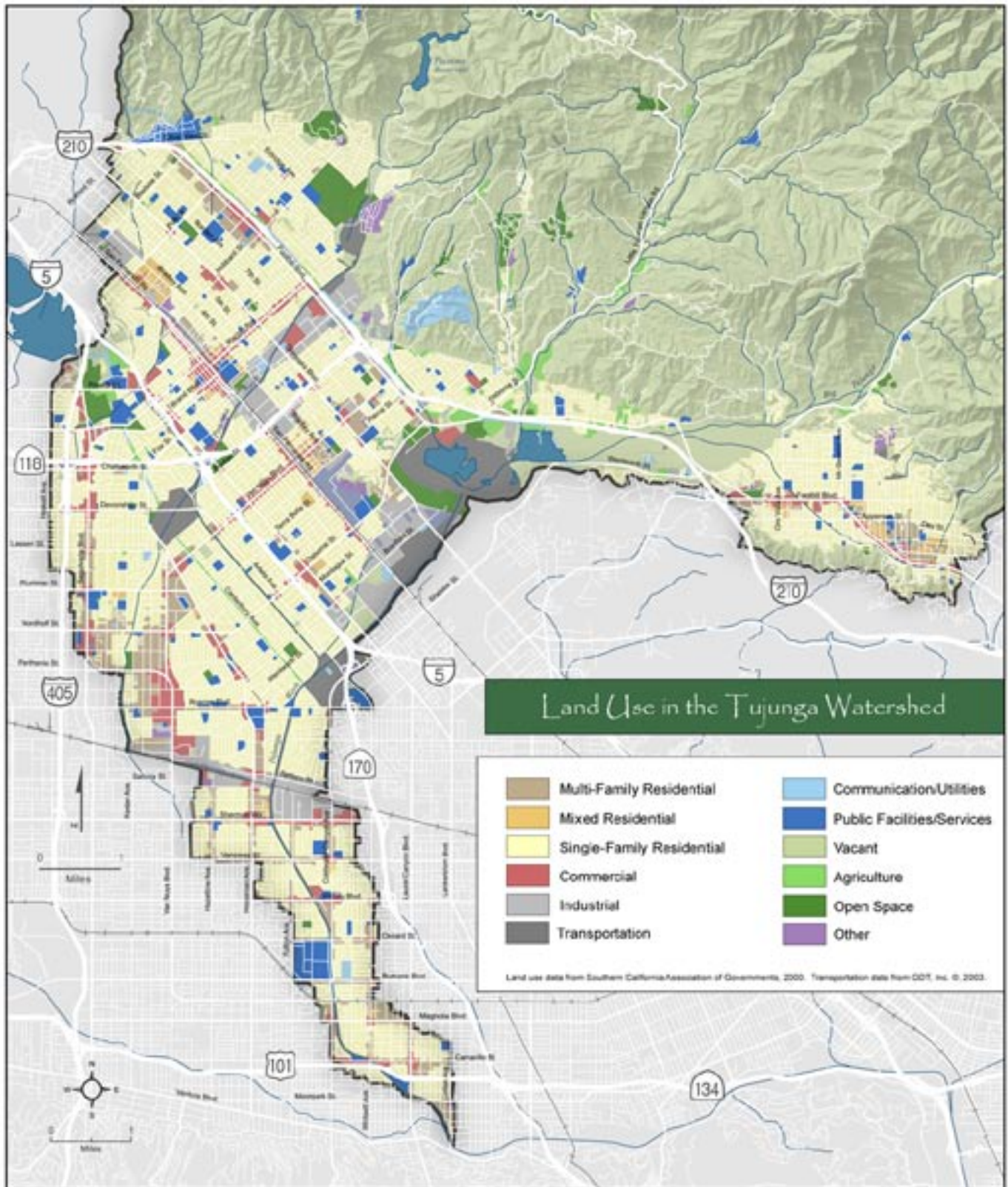
Land Use	Acreage	Sq Mi	Percent
Schools (K-12)	770.33	1.20	0.54
College and Universities	145.28	0.23	0.10
Parks and Recreation	801.00	1.25	0.56
Golf Courses	210.83	0.33	0.15
Cemeteries	194.20	0.30	0.14
Other Open Space & Recreation	585.22	0.91	0.41
Vacant	113776.94	177.78	79.11
Total	116483.80	182.01	80.99

Table G-4. Existing Open Space for the Lower (urbanized) Watershed

Land Use	Acreage	Sq Mi	Percent
Schools (K-12)	768.17	1.20	2.09
College and Universities	145.13	0.23	0.40
Parks and Recreation	800.77	1.25	2.18
Golf Courses	210.83	0.33	0.57
Cemeteries	193.43	0.30	0.53
Other Open Space & Recreation	29.09	0.05	0.08
Vacant	8669.30	13.55	23.63
Total	10816.72	16.90	29.49

Tables based upon 2000 SCAG data

Figure G-1. Land Use in the Tujunga Watershed



Recreational users also play a significant role in the management of existing and planned public open space. Active recreational uses include biking, tennis, soccer, equestrian, golf, paint ball, archery, and ORVs (motorbikes and 4-wheel ATVs), to name a few. Passive recreational uses include hiking, picnicking, birdwatching, and camping. Due to the dearth of public open space in Los Angeles, it is common for recreational users to compete for space. Parks and open space need to include innovative multi-benefit solutions to meet user demands while protecting and preserving existing habitat.

Parks

The Angeles National Forest occupies 167.5 mi² of the 224.7 mi² watershed. The National Forest Land Management Plan was recently revised and approved in September 2005. This plan, which dictates management direction and long term program objectives for the Forest, is revised every 10-15 years. Land use zones discussed in the plan are similar to zoning concepts used in local municipalities. The Forest's designated zone assignments accommodate for slight growth in recreation and facilities in upcoming years while protecting against fire risks, managing threatened and endangered species, and maintaining a healthy forest (USDA 2005). Five of the Forest's eight land use categories fall within the Tujunga Wash watershed. These zones (and their definitions) include:

- Back Country – areas managed for motorized public access and recreation use on designated National Forest System roads and trails. BC designated zones within the watershed include areas surrounding the 2 State Hwy, Angeles Forest Hwy, Big Tujunga Canyon Rd, Little Tujunga Canyon Rd, Pacoima Canyon Road, Santa Clara Road, and Mendenhall Ridge Road. Approximately 32% of the Forest within the watershed is categorized as BC.
- Back Country, Non-Motorized – areas managed for non-motorized public access and recreation use. BCNM represents the most remote and uninhabited areas of the watershed. Approximately 47% of the Forest within the watershed is categorized as BCNM.
- Back Country, Motorized Use Restricted – areas where administrative access is permitted on designated National Forest System routes (roads and trails). Otherwise, these areas are managed for non-motorized public access the same as BCNM. These areas provide administrative access to allow for maintenance and treatment (fuel reduction, high-line repairs, etc.). Within the watershed, this includes a transmission corridor (and an associated maintenance road) that runs due north just above Big Tujunga Dam as well as the Yerba Buena/ Gold Creek Trail Corridor that winds along the ridge separating Little Tujunga from Big Tujunga. Approximately 9% of the Forest within the watershed is categorized as BCNM.
- Critical Biological – areas where the most important habitat for the most threatened species can be protected. These areas include a portion of the Big Tujunga riparian corridor beginning just above the Mill Creek confluence and continuing on ~6.5 miles upstream. The lower portion of Alder Creek is also flagged for this category. This category makes up about 1% of the Forest area within the watershed.
- Developed Area Interface – areas along Forest boundaries where community development has occurred, or areas within the forest where concentrated human use occurs. This includes Big Tujunga Canyon (below the dam), the Chilao campground and ranger station area directly north of the Big Tujunga headwaters, and the San Gabriel foothills along the Forest fringe. Approximately 11% of the Forest within the watershed is categorized as BCNM.

While the Angeles National Forest provides a vast amount of open space and recreational opportunity within the upper part of the watershed, areas within the lower watershed are in short supply of local neighborhood parks and recreational facilities. Although there are a total of 36 city and county parks within

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the lower watershed (2088 acres total; 62% of which includes Hansen Dam Recreational Area) and seven parks within one-quarter mile of the watershed boundary, park space comprises less than 5% of the area. The most densely-populated areas of the watershed also tend to be the most park-poor². These areas include neighborhoods a) near Woodman Ave north of Sherman Way and south of Roscoe Blvd, and b) neighborhoods directly west of Van Nuys Blvd and south of Roscoe Blvd near the western edge of the watershed. In addition, the Trust for Public Land (TPL) Greenprinting Study, examined park access based on select criteria (including population density, income, children under 14, race, distance to parks, etc.) and identified a large portion of Arleta, located south of Whiteman Airport between Van Nuys Blvd and Osbourne St. as being severely park-poor (Figure G-2).

There are three projects highlighted in the County's Los Angeles River Master Plan that will begin to address additional open space along the river corridors. These projects include the Tujunga Wash Greenway and Stream Restoration Project, the Lower Tujunga Wash Greenway/Bikeway Project and the Pacoima Wash 8th Street Park. The Tujunga Wash Greenway & Stream Restoration Project includes developing trails and a park that diverts flow from the Tujunga Wash into a naturalized streamcourse along the west channel bank from Vanowen St. to Oxnard St. The Lower Tujunga Greenway will create a 10-acre parkway on both sides of the Wash from Riverside Dr. to Laurel Canyon Blvd. The 8th Street Park project in San Fernando will be converting vacant property used for illegal dumping into a multi-purpose natural park that will address stormwater capture and infiltration as well as recreation opportunities for nearby residents. (LARMP, 1996)

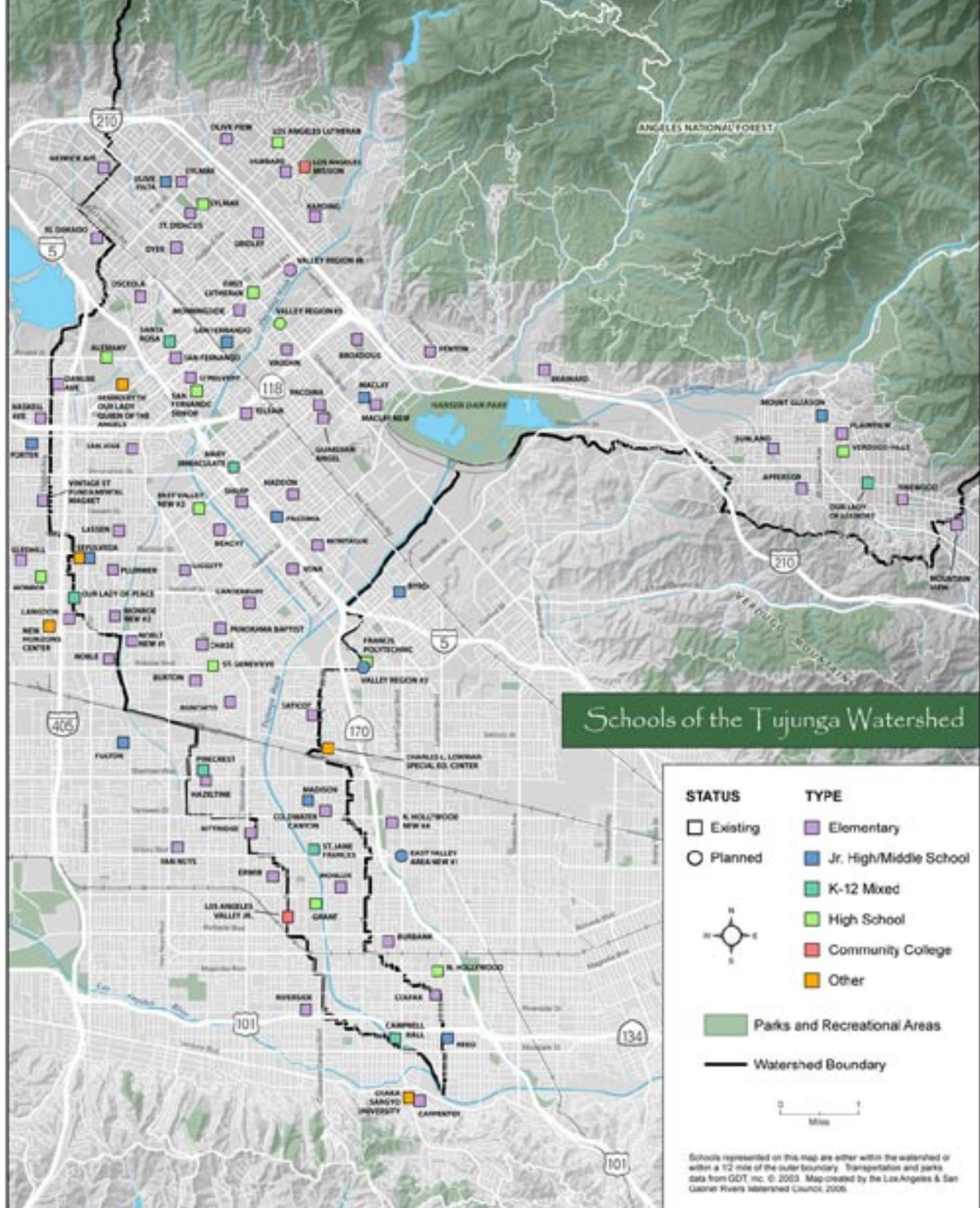
One notable observation in regards to park location: a variety of the neighborhood parks in and around the watershed are located directly adjacent to freeways. It seems that because initial neighborhood planning did not account for local park space during the City's early stages of growth, the city retroactively converted excess freeway parcels that potentially served as noise buffer zones for nearby communities into recreational hotspots. Examples include Ritchie Valens Park, Paxton Park, Valley Plaza Park, Strathern Park West, and North Hollywood Park West.

Additional recreational open space includes three golf courses within the watershed: the El Cariso Golf Course along Pacoima Wash in Sylmar, the Hansen Dam Golf Course just below the Dam, and the Angeles National Golf Club located directly within the wash of Big Tujunga, just upstream from Hansen Dam. The Angeles National Golf Club was recently opened in the summer of 2004 despite strong efforts by agencies and environmentalists to stop development in the endangered ecosystem. The course currently cuts through the floodplain that provides an important wildlife corridor between the Angeles National Forest to the north and the Verdugo Mountains to the southeast.

Schools

There are seventy six schools and two colleges occupying approximately 978 acres of land within the watershed. Fifty-five of the schools are elementary, eight are middle schools, nine are high schools, two are K-8, and two are K-12. Two new high schools, East Valley Area New High School #2 and #3, are scheduled to open in fall of 2006. All schools (with the exception of private institutions) within the watershed are operated and maintained by Los Angeles Unified School District (LAUSD). Many of the schools examined have surplus land that is underutilized. School property can provide a variety of opportunities for multi-

(2) The National Recreation and Park Association Standards and Guidelines (NRPA, 1990) recommend 6 -10 acres of park space per 1,000 residents and an accessibility standard of one-quarter mile for parks >1 acre. "Park-poor" neighborhoods are typically measured using these criteria. Additional criteria often used to refine selections include population density, household income <25k/year, children under the age of 18, block groups with more than 50% non-white residents, etc. Criteria defined here have been used in past studies conducted by Trust for Public Land and USC's Center for Sustainable Cities.



benefit projects that include water capture, infiltration, parks, recreation, habitat, and sustainability as well as educational components for children. One example is the New Monroe Elementary School #2, which has additional 2.36 acres of space left for potential expansion in the future. Regrettably, due to maintenance and liability concerns, current LAUSD policy restricts joint-use on many existing school properties beyond school hours (see Policy & Management). Because of this restriction and such a high demand for active recreational use (i.e. soccer and baseball fields, tennis courts, etc.), mounting pressure is now being placed on our passive recreational open space (Figure G-3).

Ten schools currently participate in the Cool Schools Program run in partnership through Los Angeles Department of Water and Power (LADWP) and LAUSD. This community program sponsors tree plantings to promote energy conservation as well as environmental education for the students. Broadous Elementary School in Pacoima is designated as a Cool School “Sustainable School” because of an additional TreePeople reclamation project that captures rainfall on-site and directs it into an underground detention basin where stormwater can then infiltrate into the local groundwater supply. Due to poor maintenance issues, a portion of the site (the large grass swale running through the area) has since been paved over by LAUSD. The swale helped capture, treat, and infiltrate a percentage of the runoff before it made its way into the infiltration basin. There are no plans to reintroduce the swale back into the design. As this continues to be an ongoing problem with many schools, the importance of these types of projects needs to be conveyed down to maintenance staff through the administration and proper maintenance procedures need to be put in place.

While LAUSD School Design Guidelines (Jan 2005) briefly overview and promote sustainable design in its introduction, details within the body of the document at times contradict. Asphalt is the only material cited for paving parking lots and playgrounds; permeable materials or infiltration basins are not discussed. Invasive plants (ex. ice plant, fountain grass, periwinkle, Brazilian pepper tree, etc.) are presented as options within the approved plant lists, and there are few locally native choices listed. Although new LAUSD schools are required to have a CHPS score of 28pts,³ criteria does not require that any form of stormwater best management practices (BMPs) be implemented to achieve the necessary score. Comments by CHPS staff suggest that because stormwater BMPs are not necessarily given a higher weight within the CHPS grading system, most architects choose other sustainable alternatives specified within the criteria to make the grade (such as energy-efficient lighting to address power consumption).

Transportation & Utilities

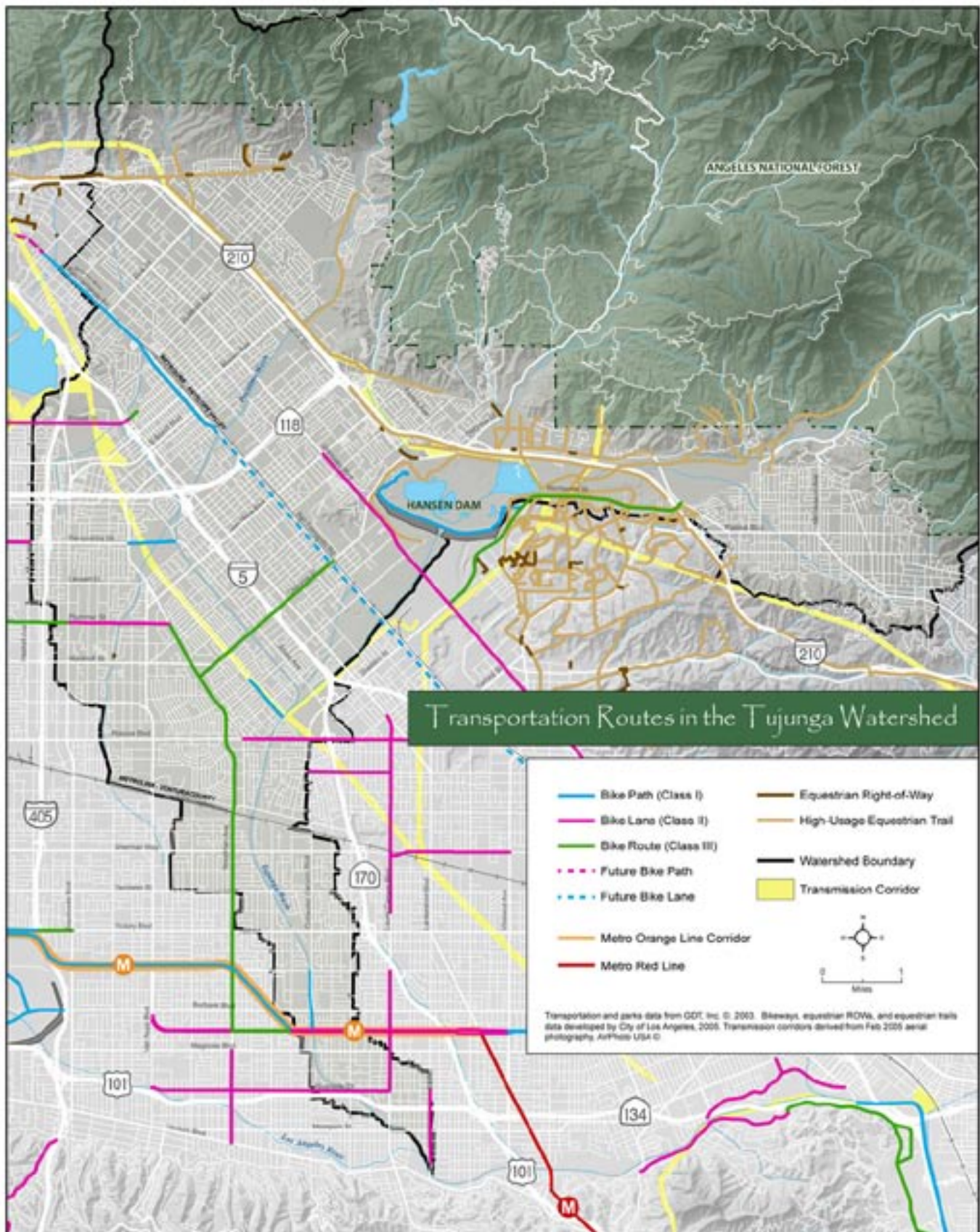
Rights of Way (ROWs)

Public ROWs, if vacant, can provide opportunities for features such as trails or bikeways, pocket parks, community gardens, and other recreational uses. In turn, this creates potential for habitat, improved groundwater recharge, stormwater treatment, and connectivity to other parks and open space.

Two particular varieties of ROWs that can be strategically designed for multi-benefit uses include flood-control channel and transmission line corridors. The majority of channel ROWs adjacent to Tujunga and Pacoima Wash are currently vacant. There are approximately 27.75 miles of open channel ROWs within the watershed. ROWs follow the length of the channel and range in width from 5-20 feet (in certain circumstances even wider). ROW widths give maintenance personnel and vehicles access to the channel.⁴ Depending on the width, these corridors could potentially be transformed into trails and bikeways coupled with native vegetation. The County’s Los Angeles River Master Plan acknowledges three projects along

(3) CHPS (Collaboration for High Performance Schools) developed a series of sustainable design best practices and evaluation criteria geared toward schools. This system has been adopted by various institutions within California. (www.chps.net)

Figure G-4. Transportation Routes in the Tujunga Watershed



the lower sections of the wash that begin to address this need, and a conceptual master plan has been developed for a trail along the Pacoima Wash through the City of San Fernando. (606) (see Bikeways & Trails below).

Five transmission corridors pass through the watershed. Corridors within the watershed are owned and operated by Los Angeles Department of Water & Power. Three of these corridors travel in a N-S direction through the Angeles National Forest. Two ANF corridors pass through the upper sections of the watershed, east of Big Tujunga Dam. The third ANF corridor begins in Big Tujunga Wash just above Hansen Dam and continues north through Lake View Terrace before it reaches the Forest boundary and continues north and east into the Antelope Valley (Figure G-4).

Two corridors run through the urbanized section of the watershed, following area topography and the street grid system in a NW-SE direction. One of these corridors follows the length of Interstate 210 from Sylmar south through San Fernando and Pacoima, enters Big Tujunga Wash, and continues into the Verdugo Mountains. The second enters the watershed from the south at the Tujunga Spreading Grounds and heads north through Arleta where it then connects to the Pacoima Spreading Grounds, continues north and exits the watershed at the Los Angeles Reservoir, just NW of the Interstate 5/405 Interchange. Although certain segments of these corridors are generally leased long-term by LADWP to businesses such as nurseries and storage facilities, both corridors crossover and link large open spaces within this urban framework.

Other types of ROWs that can help capture and infiltrate runoff, lower water use, and provide beneficial tree canopy include retrofitted medians and curbsides. While existing curbs and paved medians currently steer water directly into the stormdrains, features such as curb cuts, tree wells, and swales can be incorporated to help reduce runoff and lower irrigation requirements. One particular example in the watershed includes the Woodman Ave. median between Roscoe Blvd. and Sherman Way. This all-cement single-purpose structure currently retains inadequate vegetation/tree cover and only serves as a protective buffer between northbound and southbound traffic. Retrofits like those mentioned above can not only capture stormwater/street runoff, but also lower any water quality impacts caused by heavy traffic flow along the corridor.

Freeways

Several major highways service the area surrounding the Tujunga Wash Watershed. There are approximately 31.5 miles of freeway ROWs that are within the watershed itself (Figure G-4). A five mile stretch of Interstate 5 (Golden State Freeway), the prime north-south corridor connecting major population centers up and down the West Coast, passes through the lower portion of the watershed in a SE-NW direction. Just northeast of the 5 Freeway, Interstate 210 (Foothill Freeway) runs parallel along the foothills of the San Gabriel and Verdugo Mountains. As it enters the watershed from the south, this major east-west artery bisects a vital habitat corridor (Big Tujunga Wash just above Hansen Dam) that provides the link between the Verdugo and San Gabriel Mountains. Another major thoroughfare, State Highway 118 (Ronald Reagan Freeway) begins at the 210 Freeway in Pacoima and heads westward toward Simi Valley. One key juncture along the 118 Freeway to note: it's intersection with the 5 Freeway, Pacoima Wash, and two heavily utilized recreational parks (Richie Valens Park and Paxton Park – see parks).

In addition, there are four other highways that quickly pass through and/or run along the watershed's boundary. U.S. 101, moving in an east-west direction, crosses into the lower watershed for 1.5 of miles one mile north of the Tujunga Wash-Los Angeles River confluence. Interstate 405 (San Diego Freeway) begins at the 5 Freeway just west of the City of San Fernando and runs south along the western boundary of the

(4) LACDPW, LARMP Landscaping Guidelines and Plant Palettes, January 2004.

lower watershed. State Highway 170 (Hollywood Freeway) also begins at the 5 Freeway, except on the lower watershed's eastern border, and it runs south along this boundary. Lastly, State Highway 2 (Angeles Crest Highway) runs parallel to the southern and eastern portion of the upper watershed within the Angeles National Forest. This small two-lane highway is the main artery through the Forest's territory.

Caltrans is in charge of managing the highway system for California. Highways are engineered to convey and discharge stormwater off of the right-of-way through outfall structures (man-made or natural). As of the year 2000, there are approximately 350 outfall structures along Caltrans right-of-ways within the Tujunga Wash Watershed (200 structures in the lower urbanized portion and 150 along the 2 Highway in the upper portion of the watershed). Caltrans ROW landscaping projects need to be re-evaluated to include sustainable design and maintenance practices that incorporate appropriate low-water and drought tolerant native plants and non-invasive Mediterranean species. Currently, select invasive plants⁵ such as fountain and pampas grass, Brazilian pepper tree, cotoneaster, and some of the frequently used ivy are common in Caltrans ROWs. Also, a one-stop solution is typically used for all irrigation applications. Current practices allow for watering during storm events, during periods of the day when there are high evapotranspiration rates, during times of the year when certain plants do not need watering, etc. All new projects should include water-saving improvements such as rain and soil sensors and drip irrigation when feasible. Plantings should be done strategically so varying watering rates can be applied to different zones along the ROW. Automatic controllers need to be reset according to seasonal needs of plants and system components should be added or relocated as needed to maintain uniform distribution of water.

Railways

There are two main rail corridors spanning nine miles that cross through the lower watershed. A third rail corridor was recently converted into the Orange express bus line by Metropolitan Transit Authority (MTA) (see bus lines). These two remaining railways, owned by Union Pacific (UP), function as both commuter and freight lines (Figure G-4). While both run in a SE-NW direction through the watershed, the southern-most line is shared by freight traffic, Amtrak, and the Metrolink Ventura County line. Connecting with Union Station in downtown Los Angeles, this line runs through North Hollywood, Valley Glen, and Van Nuys and heads west to Simi Valley. This line also intersects with the Bob Hope airport in Burbank four miles east of the watershed. To the north, the second rail line runs between Interstate 5 and Interstate 210 through Sun Valley, Arleta, Pacoima, San Fernando and Sylmar. This line, split between freight traffic and the Metrolink Antelope Valley Line, travels north to the Lancaster/Palmdale area from downtown Los Angeles.

Bus Lines

The Metropolitan Transit Authority (MTA) services all bus lines within and around the Tujunga Watershed. As mentioned above, MTA recently converted an out-of-service Union Pacific rail line into the 14 mile-long Orange express bus line. This major east-west line, connecting the west valley with the North Hollywood Red Line hub, has its own dedicated roadway strictly for buses. One of the valley's major north-south bus corridors includes the 761 rapid and the 233 line, both of which begin northwest of Hansen Dam and follow Van Nuys Blvd. from Interstate 210 south to Ventura Blvd.

Bikeways and Trails

Many of the existing bikeways within the watershed have limited connectivity between other trails, parks, and major landmarks (schools, libraries, etc.). There are two major bike corridors (Class I)⁶ located within the watershed. The first is the Hansen Dam bike path that carries 2.5 miles along the top of the dam. The

(5) Taken from the Cal-IPC inventory (www.cal-ipc.org)

second is a 14 mile east-west corridor (a $\frac{3}{4}$ mile stretch of this corridor passes through the watershed) that travels along the entire length of the new Orange express bus line (see Bus Lines), connecting the west valley with the North Hollywood Red Line. A third major corridor is in the planning stages and will follow the Metrolink Antelope Valley Rail Line from Sylmar south to Burbank. There are currently no major north-south bikeways within the watershed except for a 5.75-mile long Class III path beginning on Osbourne St. (at San Fernando Rd.) and traveling south onto Woodman Ave., where it ultimately connects with the Orange Line Corridor (Figure G-4). Because Class III paths do not have their own dedicated right-of-way (Class III routes generally share roadways and have limited signage), heavy traffic can discourage use.

The County's Los Angeles River Master Plan has identified the Tujunga Wash ROW as a major north-south corridor that can provide multiple-beneficial uses (including trails). A $\frac{1}{2}$ mile Class I path along the Great Wall of Los Angeles (next to Los Angeles Valley College between Oxnard St. and Burbank Blvd.) was the first project to begin establishing a Tujunga Wash Greenway trail between the upper and lower watershed. Other planned projects include further development of the trail just north of Valley College (from Oxnard St. north to Vanowen Blvd.), and development of a trail along both sides of the Wash from Riverside Dr. to Laurel Canyon Blvd. These projects account for only 2.25 mi. of the 9 mi. stretch from Hansen Dam south to the Los Angeles River confluence. Projects or plans for other trail sections of the Tujunga Wash corridor have not yet been identified.

A conceptual master plan for a Greenway/Bikeway along the Pacoima Wash ROW through the City of San Fernando was developed in 2004 (City of San Fernando, 2004). The first section of the project, between 8th St. and San Fernando Rd. is scheduled to break ground in 2007.

Similar to bikeways, those trails within the lower watershed dedicated for hiking, equestrian, or multi-use (i.e. equestrian use, hiking, and biking) tend to be fragmented. While there are a variety of multi-use trails within Hansen Dam and in and along the foothills of the Angeles National Forest, few of these trails are interconnected with the nearby community. Dedicated equestrian ROWs established within foothill communities are highly disconnected and riders are forced to use undesignated public ROWs (i.e. streets) to navigate to foothill trailheads (Figure G-4). Some riders are now opting to load horses into their trailers and drive to the trailheads instead of trying to maneuver their horses through traffic (Covarrubias, 2006).

There have been select groups undertaking major efforts to both identify and connect existing trails to larger systems. The most notable effort is the development of the Rim of the Valley Trail Corridor (~50 miles), or more recently referred to as the Marge Feinberg Rim of the Valley Trail. Feinberg, who recently passed in 1999, based her 1974 master's thesis at CSUN on a concept that joined parks, open space, wildlife habitat, trails, and recreational opportunities within and between the Santa Monica, Santa Susana and San Gabriel Mountains (SMMC 2004). She dedicated the remainder of her life to preserving land as well as providing outreach to carry out this vision. One section of the trail enters the watershed from the west just north of the 210 Freeway in Sylmar and connects the 65-acre City of Los Angeles Stetson Ranch Park to SMMC's 240-acre Wilson Canyon Park. The trail then heads further east connecting with Hansen Dam Park and continues on into the Angeles National Forest and Verdugo Mountains.

While trails data for this area is limited, high-traffic multi-use trails identified within the lower watershed include the Akens Canyon Trail, Doane Trail, Doc Larsen Trail, Fascination Spring Trail, and Oak Spring Trail. This series of trails winds around and above Lake View Terrace into the Angeles National Forest. Other noteworthy trails include the 2-mi. Hansen Dam Equestrian Trail which follows along the dam base.

(6) Class I bike paths are separate, off-road right of ways shared by bicyclists and pedestrians (LACBC).

Airports

Whiteman Airport, located in Pacoima just west of Hansen Dam, is the only airport within the watershed (Figure G-5). Owned by the County, the airport occupies 184 acres and is open to the public. A County Aviation Commission advises the Board, LACDPW, and Regional Planning on matters relating to management and operation of their airports and compatible land uses around these airports. The airport itself is host to small aircraft (turboprops, helicopters, etc.) for general aviation purposes; no large commercial flights fly into Whiteman. Airport operations currently average 296 flights a day. Projected growth figures suggest that the airport may be at full capacity (the site can accommodate up to 960 aircraft) by the year 2010. There are approximately 43 acres of undeveloped land (predominantly hillside) currently located directly behind the hangars that separate the airport from a small residential neighborhood to the northeast. This vacant space is directly adjacent to a City of Los Angeles pocket park (Roger Jessup Recreational Center).

Vacant Lots

Vacant lots may consist of developed or undeveloped land that was abandoned, repossessed, city or county surplus no longer in use, land that cannot be developed due to zoning restrictions/ordinances, etc. Acquisition of key properties can help preserve or convert these interstitial spaces into protected open space, urban forests, recreational spots, and educational opportunities for area residents.

The City of Los Angeles currently has approximately 470 acres of surplus land located within and adjacent to the Tujunga Watershed. The current land use designation and acreage for these vacant properties have been summarized in Table G-5. Based on County parcel records, several other potentially vacant properties have been identified within the watershed (Figure G-5). These are lots that are located outside the Angeles National Forest jurisdiction.

Table G-5. Vacant Lots Within the Watershed (outside Angeles National Forest jurisdiction)
(based on May 2006 LACDPW parcel data)

Land Use	# of Parcels	Acreage
Commercial	276	366.66
Government	65	703.26
Industrial	105	166.62
Institutional	16	102.06
Other	38	511.02
Recreational	5	174.44
Residential	3466	5554.14
Waste	45	829.61
Total	4016	8407.81

Brownfields

Brownfields represent potential redevelopment properties once occupied by industry or commercial use that have alleged or confirmed contamination issues. Site identification can provide key source information for local or regional environmental problems such as soil/groundwater contamination. If proper measures are taken to correct and clean-up these sites, potential re-use or redevelopment of the site could include new schools, parks, or other green space. Because the cost of investigation and remediation many times overshadow the net worth of the property, the government (headed up by U.S. EPA and CalEPA) offers

programs and other incentives that organizations, developers, etc. can use to help fund cleanup efforts.

There are currently five brownfield sites located in the Tujunga Watershed. Four of the five sites are located along the San Fernando Road and Union Pacific Railroad industrial corridors discussed in the introduction of this section. Four sites are confirmed as being contaminated, and the other is a historic site that needs to be re-evaluated. Three of the confirmed sites are currently being cleaned-up by the property owners with oversight from California Department of Toxic Substances Control (DTSC). The fourth site, Holchem, Inc., is a hazardous material transfer station that has had spill issues in the past. This site is of special concern because a few miles downgradient exist two of LADWP's main drinking water wellfields. DTSC is the leading enforcement behind the site remediation. The Remedial Action Plan for clean-up was just released in December 2005. Due to the land use, ownership, and/or site status, none of the brownfield sites discussed in this section have the potential to be an open space/greening project.

Major Facilities

There are several large single-purpose facilities located within and around the watershed that are currently being under-utilized (Figure G-6). Such facilities could incorporate multi-benefit elements that provide additional recreational opportunities, flood protection, habitat, stormwater capture, and infiltration. Example sites include local spreading grounds (Hansen, Branford, Pacoima, Tujunga, and Lopez), exhausted mining pits (Sheldon, Boulevard, and Cal Mat), and the Los Angeles DWP Valley Steam Plant. One other predominant facility type in this section of the valley includes the presence of landfills. Because such landfills can be a potential health hazard to surrounding communities, their level of occurrence needs to be addressed.

Power Generating Facility

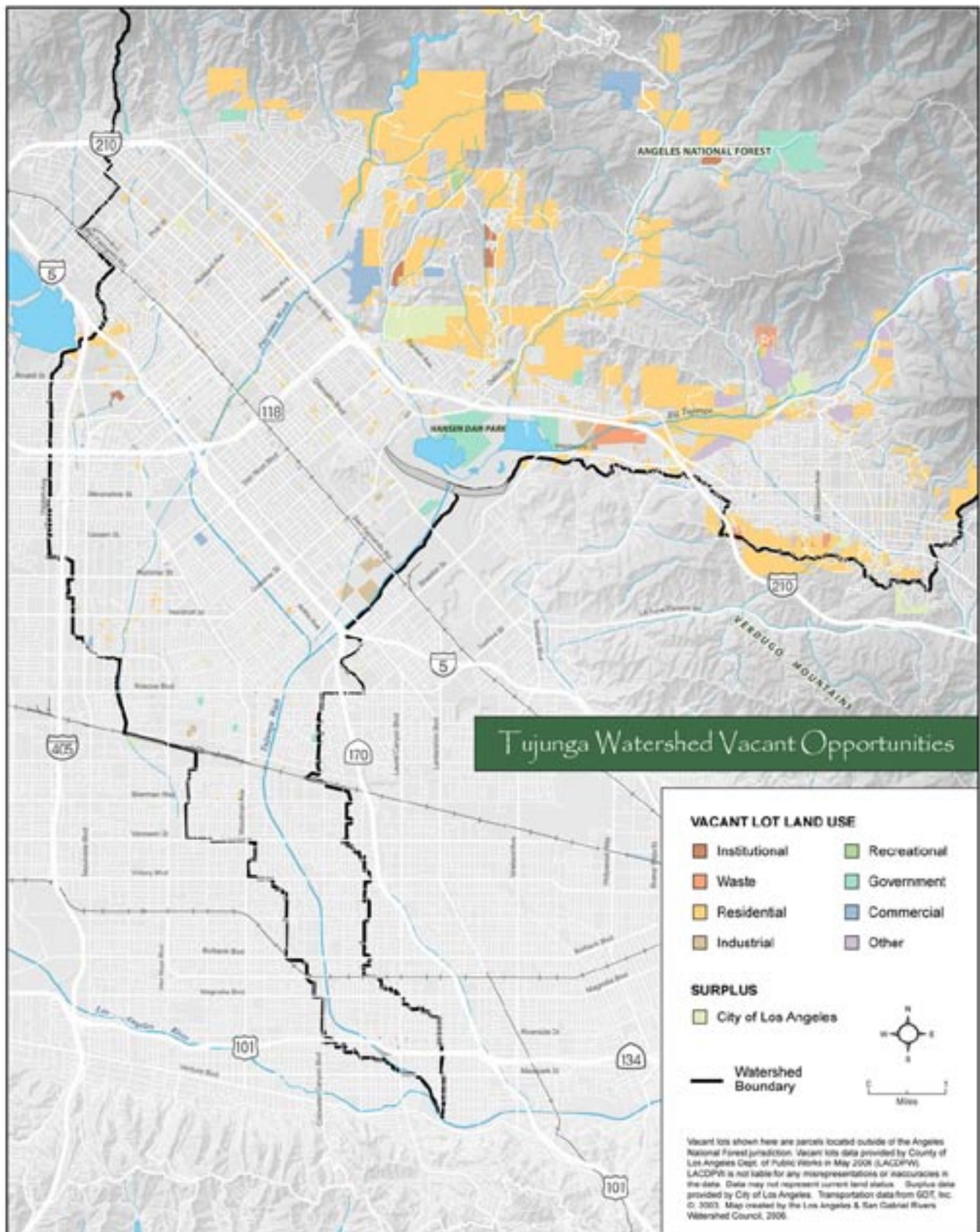
The 155-acre Valley Steam Plant is located along the east bank of Tujunga Wash below Hansen Dam. The Sun Valley Watershed Management Plan has identified this site as a large contributor to substantial runoff and flooding problems on San Fernando Road. Listed as a Phase I project, the plan proposes to incorporate onsite retention and infiltration basins to capture runoff from the plant and surrounding areas for up to a 50-year storm event. Retention tanks could be used to store stormwater for plant reuse and nearby gravel mining activities. There is also an additional open space component that features native landscaping, habitat restoration, and recreation for employees (LACDPW, 2004).

Landfills

The region directly below Hansen Dam is well-known for its heavy mining activities (see Pits). Historically, as mining production ceased within a particular operation, exhausted pits were converted into landfills. Presently, while the Tujunga Watershed has no active landfills within its boundaries, there are two large active operations adjacent to the watershed in Sun Valley and one operation to the west of the watershed in Sunshine Canyon. These landfills, if not properly maintained and operated, can have harmful effects on local water supply and air quality as well as contributing to noise pollution in the area.

There are four historic landfill sites within the watershed. The Moe Russell Landfill and the Lopez Canyon Landfill are located just north of the 210/118 Freeway interchange. The smaller 81-acre Moe Russell site closed in 1964 and has since been converted into a trailer park and manufacturing facilities. Across the road, the 399-acre Lopez Canyon property recently closed in 1996 and is intended to be transformed into a non-irrigated, low intensity open meadow area for passive recreational activity (City of Los Angeles SRECD, 2006). The Branford Landfill, located adjacent to Boulevard Pit just below the Hansen Spreading Grounds, was closed in 1961 and has since been vacant. The City of Los Angeles had sold the property to a developer (Sunquest LLC) in 2001 with the intent that the development (a business park for industrial

Figure G-5. Tujunga Watershed Vacant Opportunities



and commercial uses) would create several jobs for local residents, but politics and remediation problems between the developer and city officials have since delayed the project. The last site, the Glenoaks Dump, was located just below Hansen Dam where the Golf Course now sits. No information on its size or period of operation is available.

The Sheldon-Arleta Landfill is located directly adjacent to the watershed just to the east of the Tujunga Spreading Grounds. This landfill was closed in 1974 and currently sits vacant on approximately 50 acres of land. According to the Solid Resources Engineering & Construction Division for the City of Los Angeles (2006), the city plans to leave it as open space for passive recreational activities. While research has not identified the true lining status of the landfills, we can assume most were unlined based on their opening date of operation. These landfills (with the exception of perhaps Lopez Canyon) were opened before regulations were established.

Two other significant landfills outside the watershed include the Bradley Landfill and the Cal Mat Pit. Formerly an exhausted pit, the 156-acre Bradley Landfill is located directly to the southeast of the LA DWP Valley Steam Plant. It opened in 1959 and is currently owned by Waste Management. The landfill can accept up to 10,000 tons per day. Air, trash, and noise pollution from the landfill has caused much contention with nearby communities over the years. Currently, Waste Management is examining the potential to increase the landfill height and continue operation until its permit expires in April 2007. According to the Program EIR (Environmental Impact Report) for the Sun Valley Watershed Plan, the eastern section of the landfill is unlined. The EIR states, "To ensure that existing groundwater recharge operations at nearby spreading grounds in SFB do not inadvertently inundate the landfill materials, the Regional Board, Waste Management Inc., ULARA Watermaster, and LACDPW have jointly established a monitoring well "alert level" beneath the landfill at 745 feet above mean sea level (msl). If groundwater elevations in monitoring wells at the landfill site reach 745 feet msl, recharge at nearby spreading grounds are temporarily reduced or discontinued until the water table falls."

Vulcan's Cal Mat Pit is currently used as a Class III landfill for inert waste such as construction debris. It is located just southeast of Sheldon Pit in the Sun Valley Watershed. The Sun Valley Watershed Management Plan lists Phase I and Phase II project sites for Cal Mat. Phase I includes diverting nearby runoff from large storm events into the pit for retention, treatment, and infiltration while retaining a portion of the site for landfill operations. After the landfill closes, the Phase II project proposes to create a permanent lake in a 30-acre recreation area that would also be used for flood control (LACDPW, 2004).

Pits

Due to the underlying geology originating from Tujunga's alluvial outwash, there is a variety of mining operations located in and around the watershed. In fact, the Sun Valley Management Plan (LACDPW, 2004) describes the area as having "the highest concentration of mineral processing facilities in Los Angeles." Three pits key to this area include the Boulevard Pit (located on the west bank of Tujunga Wash directly below the Hansen Spreading Grounds), Sheldon Pit (located along Tujunga Wash's east bank directly below the dam golf course), and Cal Mat Pit (located directly southeast of Sheldon Pit). Other pits in the area have traditionally been converted into landfills (ex. Bradley Landfill).

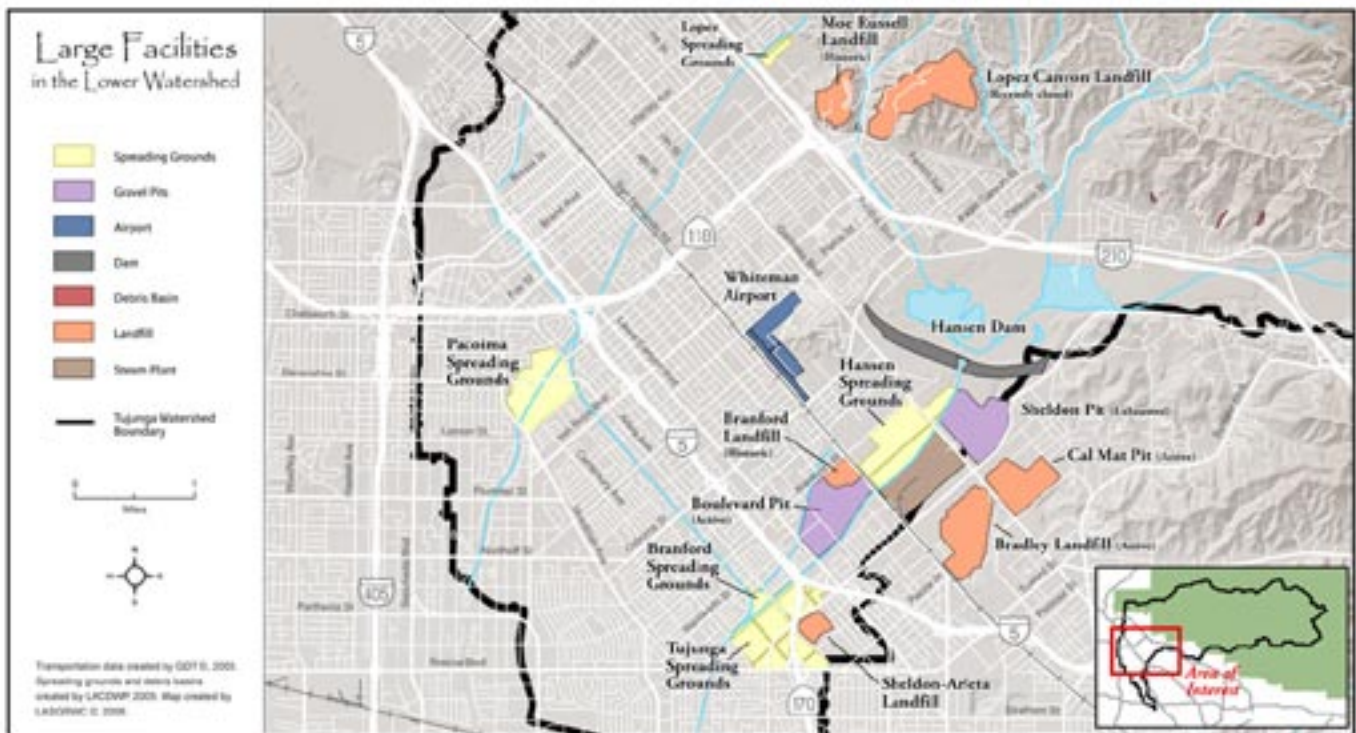
Boulevard is the only active operation of the three and is expected to be exhausted by 2008 (LACDPW, 2004). It also has led the state and the nation in sand and gravel production over the past six years (Kohler, 2004). Vulcan owns both Boulevard and Sheldon Pits and uses exposed groundwater from Sheldon for gravel processing. Additionally, Sheldon is used as a disposal site for sediment and wash water (LACDPW, 2004). Cal Mat Pit is currently being used as a Class III landfill for construction debris.

While Boulevard is currently the only pit technically within the watershed boundary, future engineering modifications could incorporate both Sheldon and Cal Mat Pits as shared entities between the Tujunga and Sun Valley Watersheds. For example, Phase II project components of the Sun Valley Watershed Management Plan propose diverting excess flow from Tujunga Wash into Sheldon Pit for stormwater retention and infiltration purposes in addition to developing treatment wetlands and park space (LACDPW, 2004). Concerns for storing water in the pits include raising groundwater levels to the point where nearby landfills (existing and closed) would become inundated, thus applying further pressure to the trapped methane gas within the landfills. Updating the gas collection system and installing impermeable lining are a few of the solutions being examined (The River Project, 2002).

Spreading Grounds

The watershed's five spreading grounds, currently owned and operated by LACDPW (except for Tujunga, which is owned by LADWP), could also potentially provide up to an additional 314 acres of recreational open space during the dry seasons (summer and fall). Additionally, The Hansen Spreading Grounds infiltration potential is currently limited due to environmental issues associated with the Bradley Landfill. Because the landfill is unlined, the groundwater levels cannot exceed a height of 745 feet above mean sea level (msl) (see Landfills). A joint-use could relieve some of the continuous demand for active recreational space in the area and allow for other critical areas to be preserved for habitat.

Figure G-6. Large Facilities in the Lower Watershed



Conclusions

Even though the Tujunga Watershed has been developed in a very aggressive manner that precludes it from functioning as a completely natural system, the system in place is rife with potential opportunities to expand and enhance open space, access and connectivity, create recreational areas, preserve and restore habitat, and support educational programs and curricula.

Growth: The lower, urbanized portion of the watershed is dominated by residential use, although there still is a sizeable percentage of vacant land just below the Forest jurisdiction (within the unincorporated portions of Los County and along the City of Los Angeles' northern fringe). Additionally, there is an increasing threat of high-density development (infill) among many of the foothill equestrian communities and single-family residences located in Sylmar, Lake View Terrace, Sunland, and Tujunga.

Adaptive Re-use of School Grounds: There are seventy-six schools and two colleges occupying approximately 978 acres of land within the watershed. Many of the schools examined have surplus land that is underutilized.

Park Distribution: The most densely-populated areas of the watershed tend to be the most park-poor. Although there are a total of 36 city and county parks within the lower watershed (2088 acres total; 62% of which includes Hansen Dam Recreational Area) and seven parks adjacent,⁷ park space comprises less than 5% of the area.

Recommendations

While many opportunities have been lost in the lower Watershed due to development and planning shortsightedness, there are many opportunities for improvement that still remain.

Parks and Open Space: Parks and open space need to include innovative multi-benefit solutions to meet user demands while protecting and preserving existing habitat. School property can provide a variety of opportunities for multi-benefit projects that include water capture, infiltration, parks, recreation, habitat, and sustainability as well as educational components for children.

While the Angeles National Forest provides a vast amount of open space and recreational opportunity within the upper part of the watershed, areas within the lower watershed are in short supply of local neighborhood parks and recreational facilities. Interstitial space adjacent to freeways that currently serves as a noise buffer zone for nearby communities can be converted into dynamic functioning recreational spaces.

Schools: By simply creating Sustainable Guidelines and/or Advisory Committees for institutions such as LAUSD, alternatives can be updated such as substituting pervious paving for Asphalt for parking lots and playgrounds. Permeable materials or infiltration basins are proven systems on school grounds. Landscape Guidelines should be reviewed to avoid invasive and high-water plants as options within the approved plant lists, and local native choices should be encouraged.

There are progressive actions being taken through the Cool Schools Program run in partnership through Los Angeles Department of Water and Power (LADWP) and LAUSD. Ten schools in the Watershed currently participate in this community program that sponsors tree plantings to promote energy conservation as well

(7) Class I bike paths are separate, off-road right of ways shared by bicyclists and pedestrians (LACBC).

as environmental education for the students. Future efforts should include expanding Program participation throughout the lower watershed.

Transportation & Utilities: Public ROWs, if vacant, can provide opportunities for features such as trails or bikeways, pocket parks, community gardens, and other recreational uses. In turn, this creates potential for habitat, native plantings, improved groundwater recharge, stormwater treatment, and connectivity to other parks and open space.

Caltrans right-of-ways can be re-evaluated to include sustainable design and maintenance practices that incorporate appropriate low-water and drought tolerant native plants and non-invasive Mediterranean species. The simple use of rain and soil sensors and seasonal resetting of automatic controllers can prevent watering during storm events, during periods of the day when there are high evapotranspiration rates, and during times of the year when certain plants do not need watering can preserve water and enhance native species.

The incompleteness of the current bicycle trail system requires additional trail linkages to allow for interconnection throughout the watershed. Easements along waterways could help structure a trail system that connects the Los Angeles River to the Angeles National Forest (as there are currently no N-S bikeways within the watershed).

The most ambitious trail project in the watershed aims to both identify and connect existing trails to a larger system, creating the Rim of the Valley Trail Corridor (~50 miles). The project aims to join parks, open space, wildlife habitat, trails, and recreational opportunities within and between the Santa Monica, Santa Susana and San Gabriel Mountains (SMMC 2004). Vacant properties along the corridor that are currently not preserved should be identified and prioritized for acquisition (see below).

Surplus/Vacant Property: Vacant parcels and surplus property represent opportunities for habitat, pocket parks, infiltration basins and recreation. While the focus for acquisition may be placed on those larger parcels adjacent to waterways (riparian zone redevelopment), special attention should also be given to identifying and acquiring available space within park-poor neighborhoods and along potential trail corridors.

Major Facilities: There are several large single-purpose facilities located within and around the watershed that are currently being under-utilized such as the watershed's five spreading grounds, Hansen, Branford, Pacoima, Tujunga, and Lopez. These areas can potentially provide up to an additional 314 acres of recreational open space during the dry seasons (summer and fall). These facilities could incorporate multi-benefit elements that provide additional recreational opportunities, flood protection, habitat, stormwater capture, and infiltration. This type of joint-use could relieve some of the continuous demand for active recreational space in the area and allow for other critical areas to be preserved for habitat.

The 155-acre Valley Steam Plant is located along the east bank of Tujunga Wash below Hansen Dam and has been identified by the Sun Valley Watershed Management Plan as a significantly large contributor to runoff and flooding problems on San Fernando Road. Listed as a Phase I project, the plan proposes to incorporate onsite retention and infiltration basins to capture runoff from the plant and surrounding areas for up to a 50-year storm event. Retention tanks could be used to store stormwater for plant reuse and nearby gravel mining activities and the surplus space features native landscaping, habitat restoration, and recreation for employees (LACDPW, 2004).

History and Culture

Introduction

The interaction between people and their watersheds and the change in this interaction over time are important parts of the puzzle of watershed condition. Over centuries, people and cultures come and go and with them their practices and perceptions of the physical and biological place around them. Cultures and societies evolve over time, sometimes responding to natural events and constraints, sometimes causing them. Watershed assessments include descriptions of who lived in the watershed over time and how they related to the place. This description can be used to understand changes in the watershed over time and the emergent conditions that result from the relationship.

Little remains in the lower watershed that would be familiar to the inhabitants of 200, or even 75 years ago. Certain landmarks such as San Fernando Mission, Andres Pico and Lopez Adobes, and Bolton Hall still persist. The Great Wall of Los Angeles mural provides a visual timeline of the region's cultural evolution, and reminders of history are still apparent throughout daily life. For example, the names Tujunga and Pacoima originate from the Tataviam language and mean "old woman place" and "the entrance," respectively (King, 2004). The City of San Fernando takes its name from the mission established there in 1797, and Van Nuys is named for the powerful wheat merchant who once owned the land. Many of the street names, such as Chandler, Sherman Way and Lankershim Boulevards are named after people who played pivotal roles in shaping the watershed's future.

Historical events, environmental forces, cultural sensibilities and socioeconomic changes have all shaped the current state of the watershed today. In considering the cultural history of the watershed, we will focus on the area currently defined as the watershed. However, we will also discuss places and events that occurred within what was then the Tujunga Watershed, but are now outside of its official boundaries as determined by human intervention (see Figure C-1 in the Hydrology section of this report).

Findings

Early History and the Mission

Before the Europeans began their settlement of the Tujunga Watershed, the region was inhabited by the indigenous Tataviam. The Tataviam are part of the Shoshone Nation and anthropologists have placed them as having settled in the region as early as 450 A.D. (Ortega, 2005). Studying the history of the traditional life of the Tataviam is difficult because the past is preserved only through oral tradition that has been handed down throughout generations. Rita N. Rivera, an elder of the Tataviam tribe who died in 2001, recounted stories of her ancestors dating as far back as the 1850s (Stassel, 2001). Such oral histories are the primary source of information about indigenous peoples before the arrival of the Europeans. After the founding of the missions, the letters and diaries recorded by the Spanish monks also included observations of the Tataviam daily life.

Tataviam means "People facing the sun", as they built their homes on south-facing slopes. They later became known as the Fernandeño, because of their role in the construction of the San Fernando Mission (Ortega, 2005).

The Tataviam were strongly attached to the land. They lived without agriculture or domestic animals. Deer, rabbits, quail, squirrels, birds, lizards, snakes, grasshoppers and caterpillars were hunted and trapped; and

acorns, yucca, juniper berries, chia seeds and buckwheat were gathered for sustenance. Rivers and creeks were essential to the Tataviam not only for water, but for the willows and tule reeds that surrounded the riverbanks. These played a crucial role in the construction of shelter and the settlement of their villages. The typical Tataviam home, or Ki'j, was a dome-shaped framework of willow in a circle between 12 to 20 feet in diameter. The poles were bent in at the top to form a dome, then smaller saplings or branches were tied on cross-wise. To cover the outside, bulrush or cattails were woven into the frame. A hole in the top, which was covered with a hide when it rained, allowed for a fire pit in the center of the Ki'j. If it rained, the people could cook inside and remain warm and dry. The larger villages also contained gaming and dancing areas, cemeteries, granaries, work areas and sauna-like sweathouses called Sehé used for cleansing and relaxation (Tataviam Cybrary, 2005).



Figure H-1. Tataviam Village
(Fernandeno Tataviam Tribal Council, Inc. 2004)

The Tataviam paid meticulous attention to the drainage and flooding patterns of the watershed. They felt a connection to the water and natural resources that many Westerners now do not understand. A Tataviam tribe member stated, "The tribe sees water as their blood. Like veins carry the blood through the human bodies so do the rivers carry water through mother earth. If our blood would dry we would die, same as mother earth." They relied on the land for survival, yet still worked to conserve their natural resources. According to an elder from the Tataviam tribe, water boundaries and hunting boundaries between tribes were enforced in order to preserve resources and maintain the balance of nature and their blood (Ortega, 2006).

When Spanish conquistador, Hernando Cortez, invaded and conquered Mexico, all of the unknown land to the North was claimed for Spain. In 1769 Spain sent Gaspar de Portola and Jesuit priests to California to establish forts and missions. This expedition brought about a significant transformation in the culture and ecosystem of the region. Spanish influence and the Catholic Church altered the lives of the Tataviam forever (Pozzo, 2005). As K. Roderick (2001) states in his book, *The San Fernando Valley: America's Suburb*, "they (the indigenous people) could not have known that their world had in an instant drastically changed."

On September 8, 1797 Mission San Fernando Rey de España was established by father Lausen, successor to father Junipero Serra. The limestone mission, located in what is now the City of San Fernando, was established to close the gaps in El Camino Real and to "civilize the heathens, baptize them as Christians and put them to work producing goods." By 1804, nearly 1,000 Tataviam lived at San Fernando Mission and by 1806, they were planting crops, raising cattle and producing hides, leather goods, adobe bricks, tallow for candles, soap, and cloth (Nunis, 1997).

The mission system was designed to be a "temporary establishment" to teach the indigenous people how to manage a self sustaining pueblo and some contend, to Christianize native Californians. The natives were drawn to the missions. However, once they were baptized and converted to Christianity they became known as *neofitos* or neophytes and were not able to "leave without permission." Historians described the lifestyle of the neophytes as being harsh. They spent their days attending mass, working in the fields, and tending the animals. According to historical records, *neofitos* were whipped by Spanish soldiers for desertion. A large number of the native people were baptized and integrated into the mission lifestyle. In the first year, 92 indigenous people were baptized. In total 1,586 indigenous neophytes were converted to Catholicism at the San Fernando Rey (Roderick, 2001).

Over the next 50 years, the number of indigenous people dwindled significantly due to “disease, changes in their diets and the obliteration of their culture and language” (Pozzo, 2005). The indigenous ecosystem was transformed as well. The Spanish expeditions and settlers literally brought the seeds of change with them. Yellow mustard and invasive grasses quickly out-competed the valley’s native grasslands.

The San Fernando Mission helped California and this region become an important participant in trade between other countries and paved the path for the large ranchos and the subsequent real estate boom (Falzarano, 2003).



Figure H-2. San Fernando Mission.
(Oviatt Library, CSUN)

The period of Spanish rule was described as “simple and feudal” (Pozzo, 2005). Large pieces of land throughout the region, or ranchos, were deeded to Spaniards. The introduction of the ranchos brought about a great shift in land use, altering the landscape further. Livestock became an important resource, and by 1826 there were 56,000 longhorn cattle and 1500 horses and ponies in the San Fernando Valley (Roderick, 2001).

When Mexico succeeded in gaining independence from Spain in 1822, the Mexican government began to secularize the missions, and the management and use of the missions changed. The secularization of the missions led to controversy between the northern and southern regions of California and ended in an armed revolt. The Southern Californians wished for private control of the land without the influence of the priests. Their victory led to changes in land ownership. In the 1830’s California officials began to confiscate mission lands, but usually left the buildings under the control of the church.

Statehood and Boom Towns

The discovery of gold in the San Gabriel mountains in 1842 brought European, Latin American and Chinese immigrants to area, increasing the valley’s diversity.

In 1845 Pio Pico, whose ancestry was a mixture of African, native American, and European Spanish, became the last Mexican Governor of Alta California - and the first subdivider of the San Fernando Valley. Anticipating a war between Mexico and the United States, he dispersed his large land holdings. Seven ranchos were established in the valley: Rancho El Escorpion, Rancho Encino, Rancho Cahuenga, Rancho Providencia, Rancho San Rafael, Rancho Tujunga and Rancho Ex-Mission San Rafael. Within the Ex-Mission Rancho San Rafael, Geronimo and Catalina Lopez operated the Lopez Station. The station, now in the city of San Fernando, served as a resting place for travelers and was the first public school in the valley. In later years it also served as a post office. When war was declared in May of 1846, Governor Pico sold a large portion of the valley to Eulogio de Celis for \$14,000. De Celis was a Spaniard who now became the owner of the largest parcel of land in Alta-California, 116,858 acres (Roderick, 2001).

On January 11, 1847, the United States Bear Flag Battalion, led by Col. John C. Fremont, clambered down what is now known as Newhall Pass to claim victory over Mexico. They occupied the mission and sent emissaries for peace. Two days later, at Rancho Cahuenga, Alta California capitulated and became the American territory of California. The Treaty of Guadalupe Hidalgo of 1848, under the terms of which Mexico sold much of what is now the Southwest United States to the U.S. government for \$15 million, finalized the transition.

Life during the rancho era was more relaxed and less pious than during the time of the Spanish missions. The Californios lived life without “thought to the future, and life was lived for the moment.” They participated in a number of large celebrations throughout the year, such as Saint’s Days, dances, and weddings. Rodeos, bullfights, horse races and gambling were also common and provided entertainment for the families living on the ranchos. The rancho lifestyle was centered on a large and strong family structure. “The rancho provided a home for a host of poor relations, entertained strangers as well as friends...” (Pozzo, 2005).

The rancho owners had financial difficulties during the first half of the nineteenth century. They often did not have much cash, because while the region was “rich in land and cattle”, the ranchos did not produce many goods. The Californios had to depend on foreigners for consumer goods, and many elites found themselves in serious debt (Pozzo, 2005). By tradition, travelers could expect gracious accommodation at ranchos, so one rancher was compelled to post a notice in the newspaper delicately asking those who wished to call “...not forget to bring with them what is necessary to defray their expense” (Roderick, 2001).



Figure H-3. Cattle Ranching on the Valley Plain
The San Fernando Valley: America’s Suburb 2001

Cattle ranching as a major activity was brought to a sudden end by the disastrous drought of 1863-1864, which resulted in the loss of practically all the cattle and sheep in California (USBR, 2006). One resident was prompted to observe: “I could have walked across the valley on the bones of sheep and cattle.” Pio Pico sold the rest of his share of the land to Isaac Lankershim in July of 1869. The Rancho Ex-Mission San Fernando was split in half between Lankershim and the heirs of Eulogio de Celis (Roderick, 2001).

U.S. businessmen had begun investing in California when it belonged to Mexico. These entrepreneurs recognized the value of the natural resources in the San Fernando Valley and saw an opportunity to profit from the land. At this point, the watershed was sparsely populated and largely undeveloped beyond the San Fernando Mission.

The completion of the transcontinental railway on May 10, 1869 caused great changes in the Tujunga Watershed. When former California Governor Leland Stanford, owner of Southern Pacific Railroad Lines, promised that he would extend the railroad lines from San Francisco to the valley, Charles Maclay, a California Senator from San Francisco, purchased over 56,000 acres of land (essentially the northern half the valley) for about \$2.00 an acre from the de Celis family.

Chinese laborers built the rail line extension, but by 1882 the Chinese-exclusion act would halt laborers' entry and bar them from citizenship. The town of San Fernando was developed as a station stop for the railway, giving birth to the booming towns of the San Fernando Valley. Maclay's agents would greet potential buyers with a free barbeque and a sales pitch. Town lots sold for an average of \$75 each and farmland anywhere from \$5 to \$40 an acre. Maclay formed an equal partnership with brothers Benjammin and George Porter. During the 1880's Maclay and his business partners busily created a number of small towns and subdivisions, attracting people with cheap land, even though the area was still very rural and offered few amenities (Roderick, 2001).

By 1880, English speakers outnumbered Spanish speakers for the first time, and land use in the valley had shifted once again. Numerous types of agriculture were attempted, each culture bringing with it a different crop, with various results. In the southeast watershed where the water table is most shallow, vineyards and fruit orchards flourished. Olives did well in the north valley. Small-scale irrigation was tried with citrus in the mostly frost-free alluvial fans. Similarly, a single farm a few miles from San Fernando produced vegetables with irrigation (Rodrigue and Rovai, 1996).

The next dominant landscape was determined by Issac Lankershim and his son-in-law. Isaac Newton Van Nuys, who together owned 47,500 acres of the valley. Lankershim, who noted how naturalized oats flourished without irrigation, began dry-land wheat farming, establishing the dominant land cover between 1877-1910 (Rodrigue and Rovai, 1996). Lankershim and Van Nuys built the largest wheat-growing empire in the world, the Los Angeles Farm and Milling Company. Van Nuys can be credited for mapping the valley when he instructed one of his ranchers to plow a 20-mile line through the dirt, dividing the Porter-Maclay and Lankershim lands. This line later became Roscoe Boulevard.

Figure H-4. Lankershim-Van Nuys Wheat Harvest 1900
(Canoga-Owensmouth Historical Society)

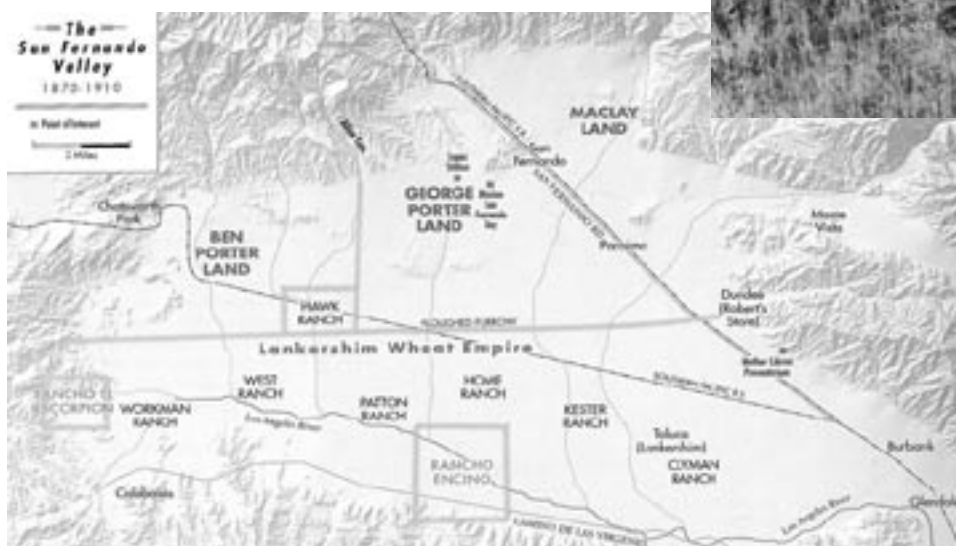


Figure H-5. San Fernando Valley, 1870-1910.
(The San Fernando Valley: America's Suburb, 2001)

Water...

Lankershim and Van Nuys, as well as orchard owners in North Hollywood, who found that they could double their yield using gas well-pumps to irrigate with groundwater, were among numerous landowners who attempted to legally assert the doctrine of riparian rights to both the surface waters of the river and the groundwater basin. These lawsuits would ultimately culminate in the City of Los Angeles vs. A.E. Pomeroy, wherein the Supreme Court ruled that Los Angeles had succeeded, by virtue of the Treaty of Guadalupe Hidalgo, to all the rights which it had enjoyed as a Spanish pueblo; therefore, its claim to the waters within the watershed was prior to that of all appropriators subsequent to 1781 (McWilliams, 1946).

With their pueblo rights established, Los Angeles had sufficient water to meet its needs. However, given the expanse of the landscape, empire builders of the period saw the growth potential of the region as limited only by its water supply. A syndicate financed by Harry Chandler and Harrison Gray Otis, president and vice president of the Los Angeles Times, respectively, suburban railway builder (and member of the city's water board) M.H. Sherman, E.H. Harriman, E.T. Earl, and banker Joseph F. Satori, worked quietly to acquire 108,000 acres of land in the valley, including Lankershim's large holdings.

Sherman was close to former Los Angeles mayor Fred Eaton who, along with J. B. Lippincott had begun to orchestrate a series of complex and disingenuous arrangements to secure the land and water rights to all the Owens Valley, 238 miles away. They stealthily bought every other property along the Owens River and all the irrigation canals, ultimately forcing the remaining property owners to sell (Falzarano, 2003).

With San Fernando Valley land and Owens Valley water rights in hand, the syndicate proposed to the Water Board that the City of Los Angeles should build – and finance – a massive aqueduct. The city agreed to float a \$25 million bond, but the voters still had to approve it. A drought in 1904 helped the syndicate utilize their power of the press to stimulate widespread fear of a water shortage, and project sponsors clandestinely dumped water from reservoirs into the sewage system, prompting a water shortage so severe that on the eve of the election, an ordinance was passed forbidding people to water their lawns. On September 7, 1905, citizens approved the bond issue (McWilliams, 1946).

With the promise of so much water in the valley, land values soared. Land that the syndicate had paid between \$35 and \$50 an acre for a few years previous was sold for between \$500 and \$1,000 an acre, yielding them an estimated \$100 million dollar profit, at the expense of the residents of the Owens Valley and the city of Los Angeles (McWilliams, 1946).

The engineer in charge of the aqueduct project for the city's Department of Water and Power was one-time zanjero and protégé of Eaton, William Mulholland. He designed it to terminate thirty miles outside the City of Los Angeles in the San Fernando Valley. It was capable of delivering a quarter billion gallons a day - ten times more water than the city could use in 1913 when the project was completed (Falzarano, 2003). At this point in history, it could be argued that the city didn't need more water, the water needed more city.

While the aqueduct did not actually reach the City of Los Angeles, a third of the water used for



Figure H-6. Opening of the Los Angeles Aqueduct, 1913.
(San Fernando Valley Historical Society)

irrigation in the valley would still accrue to the city by transfer to groundwater through the natural connection of the Glendale Narrows. However, since revenues from demand within the City of Los Angeles would not be sufficient to repay the bond interest on the aqueduct construction, the final pieces of the complex scheme had to be implemented. A landowner in the valley paying to irrigate a one-acre orchard could transform his acre into several residential units requiring the same amount of water. If all these new homeowners could become tax-paying citizens of the City of Los Angeles, the bond would be more quickly satisfied. Annexing the valley would ensure the City's rights to all Owens River water and enough citizens to pay the bills (Falzarano, 2003).

In 1915, nearly all of the subdivisions in the Tujunga Watershed became incorporated into the City of Los Angeles, excluding the Cities of San Fernando, Burbank and Glendale. The water from Owens River transformed the San Fernando Valley into a rich agricultural region and contributed to a rapid increase in the number of new homes built between 1916 and 1923 (Falzarano, 2003). Ironically, many of these homes were built directly in the floodplains of Tujunga and Pacoima Wash.

. . . Water Everywhere

After the influx of settlers, native vegetation had been all but obliterated in the lower watershed and "floods, and forest fire problems multiplied" (Pozzo, 2005).

The arrival of the railroad brought more than just transportation and people to the region, the hurried development of the rail infrastructure precipitated a domino effect on the watershed's hydrologic cycle that would lead, in short order, to the complete channelization of the system. Confinement of the waterways, in turn, facilitated increased development.

After the storms of 1914, the County sent James P. Reagan, the Los Angeles County Flood Control Engineer all over the region to interview landowners of long standing about their experiences with flooding in the region, and to solicit their opinions about what should be done. Of those interviewed about the Tujunga Watershed, a majority remarked upon the construction of the Southern Pacific Railroad as the most singular intervention of consequence.

J.T. Wilson and J.H. Barclay were among those interviewed. Both had first come to the San Fernando Valley from Los Angeles in 1871 and had paid close attention to the hydrology in the region. According to their accounts, when they first came to the valley, the country was covered in "juniper, elders and some oak trees." The Tujunga Wash was running into the Los Angeles River with fewer branches that were narrow and deep, and with no great wide stretches as had developed by 1914. Pacoima creek was "only about one-third as wide as it is now." Mr. Barclay noted that the Southern Pacific Railroad had only left one 22 ft.-wide opening for the Tujunga, causing the channel to erode to a depth of about 40 or 50 feet. Mr. Wilson noted a change in 1875, when the "Tujunga broke out at the SPRR [Southern Pacific Railroad] and followed the railroad and the



Figure H-7. Railroad Bridge Washout, 1914
(Los Angeles Public Library)

washout left the ground in about the same shape as it is at the present time.” He said the railroad built a dike to force the water to go under the bridges, but in every large rain since, the wash continued to obliterate the dike (Reagan, 1915).

Wilson did not approve of the efforts to cement the channels and recommended willow and other grasses could provide “bank protection,” and recommended specifics for developing spreading grounds at the mouth of the canyon to help mitigate storm flows and encourage water absorption into the ground (Reagan, 1915).

The subsequent report to the Board of Supervisors made five primary recommendations for the watershed: construction of a masonry dam with a large impounding reservoir in Tujunga canyon, construction of a rock fill dam at Pacoima canyon, spreading of stream flows on 3,135 acres of land set aside for infiltration at the canyon mouths, check dams in the upper watershed, and reforestation of mountain slopes (Olmsted, 1915). The state legislature created the Los Angeles County Flood Control and Water Conservation District in June of 1915.

In 1931, the County constructed Big Tujunga Dam about 14 miles upstream of the valley floor to impound storm flows and conserve water. In March of 1938, after several days of rain had filled the dam to capacity, the region was hit by another storm front, and a decision was made to open the dam gates. A torrent of water poured through the canyon and across the valley floor, killing ninety-six people (Roderick, 2001). The flood ultimately led to the channelizing of the Los Angeles River and its tributaries.

The Hansen Dam, the largest earth-filled dam in the world, was built in 1940 to retain drainage from the Big and Little Tujunga canyons. It was named for Dr. Homer Hansen, who owned the property and 14 miles of the riverbanks in Big Tujunga Canyon. The construction displaced streets and ranches, but a 1,500-acre facility with picnic areas and a recreational lake was built for the community in return (Pozzo, 2005). With storm flows contained, development of the valley could continue unabated.



Figure H-8. Construction of Hansen Dam, 1939.
(San Fernando Valley Historical Society)



Figure H-9. Olive grove in Sylmar.
(West Valley Museum, CSUN Library)

The Valley Identity Evolves

With the seemingly unlimited availability of water for irrigation, agriculture was the culture of the valley during the 1920s (Roderick, 2001). There were a number of large ranches. Various crops flourished during this time period including olives, sugar beets, grapes, walnuts, oranges, tomatoes and lima beans (Roderick, 2001).

During the 1920s and 1930s Tujunga became famous after “Singing Jimmie Smith” wrote and recorded an homage: “The Best Little Town in the U.S.A.” Bolton Hall, built from boulders and rocks that washed down the canyon, served as an important location for community building and cultural events and was used as the venue for a number of civic organizations, concerts, meetings, and dances, as well as all church services (Pozzo, 2005).

Agriculture was not the only industry that boomed during this time period. Shortly after the beginning of the twentieth century, movie directors began to flock to the valley for filming because of its versatile terrain and authentic looking western locations. In comparison to New York or even Hollywood the valley was predictably sunnier, this was an advantage to film makers since every frame of film had to be exposed in natural light. Thousands of films, including *Birth of a Nation*, *Casablanca* and *It's a Wonderful Life* were filmed in the area. With a little movie magic, the areas varied terrains stood-in for just about anywhere on earth.

In 1928 Mack Sennett, also known as “The King of Comedy”, built Sennett Studios on a former lettuce ranch along Ventura Blvd. near the confluence of Tujunga Wash and the LA River. His movies featured famous comedian Charlie Chaplin. However, the Great Depression hit and the studio was forced to close due to bankruptcy. In 1935 the studio became known as Republic Studios, home of movie cowboys Gene Autry, Roy Rogers and John Wayne, and grew to making fifty movies a year. In 1963 CBS Television Network leased the studios and through various business deals with production companies, has been home to a number of television series and movies (Roderick, 2001).



Figure H-9. Republic Studio, 1930.
(San Fernando Valley Historical Society)

A number of movie studios, including Universal, Warner Brothers and Disney, were established along the banks of the Los Angeles River. The motion picture business became the valley's third largest industry, behind ranching and real estate development. Studio City was developed adjacent to Sennett Studios, covering almost 500 acres with residential subdivisions and businesses. Maxwell Terrace, at Ventura and Laurel Canyon Boulevards, became the first housing development in the southern watershed (Roderick 2001).

As the movie industry moved to the San Fernando Valley, movie stars came to the valley to live and relax. Actors and actresses enjoyed a lifestyle that catered to their more pampered sides. Country clubs, golf courses, airfields, polo and cricket fields, equestrian centers, and swimming pools appeared in the valley to serve the wants and needs of the rich. One remaining example of this is the Lakeside Country Club, which attracted a large number of celebrities (Roderick, 2001).

While the seemingly perpetual sunshine was one of the things that made the valley attractive to the movie industry, the literary community often illuminated the dark side of valley life. Raymond Chandler's short story *Red Wind* focused on the effects that the valley's Santa Ana winds often had: "[T]hose hot dry [winds] that come down through the mountain passes and curl your hair and make your nerves jump and your skin itch. On nights like that every booze party ends in a fight. Meek little wives feel the edge of the carving knife and study their husbands' necks. Anything can happen." James M. Cain's *The Postman Always Rings Twice* and *Double Indemnity* were also set here.

Transportation and Parks?

In 1911, The Pacific Electric Trolley system, which had been established by M.H. Sherman was taken over by a group of investors, many of them the same men who engineered the great land and water scheme. By 1913, they had extended the trolley system to the far reaches of the valley. The red car system stretched from the valley to as far east as Azusa and Covina, and as far south as San Pedro, Santa Ana and Newport Beach (EHRA, 2006). The valley's roads were still largely dirt; new automobiles and horse-drawn carriages shared a single road through the Cahuenga pass to the city. The trolley gave residents, especially young people, freedom to travel the region. The trolley took valley residents to the beach, the mountains, Hollywood and a numerous attractions that drew newcomers to the region including "freak exhibits" and other "must sees" (Pozzo, 2005).



Figure H-10. The "Red Car" comes to Van Nuys, 1911.
(Los Angeles Valley College)

In 1907, the Reverend Dana Bartlett published *The Better City*, wherein he promoted the notion that nature offered the regenerative powers to help battle temptations and vices. Citing growth projections, he advocated for the creation of parks, especially ones that presented “the natural condition which the city dweller longs for; parks so large that there is room for the planting of all kinds of trees in their native soils and altitudes.” He called for the city to engage a planner to realize this grand vision.

Twenty years later, the prestigious Olmsted Brothers and Harland Bartholomew and Associates Firms were hired by a “citizens committee,” comprised largely of Chamber of Commerce members, to develop a comprehensive plan to address the need to dedicate park space in the rapidly expanding Los Angeles region. In their report, *Parks, Playgrounds, and Beaches for the Los Angeles Region*, they found that the region spent more than other comparable American cities to “advertise its assets, but also spent the least to maintain and enhance them,” that Los Angeles did not meet the minimum recreation facility number, that the Los Angeles River was serving as a sewer for industries rather than as a clean water source, and that dozens of the City’s parks should be condemned due to their filthy and unsanitary condition. The plan was submitted to the committee in 1930, but was quietly shelved (Hise and Deverell, 2000).

Three factors have been variously attributed to the plan’s deliberate demise. First, given the wide geographic scope of the plan, the City’s existing Parks Department and Playground Recreation Department faced elimination in lieu of a new countywide parks commission. Second, the cost was high, and the City was still using revenue from taxes to pay for the construction of the Los Angeles Aqueduct. In addition, faced with the reality of the choice, the major developer/landowners in the valley preferred to maximize their potential profit rather than set aside land for a shared park system. (Hise and Deverell, 2000; Falzarano, 2003).

By the 1920s, as the popularity of automobiles increased, trolley service to some communities was discontinued as tracks were paved over, and the trains had to yield their high speed right of ways to traffic crossings. Lack of public support defeated plans for a subway or elevated rail system, and bus lines began to replace the red cars in many areas (USC, 2002).

World War II brought a brief resurgence in popularity to rail travel, and the refurbishing of some lines. At its peak, the Pacific Electric Railway was huge: 1,150 miles of track covering four counties and 900 cars. 1944 marked the highest ridership: over 109 million passengers. But by the 1950s it was clear that the automobile had become the premier means of travel in L.A. The explosive growth and sprawl of L.A. in the postwar years, lack of public money to keep up the existing lines, and the huge increase in automobiles all conspired to kill the red cars. The last regular trolley car left the valley at the end of 1952. All trackage was pulled up except for the SP trackage in the vicinity of North Hollywood. The right-of-way through Cahuenga Pass was paved over in 1957 to add two additional lanes to the Hollywood Freeway (EHRA, 2006).

World War II Industry and the Post-War Boom

By 1936, the City of Los Angeles controlled the electric power business within city limits. The combination of water and power supplies made the region an ideal location for some of the nation’s largest industries, including chemicals, electronics, and of course, aircraft design and manufacturing for World War II. In 1940, as the country was entering into World War II, aircraft factories had begun to emerge near the valley’s airfields. Residents became welders, assemblers and designers for warplanes and machinery. After the bombing of Pearl Harbor, Lockheed Corporation employed 90,000 people (Falzarano, 2003). By the end of the decade, nine of the ten largest manufacturers in the valley were in the service of the Defense Department (Roderick, 2001).

The 3,177 people of Japanese descent that lived in the San Fernando Valley were important contributors

to the agricultural economy in the region. When President Roosevelt signed the order that forced them into internment camps in 1942, the farms that much of the valley's economy relied upon were left to fallow until women and teenage boys (who comprised much of the remaining work force not drafted for the war effort) took over the farming (Falzarano, 2003). After the war ended and the Japanese Americans were released, they returned to their former homes and farms to find out that they had lost everything. Their land had been turned into subdivisions or was owned by other people, and they were not able to participate in the "valley dream" that benefited war veterans and families looking for a fresh start (Roderick, 2001). The San Fernando Valley Japanese American Center opened in 1951 to preserve the culture and language of the Japanese American community in the valley. It continues to this day to serve as a vibrant community center (SFVJACC, 2006).



Figure H-11. Panorama Ranch 1946, with Tujunga Wash on right, Pacoima Wash on left.
(Los Angeles Public Library)

Panorama City became an important hub for the rest of the valley because of its amenities and job-creating industries. The second largest General Motors plant in the country, the Schlitz Brewing Company, and the Carnation Research Laboratory all sprung up around it. The San Fernando Valley was quickly deemed "the best real estate market in the world." The region, with its suburban lifestyle, suddenly became very attractive to veterans on the GI Bill who with their families moved into the newly built, affordable tract homes. Radio stations promoted the valley lifestyle to their nationwide listeners, with one broadcaster saying GI's liked it because "it reminds them of their own hometown" (Roderick, 2001). After World War II, the area became almost completely white and middle class. This was a trend was the "epitome of everything that we associate with the great demographic dispersion of the post-war era" (Kotkin and Ozuna 2002).

Before the war, much of the region was relatively rural and lacked running water, sewers, paved roads, and streetlights. Post war development in the San Fernando Valley witnessed the introduction and rapid proliferation of the suburb to the Tujunga Watershed. Developer Fritz R. Burns, and industrialist Henry J. Kaiser, had introduced standardized tract housing in North Hollywood just prior to the war. On May 9, 1945, the day after World War II ended, they announced their plan to develop Panorama City. Burns and Kaiser constructed their idea of the perfect town and provided the modern infrastructure to support it. Schools, churches, hospitals, and commercial centers needed to serve the population soon followed (Roderick, 2001).



Figure H-12.
Panorama City and shopping center, 1955.
(Los Angeles Public Library)

By 1950, the San Fernando Valley's population exploded to 402,538 residents, becoming the ninth-busiest urban area in the United States. In short order, the area had transformed from a sparsely populated region dominated by agriculture to a bona fide American suburb.

The development of the valley allowed for a lifestyle different from, but in proximity to, urban living. The valley lifestyle during the Post war era was characterized as "casual" and became what is now known as the "Southern California way of life." Tract homes allowed for families to have their own spacious yards and entertain guests with barbecues and backyard pools. There were parks to play baseball in, and "safe" streets to wander. When the Dodger's moved to Los Angeles in the 1950s, baseball became an important part of daily life and fans spent their summers listening to the World Series on their radios. Churches and synagogues were important institutions where valley residents interacted and built their strong community connections. (Roderick, 2001)

While many enjoyed "valley living," some realized the importance of the past and fought to keep the region's rural roots. 1940's city-planning director Charles B. Bennett predicted the harmful impacts of growing too fast. He proposed a new way of living that embraced the current changes and the old way of life. He believed that it was possible to preserve the rural past and maintain open space. He proposed mixed zoning to maintain small farms, and emphasized the natural beauty of the region by proposing the planting of native trees and the creation of bridle paths along the washes and tributary streams. However, growth was important to developers who believed that the region could grow to 2 million, and Bennett's ideas were dismissed (Roderick, 2001).

After the elimination of the trolley system, public transportation was virtually nonexistent and automobiles were necessary to navigate the region. As more people flocked to the valley, dependence on automobiles caused smog to become a serious health issue, especially for children. Congestion increased, and it wasn't

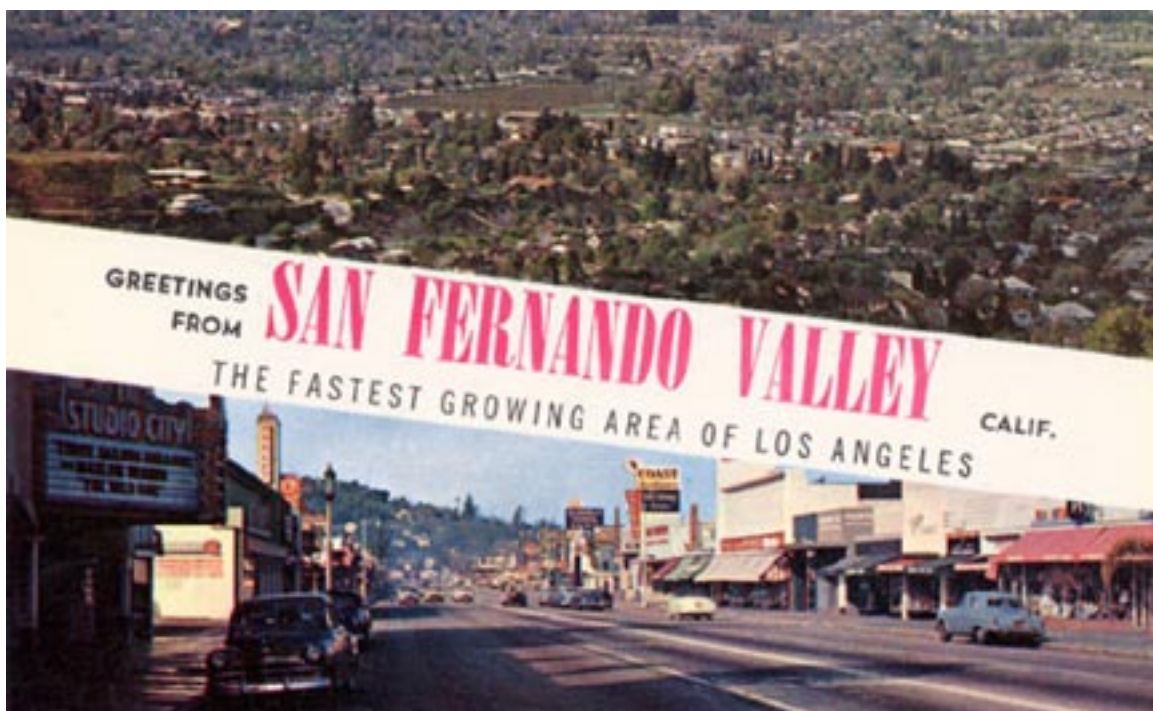


Figure H-13. '50's post card.
(Delmar T. Oviatt Library, Urban Archives Center)

until the 1960's that freeways would be constructed to ease the traffic on the small, country roads. Many of the reasons that people sought to live in the valley seemed to be drifting away, and these problems began to infringe on the "valley life" so many adored (Roderick, 2001).

Confirming the predictions of Bartlett, the Olmsteds, and Bennett before him, a city planning consultant in 1956 commented: "The valley is neither as livable or efficient as it might have been." He noted that not enough land had been set aside for parks and public spaces to support cohesive communities, and the proliferation of strip malls was "not only inefficient in that it strangles traffic movement, but it is violently ugly and blighting to the residential areas fringing it." He concluded that suburbia had been allowed to "sprawl uniformly mile after mile, with little variation in density or dwelling type, making for monotony not only of view but of inhabitants" (Roderick, 2001).

Changes in America's Suburb

In the late 1950's the community of Pacoima came to exemplify the valley's changing culture through a rock and roll idol and a Baptist minister.



Figure H-14.
Richie Valens signs autographs for fans, 1958.
(Del-Fi Records)

Richie Valenzuela was a guitar-playing Chicano kid whose heroes were Roy Rogers and Gene Autry. At 16, he joined the Silhouettes, a local garage band with an ethnic mix that reflected Pacoima: Black, Japanese and Chicano. They quickly became in demand at dances all over the valley. A local record company signed Richie – without the Silhouettes – to a contract and changed his name to Richie Valens. His first record hit the national pop charts within months. His second hit, Donna, was written for a white girl he met at a Panorama City party, whose parents did not approve of their dating. La Bamba was the flip side to that single. With these three hits, Richie became the first rock and roll star of Mexican ancestry and the valley's hometown hero. He was killed in a plane crash at 18. Today, a park bearing his name stands at Laurel Canyon and Paxton, and the US Postal service created a Richie Valens stamp in 2000 (Roderick, 2001).

Pacoima was the valley's defacto ghetto and a haven for the African American community. In 1960, 90% of the valley's African American population lived in Pacoima. It was the one valley community where deed restrictions, though ruled unconstitutional in 1948, were not practiced. Hillery T. Broadus, the pastor of the local Baptist Church, fought to change that. He helped found the Fair Housing Council of the valley in 1960, and through his efforts, the valley began to change. Rev Broadus helped quell tensions in Pacoima after the Watts riots of 1964 (Roderick, 2001).

Today there is an elementary school named after him on Filmore Street in Pacoima.

By 1960, population in the valley had doubled again over the course of a decade, and the arrival of the freeways opened the door for another development frenzy. Easy travel in and out of the area spelled the death knell for the last of the valleys citrus and walnut groves.

During the 1960s and 1970s, the emergent social and cultural revolution had a significant impact on the 100,000 teenagers coming of age. The children of those who sought the “American Dream” and “valley lifestyle” rebelled against their parents’ patriotic, crew-cut ethic. The new counter-culture began to fight for the right to wear their skirts short and their hair long, and refused to participate in traditions of the towns such as parades and festivals. Weekend activities were no longer centered on barbecues in their parent’s backyards. If you were a teenager in the valley, your objective was to get out (Roderick, 2001).

Teen alienation combined with car culture to create activities like car clubs, drag racing and cruising Van Nuys Boulevard on Wednesday night, or racing on the San Fernando Drag Strip, later celebrated in movies like *Rebel Without a Cause* and *American Graffiti*. Drive-in movie theaters like the Victory, the SanVal, the Laurel and the Van Nuys were date night magnets (Roderick, 2001).

By the mid-sixties, rock music festivals, war protests, and campus demonstrations for racial justice taking place in the valley were making national news headlines. In February 1966, Neal Cassady, Wavy Gravy and the Grateful Dead unleashed one of their “acid tests” at the Unitarian church on Haskell known as The Onion (Roderick, 2001).

Two months before Woodstock in June of 1969, the three-day *Newport ‘69* headlining Jimi Hendrix, Joe Cocker, The Byrds, Jethro Tull, Creedence Clearwater, Marvin Gaye, Ike and Tina Turner, and Miles Davis, among others, drew 200,000 fans to Devonshire Downs. The largest rock festival the country had ever seen was staged in the middle of suburbia (Roderick, 2001).



Figure H-15. Cruising Van Nuys Boulevard in the 60's.
(Los Angeles Times)

When two Manson Family members were arrested in San Fernando on August 8, 1969 for trying to use stolen credit cards, Manson ordered a revenge killing. The Tate-LaBianco murders brought the summer of love to a grisly end that caused valley residents to look more closely at their neighbors. The image of the valley as a safe haven had been irrevocably altered (Roderick, 2001).

In 1974, artist Judith Baca conceived The Great Wall of Los Angeles, a public art project painted on the concrete walls of the channelized Tujunga Wash, adjacent to Los Angeles Valley College. Through her leadership it was completed over five summers by urban youth. The Great Wall represents the “the history of ethnic peoples of California from prehistoric times to the 1950s” and is a “monument to inter-racial harmony”. It displays significant periods in Los Angeles history such as the Japanese internment, the Zoot Suit Riots and the Civil Rights movement. The Great Wall includes a greenway and trails and is recognized as the largest mural in the world (SPARC, 2006).

The 1970s brought controversy over school bussing, with many valley residents fighting to maintain the status quo. Under pressure to de-segregate the school system, Los Angeles board of education planned to bus thousands of students all across Los Angeles. In fear, many families moved their children to private schools or left the valley for smaller municipalities outside the school district. White flight accelerated the changing face of the valley (Roderick, 2001).

Shopping malls like Valley Plaza and Sherman Oaks Fashion Square became social centers for those too young to drive themselves out of the valley, especially young girls. This new subculture would be widely satirized in later years in the hit song 'Valley Girls' (written by Moon Unit, daughter of local counterculture icon Frank Zappa).



Figure H-16. Great Wall of Los Angeles Mural (Detail).
(SPARC)

In the 1980s, pornographic film production and distribution began to replace manufacturing as one of the valley's largest industries, as the General Motors and Lockheed plants closed their doors. Welfare caseloads in the watershed soared by 80,000 in the year and a half following Lockheed's closure. Formerly working class families were now living below the poverty line.

In the wake of widespread unemployment, another subculture took root in the valley. Several prominent gangs emerged and gang violence became an issue of concern. The most dangerous street in Los Angeles, according to the LAPD, was not in South Central or East L.A., but in the Tujunga Watershed on Blythe Street, a few blocks from the shuttered General Motors plant (Davis, 1997). The Los Angeles Police Department has three gang injunctions within the watershed: Blythe Street, Langdon Street and the Pacoima Project Boys (LAPD, 2006).

The New Century

In the Tujunga Watershed, minority populations now constitute the majority of the overall population (see appendix 4). This is clearly expressed by the record of commonly spoken languages in public schools. After English and Spanish, the most common languages in the valley are Armenian, Korean, Tagalog, Vietnamese, Farsi, Russian, Thai, Punjabi, Arabic and Khmer. The least diverse sections of the valley are now the traditional minority enclaves. Elementary schools in Pacoima feature just one non-English language: Spanish (Roderick, 2001).

The valley was once considered a suburban area, but that may no longer be the case. The valley is following a pattern that is occurring across the country, and is actually considered an "older suburb" or "midopolis". Residents have left and begun to move further out of the region into more remote suburbs, and change occurs in the racial and ethnic makeup of the area. Many have made the claim that the valley has evolved into "a city in its own right" (Kotkin, 2001).

The concept of the valley becoming a city in its own right is one that had emerged in 1941, in 1960 and in the

mid-1970's. As valley disaffection reached another peak in 1999, the issue of secession was put to the entire city of Los Angeles for a vote. Throughout the debates, the question of water rights was repeatedly raised. In the end, voter turnout was abysmal and the measure failed. But the valley, particularly its underserved communities, continued to express dissatisfaction (Roderick, 2001).

Secession proponents had sought an increased and more efficient level of services, and increased representation for local constituents in the decision-making processes that affect their lives. In an effort to address some of these concerns, Neighborhood Councils were established through an amendment to the Los Angeles City Charter in 2000. Eight of these councils are entirely or almost entirely within the boundaries of the Tujunga Watershed, and nine more have portions of their districts within the watershed (see appendix 4). These councils are recognized as entities of city government, and are involved in land use decisions, delivery of city services, and budgetary processes. In order to incorporate "a more holistic view of the definition of community" and legitimize themselves with those they serve and those they seek to influence, stakeholders with diverse interests are included in the determination of a council's activities. The degree to which they succeed "will affect whether Los Angeles retains its current identity and structure" (Parlow and Keane, 2002).



Figure H-17. Some residents feel that the San Fernando Valley should become its own city. (Los Angeles Daily News)

Although the Tujunga Watershed has changed since it was considered "America's suburb", it is still seen as a place where a hard-working family can live the American dream and climb the social ladder. However, the economically built tract homes and apartment buildings that represent relatively affordable housing opportunities for middle-class immigrants are rapidly aging. For developers, this represents a redevelopment opportunity.

Many neighborhoods in the watershed are facing challenges that impact the very things that define their identity. Communities with high percentages of middle class renters are seeing affordable apartments replaced by a proliferation of high-end owner-occupied developments that threaten to limit diversity. Equestrian areas with the last of the large tracts of open space are being replaced with condominiums that meet new density requirements. Density is encouraged along areas defined as transportation corridors, but with the exception of the new Orange express busway, the range of available transportation options in the watershed has not increased along with the population.

In a recent study eighteen percent of valley residents indicated that traffic was what they "liked least about the San Fernando Valley" and sixteen percent indicated, "population/ overcrowding." Twenty four percent indicated that they were "very concerned" and thirty eight percent responded that they were "concerned" about water pollution (EASFV 2000).



Figure H-18. The lower watershed today.
(The River Projects)

Conclusions

It might be argued that certain seminal events that would ultimately have a direct impact on much of the southwest's water took place within the Tujunga Watershed. The numerous lawsuits over riparian rights which ultimately led to the legal determination asserting the city's Pueblo Rights; the creation of the Owens Valley Aqueduct, which became the first of several massive man-made delivery systems to alter eco-systems far beyond local boundaries; the arrival of the railroad, which altered a critical point in the region's hydrology and spawned the genesis of modern flood control. These events together facilitated the rampant development and sprawl that continues to impede watershed function.

The indigenous groups that originally inhabited the region understood the natural cycles of the watershed and preserved the natural landscape to work with the natural hydrologic cycles rather than attempt to control nature. As settlers began to move to the region and introduce new types of land use practices, including livestock, farming and railroads, they ignored the natural conditions and suffered the consequences of flooding. In the 20th century, modern engineering made it possible to obviate human accommodation to nature, but also had the effect of limiting human awareness of natural conditions and access to precious natural resources. The unabated development that followed produced a lack of public open space, significant traffic, and air and water pollution.

Over the past 100 years, the Reverend Dana Bartlett, Olmsted Bros. and Bartholomew Assoc., and Charles Bennett all made recommendations for open space and land use from the perspective of how these approaches would benefit the psychological, social, and spiritual health of human communities. In each case, expediency or profit won out.

People are beginning to think critically again about their relationship to the land and how some of the negative impacts of sprawl and development can be reversed or at least ameliorated.

Recommendations

Improving the human relationship to the watershed is a fundamental requisite for meaningful change. Effort will need to be expended towards expanding awareness and appreciation of the natural character of the Tujunga/Pacoima Watershed, and fostering a human community that values the intrinsic ability of natural eco-systems to support and improve their quality of life. The Senegalese environmentalist Baba Dioum said it succinctly: "In the end we will protect only what we love. We will love only what we know, and we will know only what we are taught."

Establishing an identity for the watershed that links to its natural history can shape perceptions, and inform and justify sustainable practices. In order to assist communities in developing a stronger sense of place, we can begin with those who are actively engaged in learning.

Work with the state's new Education and Environment Initiative to develop and promote curricula in schools that focuses on the specifics of the local eco-system, highlighting habitat, water supply and water quality issues, flood safety, sustainable living, and environmental justice.

Partner with Los Angeles Valley College and Mission College to develop and implement local monitoring and stewardship programs. With the proper resources, students can gather and analyze data, and act as mentors to lower grades.

Provide the community with a means to learn from the indigenous people by developing an educational Tataviam Heritage Center. Include information about tribal history and practices in local educational curricula.

Work with and involve Neighborhood Councils. Neighborhood Councils can shape land use practices and community plans and can be powerful partners in education and outreach.

Support a watershed coordinator to assist in sharing of information, facilitate partnerships, and engage local communities in identifying, prioritizing, designing, implementing and maintaining watershed improvements.

Produce Watershed-U annually in order to foster an understanding of the natural cycles specific to the watershed, inspire a native landscape ethic, provide communities with direct access to resources, create a culture of stewardship, and instill a conservation ethic linked to sustainability.

Community Economic Conditions

Introduction

The lower Tujunga Watershed is an intensely developed area faced with increasing growth pressure. Much of the major infrastructure and housing stock is aging and will likely be replaced or redeveloped within the next two decades. As more people migrate to the region and families grow, there will be increasing pressure on the watershed's infrastructure and natural resources. As redevelopment occurs, the region has the opportunity through intelligent planning to improve quality of life, further economic prosperity and maintain environmental health. Innovative approaches to redevelopment can ensure that both natural and human communities thrive as redevelopment occurs.

Findings

Demographic overview

Approximately 525,000 people live in the 225 square mile Tujunga Watershed. The upper watershed is the Angeles National Forest and is very sparsely populated. In contrast, the lower watershed is highly urbanized and contains the majority of the population.

Ethnic enclaves and concentrations of specific races dominate particular neighborhoods but the Tujunga Watershed, as a whole, is representative of many portions of Los Angeles County. Residents who identify themselves as of Hispanic or Latino ethnicity (of any race) are a comparatively small percentage of the population in Sherman Oaks and Studio City, at the southern end of the watershed, but predominate throughout the northern and central section of the lower watershed. Arleta, Mission Hills, Pacoima, Panorama City, Van Nuys, and the City of San Fernando have census block groups ranging from 80% to over 97% Hispanic/Latino residents. In Los Angeles County, 44.6% identify themselves as Hispanic or Latino; in the Tujunga Watershed, that figure is 60.7%. Neighborhoods with a high percentage of Hispanic/Latino residents also tend to have a higher percentage of children. Demographic figures from the Los Angeles Unified School District (LAUSD) substantiate this. Children are an important part of community life. There is a high percentage of children in the watershed with much of the area having at least 30% of the population under 18 years of age (see Appendix 4).

Ethnic diversity is one of the most striking features of the Tujunga watershed demographics. In the lower watershed, primarily white communities are clustered at the confluence of the lower Tujunga Wash with the Los Angeles River. In the populated regions above Hansen Dam, white neighborhoods also predominate. The rest of the watershed is somewhat better integrated, with Black or African American and Asian residents present throughout the region, but at lower percentages than in LA County. Communities with higher than average percentages of Black/African American residents tend to be neighborhoods where the percentage of Hispanic/Latino residents is lower than average, including parts of Sylmar, Mission Hills, and North Hills. This is also true for Asian residents, scattered through the watershed, with concentrations in various Arleta, Sun Valley, North Hills, and North Hollywood neighborhoods. Percentages of other races, American Indian and Alaska Native, and Native Hawaiian and Pacific Islander are low except in a very few locations (see Appendix 4). The San Fernando Valley is often described as a place where immigrants can come and have a chance of "making it." Immigrant groups include Iranians, Armenians, and Soviet Jews. The Caucasian population is decreasing while that of traditionally minority groups such as Hispanics, Asians, and African Americans is growing (Kotkin & Ozuna, 2002).

All economic indicators, including median household income, are quite variable. The percentage of individuals whose incomes are below the poverty line averages 18.1%, and ranges from 0% to over 54% in some neighborhoods. Highest rates occur in high-density areas of Panorama City, North Hills, and North Hollywood, and in Pacoima (see Appendix 4).

Economic, Industry/Commerce

Seven companies were identified as having a significant presence in the Tujunga Watershed. Four companies (MiniMed Inc., Ocal Inc., Trio-tech International, Pico Products Inc.) have between 150 and 600 employees, American Cytogenetics, Inc. has 50 employees and the largest, PMC Global Inc., has 4100 employees. CBS Studio Center is also one of the seven largest companies in the watershed, though exact information could not be obtained. The annual revenues of these businesses range from \$4.7M – \$849M (Kotkin & Ozuna, 2002). These businesses are of varied categories with fields such as healthcare, entertainment, medical supply provision, and production of various types of equipment. CBS Studio Center, American Cytogenetics Inc. and PMC Global Inc. are located along the Tujunga Wash, and Trio-tech International is located along the Pacoima Wash. Pico Products Inc. is located adjacent to the 210 and the 118 freeway off ramps and the others are not located directly off of a freeway.

In addition to these highlighted enterprises the region is known for aerospace, entertainment and biotechnology (Mulholland Institute, 2004). Sylmar, located almost directly off of the 5 freeway, Mission Hills, located off of the 405 freeway, and Panorama City, are among several communities identified supporting biotechnology clusters. The presence of these businesses in the watershed enhances the opportunity for similar business to cluster in close proximity. The creation of service sector jobs could greatly benefit the community, but in order for the jobs to remain in the watershed, the education and skill level of residents must be adequate. Fortunately, the watershed includes two community colleges, and has access to several universities as well as workforce assistance programs that are designed to provide training to prepare workers for the regions economic opportunities. (Training Alliance & Economic Alliance of the San Fernando Valley, 2001)

Housing

Housing in the Tujunga Watershed is diverse and population densities within residential communities are quite variable. Originally an area of single-family residences surrounding long-established neighborhood centers, infill housing has been built at higher densities. Multiple-unit housing tends to be clustered, often near business districts. Highest population densities occur in the central part of the lower watershed in the communities of Panorama City, North Hills, and North Hollywood (see Appendix 4). Densities are increasing near designated transit corridors, though they are not necessarily well served by public or alternative forms of transportation.

Rental vs. owner occupancy of households in the watershed is an indicator of the relative permanence of the population and tends to correlate with the density of housing units, because rentals tend to be apartments or mobile homes; this is true for these communities. Parts of the City of San Fernando and the community of Tujunga have higher than average levels of renter-occupied housing, as do some neighborhoods in the southern watershed, from Valley Glen through Valley Village and Studio City. Highest proportions of owned housing tend to be in the middle to upper section of the lower watershed, in Arleta, Pacoima, Sylmar, and Sunland. Household size is largest in these communities and lowest in the southern watershed. Household size does not correlate with population density, but does reflect a high percentage of children. Population density and home ownership sometimes correlate with economic data, as they do in parts of the urbanized watershed, but special circumstances of the Los Angeles housing market preclude generalization. High levels of home ownership occur in areas of comparatively low median household income in sections of

Arleta and Pacoima; conversely, high levels of renter-occupied housing exist in many communities with the high incomes (see Appendix 4).

Affordable housing is difficult to find in the Tujunga Watershed. Housing shortages are due largely to population growth, lack of mixed-use development, and poor use of space. These shortages have decreased affordability for many people, forcing individuals to rent instead of buy and/or live further away. However, some programs exist to make housing more affordable and to retain working professionals in the area. (Cisneros, 2003)

Transportation

There is a direct correlation between transit dependency and income level. The provision of adequate transportation services affects economic potential as well as quality of life. Transportation systems that are primarily auto-dependent have a greater impact on air quality and water quality. A variety of transportation infrastructure exists in the watershed, however the majority of it requires the use of a private automobile.

Seven major highways/freeways cross the watershed: Interstate 5 passes diagonally through the lower watershed; Interstate 210 runs parallel along the foothills of the San Gabriel Mountains; State Highway 118 begins at the 210 Freeway in Pacoima and heads westward toward Simi Valley; U.S. 101 crosses briefly through the lower watershed; Interstate 405 runs south along the western boundary of the lower watershed; State Highway 170 runs south along lower watershed's eastern border, and State Highway 2 runs along the southern and eastern portion of the upper watershed within the Angeles National Forest and is the main artery through the Forest's territory. These cover approximately 33 miles within the watershed (Figure G-4).

Two Metrolink rail lines that cross through the lower watershed serve commuters from as far west as Ventura County and as far north as the Antelope Valley. Both connect with Union Station in downtown Los Angeles. The southern-most line has one station just outside the western boundary of the watershed in Van Nuys, and another at the Bob Hope airport in Burbank four miles east of the watershed. The northern-most line has one station serving Sylmar/San Fernando and another approximately two miles outside the watershed boundary in Sun Valley. These two lines cover approximately nine miles within the watershed.

Bus service in the lower watershed varies between the northern and southern regions. North-south bus lines exist at intervals of approximately one mile throughout. In the southern portion of the lower watershed, east-west bus lines exist at intervals of a half-mile. In the middle and northern portion of the lower watershed, distance between east-west bus lines widens to as much as a mile and a half. Service on most lines is local. Rapid (express) service is provided along the Orange Line and on the Red Lines on Ventura Blvd & Van Nuys Blvd.

Pedestrian, equestrian and bicycle corridors exist, but most are fragmented and do not provide access to important destinations such as civic and commercial centers, or linkages to other transportation routes. Users are often discouraged because the corridors are disconnected and generally shared with dangerous traffic (see Land Use section of this report).

Crime

Perceptions of crime activity in the lower watershed vary depending on the neighborhood and familiarity with the region. The table below presents general statistics on crime for the four Los Angeles Police Department divisions within the watershed. These statistics provide some relative numbers, but don't provide a true picture of the watershed because each division includes areas outside the watershed. Approximately one

third of the Van Nuys and North Hills divisions lie within the watershed, and approximately two-thirds of the Foothill and Mission divisions lie within the watershed. Figures for the Angeles National Forest and the City of San Fernando were not available.

Table I-1. Crime Summary for LAPD Divisions within the watershed 7/1/05 – 7/1/06
(Source: LAPD)

Crime Type	Van Nuys	No. Hollywood	Foothill	Mission
Homicide	11	10	18	19
Rape	64	56	26	47
Robbery	595	483	286	444
Aggravated Assaults	645	670	469	594
Burglary	1,481	1,505	722	925
Grand Theft Auto	1,553	1,808	1,003	1,234
Burglary/Theft from Vehicle	2,197	2,527	931	1,164
Personal Theft	1,910	1,725	766	1,015
Total	8,456	8,784	4,221	5,442

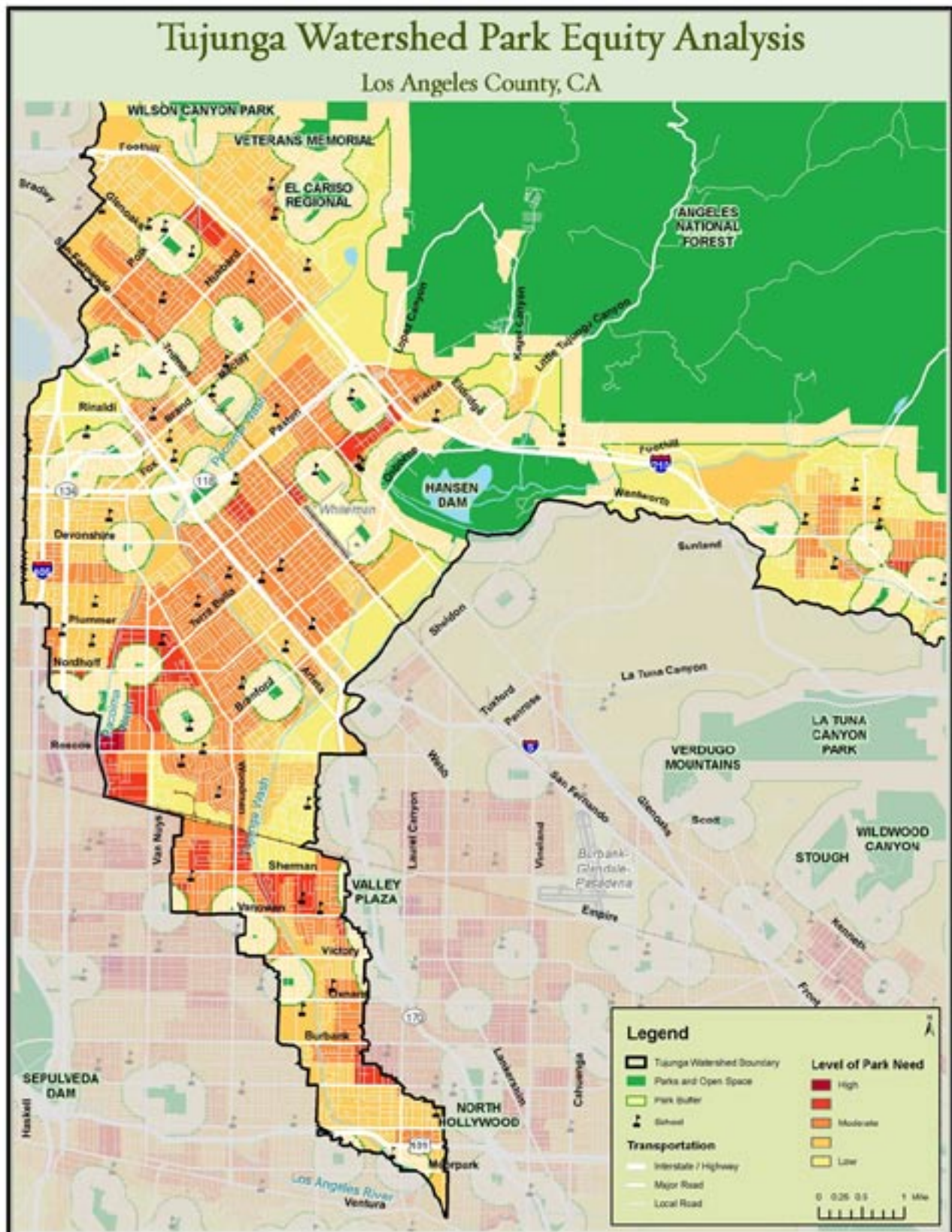
Parks and Open Space

The provision of adequate green space for the growing population will contribute to its economic vitality as well as quality of life for residents. Studies have shown that the quality of life in a community is an increasingly important factor for retaining and attracting corporations and businesses, and that parks, greenways, rivers and trails can be important contributors to quality of life (NPS, 1995).

The upper Tujunga Watershed consists primarily of Angeles National Forest land, which under federal control will remain undeveloped. Much of the lower watershed lacks sufficient community and neighborhood parks and recreational facilities. Generally accepted national standards call for between 6 and 10.5 acres of neighborhood and community parks per 1,000 residents (National Recreation & Park Association, 1999). Park space in the lower watershed comprises 2,088 total acres, but Hansen Dam Recreational Area makes up 1,295 of those acres (see Land Use section of this report). Taking into account a total population of 525,000 and existing parkspace in the watershed exclusive of Hansen Dam, watershed residents currently enjoy approximately 1.5 acres of neighborhood and community parks per 1,000 residents.

Proximity to parks improves public health and increase residential and commercial property values (NPS, 1995). A quarter mile is often considered a good walking distance for community access to a park one acre or more in size. Smaller parks an eighth of a mile is considered a good walking distance. Analysis shows that the parks in the watershed are not within walking distance of some of the highest needs population. High-needs areas were demographically defined as those with high population densities, high populations of children under 18, income under 25K, and in a census group with over 50% non-white. Figure I-1, created by the Trust for Public Land's Park Equity Model, demonstrates the results of this analysis and highlights the areas of most critical need.

Figure I-1. Park Needs Analysis
(Source: The Trust for Public Land, 2006)



Conclusions

In order to fully integrate economic prosperity and flourishing communities with a healthy environment it will be important to rethink community development in the watershed. Place making and community building are important and the watershed will benefit from communities with a mix of uses, transit oriented development and accessible green space.

The watershed's diverse population of nearly 525,000 is roughly 61% Latino, with 32% of the population under the age of 18, and 18% of households living below the poverty line. The area has several established industries that can serve as employment centers such as biotechnology and entertainment.

Redevelopment is occurring rapidly in the watershed due to aging housing stock and the continuous increase in population. Single family residences are being replaced by higher density developments. Much of the recent development is occurring near designated transit corridors, though these are not actually well served by alternative forms of transportation. Housing affordability has been declining.

The majority of the transportation options in the watershed require the use of a private automobile. This type of transportation could be considered the most damaging to watershed health because of the large amount of paved surfaces needed to accommodate vehicles. These surfaces prevent filtration and collect runoff pollutants. Additionally, the vehicles create emissions that diminish air quality and contribute to climate change. Pedestrian, equestrian and bicycle corridors exist, but users are often discouraged because the corridors are fragmented, disconnected from civic and commercial centers, and are often shared with dangerous traffic.

The lower watershed does not meet the national standard of between 6.5 and 10 acres per 1000 residents and comes in closer to about 1.5 acres per 1000 residents. This dearth of park acreage is exacerbated by the distribution of these acres, leaving only a small proportion of residents adequately served. Higher needs populations are particularly underserved. Because the watershed is highly developed there is only a small opportunity to set aside natural land or land for parks and open spaces. However, the watershed has several spreading grounds, surplus properties and public rights of way that can be designed to incorporate public access.

Encouraging concern and action in this watershed will have to begin by first piquing people's interest with messages that are basic to begin with and also very pertinent.

Recommendations

In accommodating its share of regional growth, higher density and transit accessible growth patterns are recommended for the Tujunga Watershed. These will decrease the need for costly automobile-related infrastructure and, if provision is made for adequate park and open spaces, will promote a more efficient use of resources such as land and water. In re-developing the neighborhoods of the watershed, it is important to plan for and designate open space into the design. Greenways or river corridors are a good opportunity to increase green space and provide recreational and alternative transportation opportunities. Public involvement in the planning process can insure that community priorities are met and understood.

In order to improve the quality of life in the area, residential, commercial and employment uses should be combined with a variety of housing types. In developing the economic vitality of the watershed the urban villages concept is recommended because it promotes mixed-use, pedestrian friendly development and

neighborhoods with a strong sense of place. Mixed-use areas are often desirable places that attract higher rents and property values furthering a cycle of prosperity.

The corridor development approach in the Specific Plan for the City of San Fernando is meritorious (Tung, Freedman, 2005). Three corridors were identified that will attract investment in the form of housing, office and commercial development. These corridors will be a focal point for clearly identifiable neighborhoods and will attract investment in the form of housing, office and commercial development. The design of these areas will play a role in determining their success. Streetscape is important and landscaping, pedestrian bridges, bike lanes and metered parking can encourage alternative forms of transportation and a greater street life. These development patterns are suggested because they are compact and promote an efficient use of land while also providing desirable services that help attract and retain residents and businesses.

As discussed above, the watershed contains a variety of viable businesses. In particular, the biotechnology industry has several footholds throughout the watershed. As these businesses expand they will need an increasing supply of educated workers. Therefore, in ensuring the prosperity of the region, education will be crucial. The region has many universities from which to recruit employees, and there are several economic alliances. Outreach to, and relationships with these entities should be strengthened so that the principles and practices of watershed management can become more broadly understood. Community design and quality of life in the watershed will be important in recruiting and retaining workers. People graduating from the many universities will have options and they may settle based on factors such as housing affordability, congestion and public space in addition to available opportunities.

As the Tujunga watershed continues to grow in population, transportation services will be needed to accommodate economic activity. It is suggested that future growth accommodate a greater variety of transportation options, both for environmental health and to better serve the population. Gaps in existing bikeway routes should be completed and priority should be given to Class 1 and 2 routes to encourage higher usage. Transit connections should be made available to facilitate non-automobile transportation.

Greenway corridors offer provide alternative means of transportation, preserve green space and create recreational opportunities. The opportunity exists to connect the Tujunga Wash and Pacoima Wash with the Los Angeles River Greenway. Several businesses including the larger employers, Pico Products and Trio Tech are along the Pacoima Wash. Incorporating transit connections from the greenway to the corporate campuses will be important and may offer an alternative means for employees to reach their office. A similar opportunity exists by extending the Hansen Dam bike corridor so that it could pass by the office campus of PMC Global Inc, which sits alongside the Tujunga Wash and employs 4100 people. CBS Studio Center is located along Tujunga Wash at the confluence of the Los Angeles River. As plans for Tujunga and Pacoima Wash greenways are realized, the proximity of these employment centers should not be overlooked.

As the Tujunga Watershed continues to grow in both population and commercial activity the protection of green space and habitat will be essential to maintain a high quality of life in the area and to maintain economic desirability. In the entire LA region, land for parks and open spaces is scarce and must compete with other uses. At the same time, however, there is an increasing demand for parks and open spaces that are accessible and safe. In addition, protected land provides necessary habitat for local plants and wildlife and it also promotes watershed health allowing stormwater to infiltrate and recharge groundwater.

Any plan to acquire open space or to create park lands must be sensitive to community wants and needs. One such community survey was done for the Pacoima Wash Greenway plan. While these results can't be generalized to the entire watershed, they can provide some insight on user needs. The survey showed that residents favored walking or jogging as a recreation activity, followed by bicycling (City of San Fernando,

2004). Local surveys should be utilized to create a hierarchy for use that informs potential projects and their relevance to the community.

In areas such as spreading grounds and public rights of way, additional access can be granted to allow the space to better serve the public.

The watershed now has several functioning spreading grounds that can be redesigned to incorporate public use. The Rio Hondo spreading grounds along the San Gabriel River is a precedent for potential projects (Pico Rivera, 2006). Public rights of way under utility lines also offer an opportunity to use already existing public lands for recreation and habit protection. These areas can be ideal for connecting areas for bike trails and/or habit protection.

Existing parks and open spaces can be retrofit to include best management practices such as detention and retention basins, as well as landscaping with native vegetation to allow for water conservation and habitat enhancement.

In addition to large parcels of open space, small pocket parks are also important. Because the standard for accessibility is $\frac{1}{4}$ of a mile, smaller parks that people can walk to are important to include in communities. One potential opportunity is to revitalize surplus properties, vacant lots, medians and other underutilized areas. Community gardens offer a opportunity for creating civic pride, regreening an area, improving the neighborhood aesthetic and can even be a source of food.

Because land in the watershed is in high demand, opportunities to purchase and set aside land either for conservation or for recreation are difficult. City agencies must make it a priority to set aside some of their surplus lots for parks rather than development and to strategically enforce the Quimby Act in obtaining funds and land for multiple-benefit parks.

Once people can begin to understand their relationship with the watershed they can become more aware of issues and then begin to make behavioral changes. This general education can be achieved in several ways. Local TV stations can broadcast related public meetings and related presentations or seminars. Tabling can be done in public areas, such as a local supermarket, farmers market or library where a large section of the population can be reached.

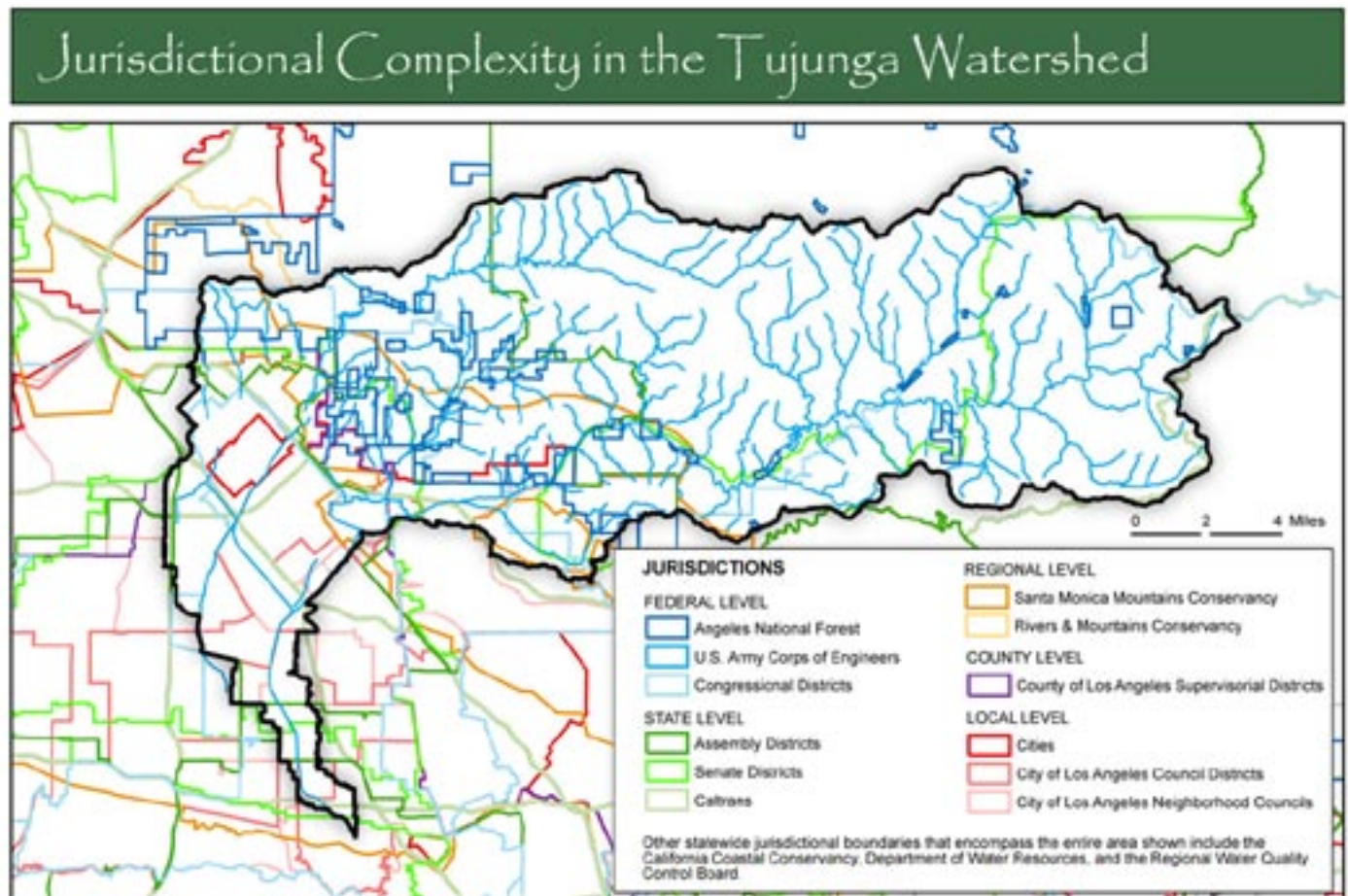
It will also be important to target individuals who are already interested and somewhat informed such as students and Neighborhood Council land use committee members. These individuals can become leaders who can then provide information to their own communities and social networks. Individuals who voluntarily attend public meetings and community events are a good starting point. To effect personal behavioral change, the establishment of an annual training class such as Watershed-U Tujunga can educate and motivate individuals.

Management & Policy

Introduction

Prospects for a holistic approach to watershed management depend on identifying how the present management system works and how it might be improved. Many agencies have jurisdiction over relevant matters in the Tujunga watershed, and their policies, procedures, operations and maintenance practices impact various aspects of watershed management, as do the legal mandates and constraints under which they operate. Some jurisdictions overlap, and most legal mandates were generated for specific, single purposes e.g. flood protection or water quality, rather than for multiple-objective planning and management, e.g. flood protection and water quality (Figure J-1). This section presents management and policy concerns by topic, with a discussion of agencies, jurisdictions, status and significant issues for each, followed by a series of recommendations keyed to the principal Goals of this plan.

Figure J-1. Jurisdictional Complexity
(Source: Casanova, 2005)



For individual maps showing Neighborhood Councils, City Council Districts, County Supervisorial Districts, California Assembly Districts, California Senate Districts, California State Conservancy Territories and US Congressional Districts in relationship to the Tujunga Watershed, refer to Appendix 5.

Land Use

As seen in Table J-1 below, nearly 75% of the land area of the Tujunga watershed lies within the Angeles National Forest (ANF), administered by the US Forest Service. About 21% lies within the City of Los Angeles, about 3% in the unincorporated area of Los Angeles County, about 1% in the City of San Fernando and a tiny area in the City of Glendale. Each of these jurisdictions establishes land use policies and regulations. Some large land uses are exempt from local regulation, including state colleges and universities, public schools and community colleges and Caltrans freeways.

Table J-1. Land Use Jurisdictions in the Tujunga Watershed
(Source: SCAG, 2000)

Jurisdiction	Acreage	Sq. Mi.	Percent
Angeles National Forest	107,187.40	167.48	74.50
Los Angeles	30,471.94	47.61	21.18
Unincorporated County	4,675.42	7.31	3.25
San Fernando	1,525.94	2.38	1.06
Glendale	19.21	0.03	0.01
Total	143,879.90	224.81	100.00

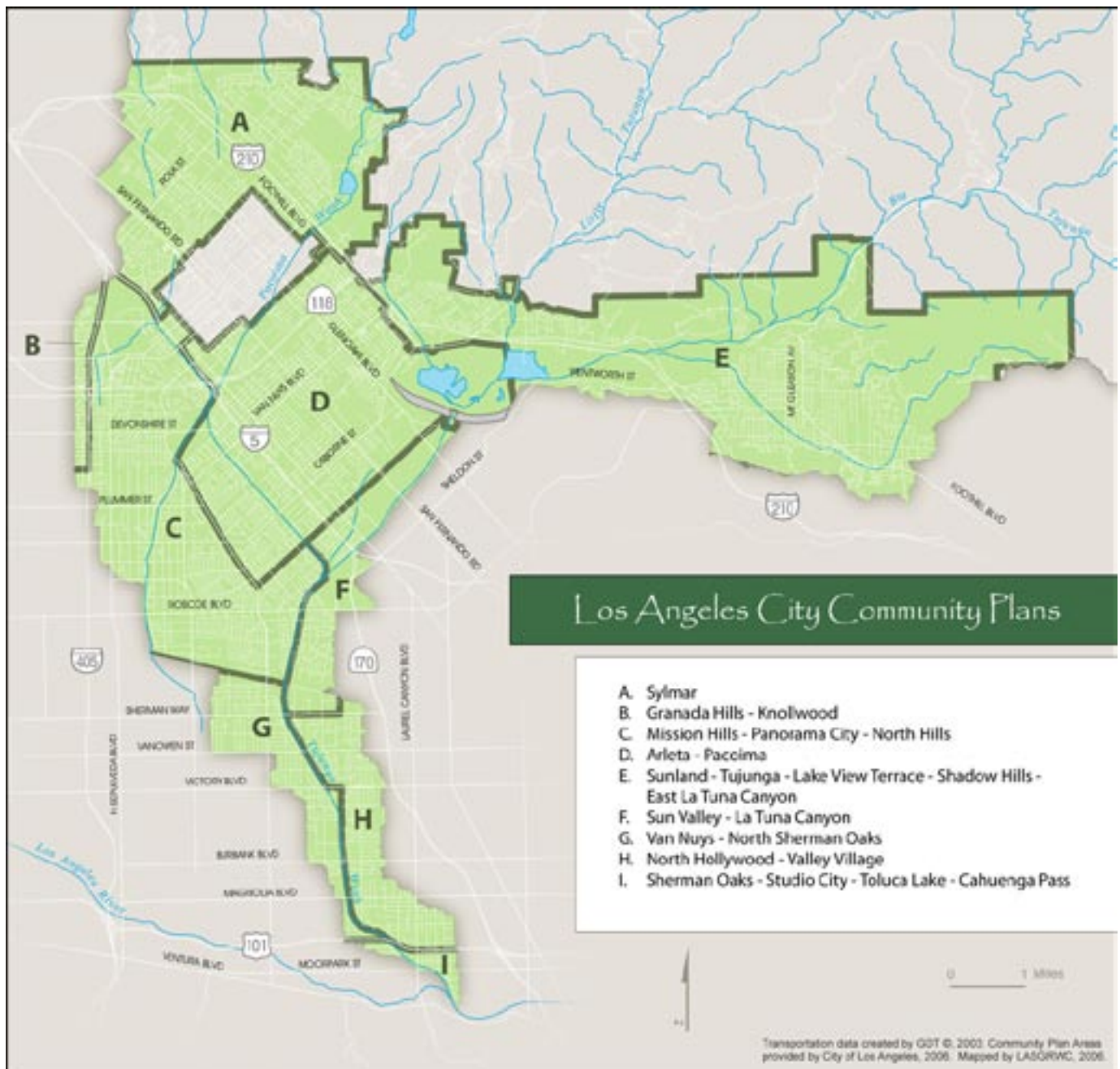
The Angeles National Forest is administered by the Forest Service, a unit of the federal Department of Agriculture. The Forest Service published a suite of land management plans for the four Southern California National Forests, Angeles, Cleveland, Los Padres and San Bernardino, in 2005, and reissued its decision in April 2006. The planning process addressed five issues: public values and uses, ecosystem elements and function, commodity values and uses, urban development and forest habitat linkages, and special area designations. Six alternatives presented a range from a status quo to relatively more emphasis on habitat vs. recreation to the reverse, more emphasis on recreation than habitat. The selected alternative includes proactive watershed management measures, improvements to riparian conditions, some efforts to control and eradicate invasive plants, and some reduction in areas potentially available for resource extraction.

California cities and counties regulate land use by means of a general plan, planning and zoning ordinances and more detailed plans such as overlay zones and specific plans. State law requires a general plan to include a minimum of seven elements: land use, circulation, housing, conservation, open space, noise and safety (Government Code Section 65302). All but noise affect watershed management. A general plan may also include optional elements to respond to local needs.

In the City of Los Angeles, the Department of City Planning has the primary responsibility for land use regulation. The City has developed its general plan in two tiers: the citywide General Plan Framework consists of all of the required elements, except land use, plus four optional elements, air quality, historic preservation and cultural resources, infrastructure systems, and public facilities and services, while 35 more detailed Community Plans comprise the plan's land use element (Figure J-2). The Framework reflects a range of growth projections and establishes citywide policies in the areas of land use, housing, urban form and neighborhood design, open space and conservation, economic development, transportation and infrastructure and public services, all of which may impact watershed management. Portions of the Tujunga watershed are included in nine of the Community Plans. The General Plan Framework was adopted in 1996 and re-adopted in 2001. Community Plans are periodically updated. Current revision dates for the Community Plans affecting Tujunga are as follows:

- 1996: Arleta-Pacoima
- 1996: Granada Hills - Knollwood
- 1996: North Hollywood-Valley Village
- 1997: Sunland-Tujunga-Shadow Hills-Lakeview Terrace-East La Tuna Canyon
- 1997: Sylmar
- 1998: Sherman Oaks-Studio City-Toluca Lake-Cahuenga Pass
- 1998: Van Nuys-North Sherman Oaks
- 1999: Mission Hills-Panorama City-North Hills
- 1999: Sun Valley-La Tuna Canyon

Figure J-2. City of Los Angeles Community Plan areas overlaid on Tujunga Watershed boundary
(Source: CoLA, 2005)



The County of Los Angeles regulates land use in 2,655 square miles of unincorporated area. The County Department of Regional Planning has the primary responsibility for land use regulation. The Department is presently engaged in a multiyear process of revising the County's general plan, which has not been comprehensively updated since its adoption in 1980. State law permits local jurisdictions to adopt individual elements of a general plan, and the County's revised housing element was adopted in 2001. A draft general plan, *Shaping the Future 2025*, including land use, circulation, conservation/open space, noise and safety elements, was circulated for public comment in 2004. In response to comments received, the Department is revising its Significant Ecological Areas program, among other aspects of the plan. Public outreach is scheduled to begin in late 2006, followed by public review of the associated Draft Environmental Impact Report and subsequent hearings before the County Regional Planning Commission and Board of Supervisors.

The City of San Fernando adopted the San Fernando Corridors Specific Plan in 2005 as an amendment to its general plan. The Corridors plan, while focused on the San Fernando and Maclay Avenue corridors, identifies the Pacoima Wash area as "primarily industrial" and notes the present swap meet site along the Wash, with frontage on Glenoaks Boulevard, as "poised for development". As a major tributary of Tujunga Wash, Pacoima Wash plays a central role in the Tujunga watershed. In 2004, the City engaged the 606 Studio of California Polytechnic University, Pomona, an advanced landscape architecture studio that prepares studies and plans, to prepare a study of the Pacoima Wash. Objectives included planning a bike path that would connect to a larger regional system and planning for increased recreational open space and habitat along the Wash. The Pacoima Wash Greenway Master Plan presents recommendations to achieve these objectives and promote the redevelopment of the Wash into a unifying element for the surrounding communities.

Public educational facilities within the Tujunga watershed include 76 Los Angeles Unified School District (LAUSD) schools and two colleges, Los Angeles Valley College and Mission College. Total area is 978 acres (Figure G-3). School and college campuses, as public facilities, present the potential for multiple-objective use. Campuses can be configured to detain stormwater and designed to infiltrate it to groundwater, or to hold and reuse it for irrigation. At present, LAUSD has incorporated stormwater BMPs into only a few demonstration projects, including Broadus School in the Tujunga watershed. While engaged in a very large program of new school construction, LAUSD has continued to develop its sites conventionally. Because the construction program is at present well under way, with many schools completed or nearing completion, and others in the construction documents phase of design, any large-scale use of school sites for watershed purposes will likely require retrofitting at substantial cost. The college campuses offer large sites that can be retrofitted to meet watershed objectives. Both school and college campuses will present jurisdictional and maintenance challenges.

Portions of the 5, 101, 118, 170, 210, 405 and 2 Freeways cross the watershed. Total area is approximately 31.5 square miles. Caltrans is under regulatory requirements to clean its stormwater discharges, and will have to make substantial investments to comply over a period of years. There may be good opportunities for intergovernmental cooperation with Caltrans to leverage some of this investment to achieve broader watershed objectives.

Land Use Issues

Density of Development

At the watershed scale, increasing density within existing developed areas, as opposed to developing new greenfield areas, can positively impact water supply and conservation, water quality, habitat and

open space. The ANF draft plan calls for maintaining forest areas and prohibiting almost all development. Both the County draft general plan and the City Framework call for increased density in developed areas, particularly in connection with transit corridors and stations and historic local centers. These plans to intensify development could be further refined to better reflect watershed values.

Distribution of Development

Restricting development in sensitive areas, such as existing native habitat, potential habitat restoration areas, hillsides, pervious soil areas and potential floodways, can positively impact habitat, open space and water quality, as well as flood protection and water supply. The County's draft general plan has been criticized for inadequately responding to ecological concerns, and the City, while addressing the need for more parks and open space in the Framework, does not restrict development in sensitive areas and does not have a plan to acquire land in such areas.

Parks and Open Space

Increasing public open space and parks in our park-poor region, presently far below national standards for acreage per capita and walking access, in addition to redressing an environmental justice imbalance, can positively impact habitat, water quality, water supply and flood protection. While the City's Framework includes an open space/conservation policy to expand parkland, neither City nor County has a plan establishing acreage and distribution targets and implementation. The City of Long Beach has such a plan, which could serve as a model for City and County.

The US Army Corps of Engineers owns and operates Hansen Dam, the largest park in the watershed, and leases portions of it to the City of Los Angeles. The Santa Monica Mountains Conservancy (SMMC), a state agency, has been acquiring land for public benefit since its inception in 1980, and has a plan that targets key parcels in the mountains, along rivers and along potential habitat linkages. Two other state agencies, the California Coastal Conservancy, which funds habitat and trail projects in coastal watersheds and provides assistance for land acquisition, and the Lower Los Angeles and San Gabriel Rivers and Mountains Conservancy (RMC), which acquires, develops and operates parks and habitat areas and funds park and open space projects, have jurisdiction within the watershed. Within the last few years the California Department of Parks has made urban parks a priority, purchasing two sites near the Los Angeles River. Their continued involvement can supplement local efforts. The nonprofit Trust for Public Land has played a key role in promoting urban parkland in the Los Angeles region and in purchasing and transferring land to government agencies. Their continued involvement can facilitate acquisitions to expand public open space. The Los Angeles Neighborhood Land Trust, a nonprofit organization that facilitates the creation of community green and open spaces, has begun to revitalize existing parks and create new parks in underserved areas of the city. They have attracted private and foundation support, and their continued involvement can supplement government initiatives.

Habitat/Recreation Balance

Achieving a balance between habitat and recreational uses of open space can meet both environmental and social needs. In the present context of park space deficiency and unfulfilled recreational needs, every site is contested ground. Plans for expansion of public open space need to be coordinated among agencies and a balance reached, taking into account where the population is underserved and where the environment is sensitive.

Design Standards

Regulations that promote or require on-site stormwater management, reduced impervious cover, low-water use planting, and a range of water conservation measures can positively impact flood protection, water supply and water quality. Neither City nor County presently has a suite of such regulations in place. The City's landscape ordinance, revised in 2005, does incentivize the use of low-water-use plantings, and encourage pervious surfaces for driveways and similar areas. But the City requires stormwater to be conducted off-site to the street or a storm drain, exactly the opposite of what is needed to support watershed management objectives. The City requires low-flow toilets but does not permit waterless urinals. Other local jurisdictions, notably Calabasas and Santa Monica, provide models for on-site stormwater management regulation.

Joint Use of School and College Campus Sites

Use of portions of public school and college campuses for such watershed purposes as stormwater detention for flood protection, stormwater infiltration, where soils are appropriate, for groundwater recharge, stormwater storage and reuse for irrigation to reduce demand for potable water, and natural treatment systems to cleanse both on-site and, in some cases, off-site stormwater before it is discharged to storm drain lines and to Pacoima Wash and Tujunga Wash can positively impact watershed management. As public sites, campuses can be managed and maintained reliably over a long period of time, so the watershed benefits will be secure. But issues of jurisdiction, cost sharing, liability and maintenance will require unprecedented cooperation and innovation by the participating agencies.

Joint Use of Caltrans Sites

Caltrans owns large areas of land, including the areas around freeway interchanges, that may be suitable for development of joint use projects that would serve not only to manage and cleanse Caltrans' own stormwater, but stormwater from adjacent areas. Detention, infiltration and storage and reuse of stormwater, as well as natural treatment systems, may be appropriate, depending on site conditions. Some linear rights-of-way may also offer opportunities for joint use. Since Caltrans must make investments to cleanse its own stormwater in the coming years, opportunities are likely to be forthcoming. As with school campuses, issues of jurisdiction, cost sharing, liability and maintenance will need to be addressed, but since most of the land in question is not accessible to the public, resolution of these management issues may be relatively simpler than for schools.

Joint Use of DWP and Edison Corridors

The linear corridors of powerline rights-of-way present opportunities for joint use that could include improved flood protection by detention of stormwater, water quality improvements, habitat enhancements and bicycle paths and trails. The utilities need to maintain access for service, and may impose restrictions on plantings, particularly of tall trees. Some of these rights-of-way are presently leased to earn revenue for the utility, and any proposed joint use would have to take the potential loss of revenue into account.

Plant Palettes

For their own projects, including parks, street tree plantings and other public facilities, governmental agencies can establish policies to favor or require locally native plants, to positively impact habitat and water supply. For private developments within their jurisdictions, municipalities can mandate or encourage the use of native and other climate-appropriate plant materials.

Flood Protection

The US Army Corps of Engineers (USACE, Corps) and the Los Angeles County Flood Control District have the primary responsibility to provide flood protection in the region. Following severe flooding in 1914, the Los Angeles County Board of Supervisors sought and obtained state legislation to create a county-wide flood control agency. The Los Angeles County Flood Control District was created in 1915 with jurisdiction over 2,760 square miles (today over 4,000 square miles). Its primary objective was to “provide for the control and conservation of flood, storm and other waste waters...and to conserve such waters for beneficial and useful purposes...” and to protect the “harbors, waterways, public highways, and property” within its jurisdiction from flood damage. In 1918, a flood control program comprising five interrelated elements was prepared for the County Supervisors: 1) conservation of storm waters through reforestation and construction of retarding works including small check dams in the mountains to reduce stream velocity and erosion, 2) containment of storm waters with dams in the mountains, 3) spreading of storm waters on gravel deposits at the mouths of canyons to replenish the water table, 4) channelization of the San Gabriel and Los Angeles Rivers to prevent siltation of the harbors, 5) acquisition of official channels of principal streams within the Los Angeles basin and permanent alignment and protection of these channels. In 1985, the Flood Control District was consolidated with other County departments to form the Los Angeles County Department of Public Works (LACDPW).

Following adoption of the 1918 program, a series of 128 debris basins and check dams was constructed along the San Gabriel Mountains, many of them within the Tujunga watershed. Pacoima Dam was constructed in 1929, followed by Big Tujunga Dam in 1931. After the massive flooding of 1938, Hansen Dam was constructed in 1940. Lopez Dam and other flood control channels were constructed in 1954. Tujunga Wash is managed and maintained by LACDPW in cooperation with the Corps. Hansen Dam is operated by the Corps; Big Tujunga, Pacoima and Lopez Dams are operated by LACDPW. The California Department of Water Resources, Division of Safety of Dams has regulatory authority over dams, and has designated Big Tujunga Dam as seismically unsafe, limiting its operations since 1979. LACDPW is presently planning a major project to seismically strengthen and upgrade the dam, increasing its storage capacity by 300%.

Flood Protection Issues

Peak Flood Flows, Tujunga Wash and Los Angeles River

Studies conducted in connection with the Los Angeles River Revitalization Master Plan, currently in preparation, indicate that peak flood flows in the River below its confluence with Tujunga Wash are sufficiently high to severely constrain options for greening the River. Flows at this reach of the River are dominated by water from Tujunga Wash, so if peak flows from Tujunga can be reduced, more opportunities may be found to reconfigure and green the River. Prospects for reconfiguring Tujunga Wash itself also depend on peak flows: the lower the peak flow, the less land required to widen the Wash enough to remove part or all of the concrete.

Hansen Dam Area

Along with Big Tujunga Dam, the Hansen Dam area presents one of the few opportunities in the entire watershed of the Los Angeles River for large-scale stormwater detention. The dam already provides major detention, but its capacity could be enlarged without additional land acquisition or rebuilding the dam. The gravel pits in the area present another important potential for detention and perhaps for additional groundwater recharge as well. Enhanced detention capacity would reduce peak flows along both Tujunga Wash and the Los Angeles River. (See above.)

Dam Operations

Weather prediction is notoriously inexact. But the advent of live satellite imagery means that responsible agencies now have the ability to track storm movements much more precisely than ever before. The implications of this new information for dam operations, particularly during storm conditions, may positively impact watershed management. To reduce peak flood flows, dam operators hold water behind their dams while it is raining and for some time after the rain stops. But, to optimize capacity behind the dam, they release water when they can establish that it is safe to do so. Since Pacific storms often occur in series, it is important to release water between storms. The new satellite information should allow dam operators to time their releases much more precisely, managing the releases for two sometimes conflicting objectives: maintaining capacity while minimizing peak flows, and holding more water for groundwater recharge. In 1995, when the Los Angeles County Drainage Area project to increase the capacity of the lower Los Angeles River by raising the levees was being litigated, re-operation of dams was discounted by LACDPW and USACE as not having significant potential to reduce the peak flood flows that are the basis of design for channel capacity. It may be timely, in light of the improved and universally available satellite information, to revisit the impact of dam operations on peak flows and the potential increases in recharge that may result, specifically both Hansen and Sepulveda Dams as they affect Tujunga Wash and the Los Angeles River respectively. Operations of Big Tujunga Dam, following its seismic upgrade, as well as Pacoima and Lopez Dams, should be reviewed as well.

Nonstructural Flood Protection and Land Acquisition

Nonstructural flood protection consists principally of floodways and detention areas. Floodways are areas directly adjacent to a stream that will flood under given flow conditions, e.g. under a five-year storm event, or under a twenty-five year storm event. Based on elevation and extent, floodways can support shrubs, trees, and recreation areas that will be periodically inundated. Detention areas hold stormwater for a period of time after a peak flood flow. In some cases the water may be held longer and all or part of it infiltrated to groundwater, and in others the water may simply be released at an appropriate time after the peak flow. Mandates and/or incentives can encourage individual private sites throughout the watershed to capture stormwater where it falls, thereby potentially reducing the total volume of stormwater that flows through the Wash. Public parks and other public sites can be reconfigured or retrofitted to detain stormwater, cleansing and infiltrating it to groundwater. Neighborhood scale multiple-objective projects to detain, cleanse and infiltrate stormwater can be developed on public rights-of-way, surplus properties or on newly acquired sites. Joint-use projects to detain, cleanse and infiltrate stormwater can be developed with public schools and colleges, Caltrans, DWP and Edison. Once sufficient nonstructural flood protection facilities are in place it will become feasible to reconfigure the existing concrete channel or remove it entirely. It seems clear that major land acquisitions would be required to realize nonstructural flood protection. If an equitable process for acquiring land can be developed, public acceptance may be gained for the major changes implied by nonstructural flood protection. One model is a trust fund with authority and funding to acquire land at fair market value over a long time span as property owners decide to sell, with proper management of properties acquired in the interim to maintain neighborhood integrity. In addition to acquisition, existing surplus public properties can be used where appropriate, or in some cases exchanged for more viable properties.

Mountain Debris Basins

The chain of mountain debris basins built after 1918 was a fundamental element of the Los Angeles area flood protection system. Some basins, inaccessible for years, have ceased to play a useful role, while others are regularly maintained. A reassessment of the debris basins and check dams in the Tujunga watershed as to their condition and functionality could lead to improvements that would positively impact flood protection and water supply.

Storm Drains, Streams, Channels, Water Bodies

The County and City own and maintain hundreds of miles of storm drains in the Tujunga watershed, with their associated catch basins and other drainage structures. The County owns and maintains Tujunga Wash and Pacoima Wash. Behind Hansen Dam, the City leases land from the Corps for recreational use.

Maintenance of existing concrete channels, whether rectangular- or trapezoidal-section type, is necessary to remove obstacles to the smooth, swift flow of stormwater for which they were designed. Obstacles include natural debris like boulders and tree limbs, trash and urban debris – and plants. Plants growing in the channels increase the “roughness” of the surface, reducing flow velocities and thereby reducing capacity, so LACDPW and the Corps periodically remove plants growing in the rivers and other channels. In some areas, plants growing within the channels have established habitat areas, not unlike the natural condition of the stream before urbanization. Where this has occurred the agencies must observe US Fish and Wildlife Service and California Department of Fish and Game requirements, principally not disturbing birds during nesting season and providing mitigation when habitat is disturbed.

Periodic maintenance of storm drain pipes and catch basins is also necessary to assure that they retain their design flow capacity. In recent years, both the City and County have been pumping out catch basins annually, and in some cases more frequently, to remove trash as well, in order to reduce the trash in streams and rivers.

For reasons of personal safety and security as well as concerns about potential liability, LACDPW prohibits entry into any of the channels it maintains. They are fenced and signed to indicate that entry is forbidden, and the LACDPW web site includes warnings about entering the channels. Despite the warnings, almost every storm season someone needs to be rescued from the fast-moving brown waters, and every few years someone, usually a child, dies in the Los Angeles River. As river parks have been developed, entry into the riverine areas is becoming common, and as the river system gradually becomes naturalized, entry will be widespread. Public education about the rainfall and flood regime combined with some form of a warning system may be needed. Under California law, if a stream is part of a park, liability is different than if it is infrastructure, e.g. a concrete channel.

Maintenance roads run along the channels, providing access for heavy trucks and machinery as well as for swift water rescue teams and light vehicles.

In connection with the development of riverside parks and trails, the County has adopted standards for landscaping, signage and maintenance along the Los Angeles River within the last three years. These standards apply to Tujunga Wash as well, but at present only within the County's right-of-way.

Water Body Issues

Safety, Security and Liability

Increased public access to the stream right-of-way, and to the stream itself as it becomes naturalized, will require some increase in police protection as well as increased public education about flood safety. Warning signs and other means (e.g. horns) of alerting the public when it is unsafe to be in the streambed will be needed. Los Angeles needs more police officers per capita without any allowance for river patrols, so the cost of police protection may be a concern. New bike paths along the Los Angeles River include solar-powered call boxes, and this seems a minimum requirement. Liability issues will have to be addressed. The most promising approach seems to be designating accessible areas as parkland.

Maintenance

Funding for maintenance is chronically lacking. See the discussion below, under Overview of Agencies with General Policy and Funding Authority, of Los Angeles County's initiative in the area of long-term funding. With the development of parks, greenways and trails along the river system, maintenance needs will increase. And with incorporation of floodways and detention areas, there will be periodic needs for cleanup and repairs following flood events. These will be infrequent, but must be anticipated. Cost sharing between parks agencies and watershed management agencies will require coordination.

Sacrificial Vegetation

Widened streams can accommodate design flood flows at lower velocities, so their surfaces can be relatively "rough" compared to smooth concrete: plants can grow within the streambed. During flood events of various sizes, some vegetation will be uprooted, while other plants will be flattened for a period of time but will recover. Uprooted vegetation can pose problems downstream, affecting flows. As the Tujunga Wash is naturalized, allowances will have to be made to accommodate sacrificial vegetation, including periodic maintenance, perhaps each rainy season. Vegetation located adjacent to maintenance access may be periodically sacrificed when heavy maintenance equipment (e.g. truck-mounted crane) is needed.

Sediment Management

Rivers move sediment. The presence of sediment in a river contributes to its stability, reducing its tendency to erode its banks or scour its bottom. To the extent that sediment is transported in a naturalized Tujunga Wash, it could affect the Los Angeles River and potentially affect the ports of Los Angeles and Long Beach. To avoid impacting the ports, provisions will have to be made, either upstream along the Wash or downstream along the River to remove sediment. Historic drawings and photos show sand and gravel extraction along the Los Angeles River near downtown Los Angeles. It may be possible to reestablish such an operation as part of an overall sediment management strategy. Adding a sediment gate to Big Tujunga Dam as part of its currently planned seismic upgrade could be an important step to initiate such a strategy, and retrofits at other dams could follow. While costly, annual or periodic sediment extraction along the River might prove more cost-effective than periodic excavations of sediment trapped behind Big Tujunga, Pacoima and Hansen Dams.

Stream Daylighting

Daylighting streams, restoring surface streams to carry stormwater and replace underground storm drain piping, has the potential to positively impact water quality and habitat among other watershed objectives. Daylighting can positively impact the character of a community and create economic value. If coordinated with other improvements daylighting can also have a positive impact to reduce peak flood flows. But daylighting can be expensive and may in some cases require reconfiguration of street and sidewalks.

Water Supply and Use

According to the Metropolitan Water District of Southern California (MWD) the Los Angeles region imports almost 60% of the domestic water it uses annually. Four aqueducts, the first and second Los Angeles Aqueducts from Owens Valley, the Colorado Aqueduct from the Colorado River and the California Aqueduct from Northern California, serve the region. Water is stored in a system of reservoirs and some is introduced into the ground and stored as groundwater. The two principal water importers are the City-owned Los Angeles Department of Water and Power (LADWP), which operates the two Los Angeles aqueducts, and MWD, a consortium of 26 cities and water districts that acts as a wholesale distributor of water from both

the Colorado River and the Bay-Delta region of Northern California. In addition to importing water, LADWP purchases some water from MWD. LADWP recharges and extracts groundwater, operates reservoirs, treats and distributes water for public use. LADWP supplies water throughout the urbanized portion of the Tujunga Wash watershed.

Depending on location and seasonal rainfall, one third to over half (e.g. 54% in the Arroyo Seco subwatershed) of some Los Angeles area subregions' water supply is local, from streams and groundwater, but in LADWP service area only about 15% of the supply is local at present. Water rights, legal rights to take and use water from streams and groundwater basins, are famously contentious throughout the western United States, and particularly so in California. A summary of relevant history, legislation and litigation is presented in the Water Supply & Use section of this report. At present, all water rights in the Los Angeles region have been adjudicated. Water rights in the Tujunga watershed are encompassed in the jurisdiction of a court-appointed official, the Upper Los Angeles River Area (ULARA) Watermaster. Any changes to the water supply regime (e.g. increased groundwater recharge) are likely to require, at minimum, review and approval by the Watermaster.

LADWP, in addition to distributing potable water, also distributes reclaimed water (treated wastewater), which at present is used for irrigation and industrial purposes. Some recent buildings have dual plumbing systems to allow the use of "graywater", rather than potable water, for toilets. Graywater may be site-produced recycled water or municipal reclaimed water. As the Tillman treatment plant expands in capacity and as LADWP installs more main "purple line" distribution piping, reclaimed water use may greatly expand, reducing demand for potable water. Given the probability of advanced treatment of wastewater being required by water quality standards (see below), LADWP has recently begun to explore the feasibility of using reclaimed water to recharge groundwater aquifers.

Water conservation has the effect of reducing aggregate demand, allowing the region to support a growing population without increasing water imports. Conservation efforts have been at the heart of both MWD and LADWP programs for several decades. LADWP water use in Los Angeles in 2002 was approximately the same as in 1986, while the population served had grown by well over half a million inhabitants. According to estimates prepared by the Southern California Association of Governments (SCAG), population will increase by about 19%, or nearly 1 million persons, within the LADWP service area alone, from the year 2000 to 2020. Most of the growth will come from local births as opposed to migration. Environmental concerns and competing water uses, both in Northern California and along the Colorado River, seem likely to decrease the amount of water available for importation to the Los Angeles region. While MWD has been exploring transfers of agricultural water and other mechanisms to increase supply, it is clear that conservation is a critical component of the water supply regime.

The channelized Tujunga Wash and the channelized Los Angeles River it joins have been engineered to move stormwater very rapidly to the ocean. In recent years, stormwater has increasingly been recognized as a potential water resource. Both the City's Integrated Resource Plan (IRP), concerned with capital planning for water supply, stormwater and wastewater, and the County-led Greater Los Angeles Integrated Regional Water Management Plan (IRWMP), discussed below in the Overview of Agencies with General Policy and Funding Authority section, recognize this potential and identify scenarios to hold and use large quantities of stormwater. This water, once detained, can be infiltrated to groundwater or stored in cisterns of various sizes for later use as irrigation or graywater. A very large groundwater basin underlies the San Fernando Valley, and soils in many areas, including much of the Tujunga watershed, are well suited for infiltration. The multiyear, interagency Water Augmentation Study, presently being conducted by the Los Angeles and San Gabriel Rivers Watershed Council, is analyzing stormwater runoff from different types of urban sites to determine whether treatment is necessary prior to infiltration. While initial results from the study indicate that

roof and parking lot runoff does not require treatment, final results are not yet available, and some stormwater capture scenarios include sand filtration and/or other treatment prior to infiltration. The IRP's preferred alternative calls for management of over 40% of runoff in the City year-round, and the IRWMP, in an early draft, calls for treating 490,000 acre-feet annually, of which up to 120,000 acre-feet would be recharged. The toxic plume that is moving through the San Fernando Valley (see Groundwater Contamination below) will limit the feasibility of recharge in affected areas for many years, but the Tujunga watershed is generally outside the contaminated areas, and offers significant recharge opportunities. Holding stormwater also raises vector control concerns and these must be addressed in concert with the responsible agencies as stormwater detention projects are developed.

Water Supply and Use Issues

Adjudication

Measures to augment local water supply, such as groundwater recharge and perhaps even stream widening and formation of floodways and detention areas, may be seen as conflicting with existing adjudicated water rights. In pursuing interagency coordination and the development of multiple-objective projects, it will be critical to involve the ULARA Watermaster throughout the planning process, so that issues potentially relating to adjudicated water rights can be addressed in a timely manner without triggering further judicial review.

Conservation

The principal means of conserving water depend on public education, hardware, landscaping choices and water pricing. Intensified, sustained public education and outreach efforts can have direct impacts to reduce water use as well as indirectly supporting other conservation measures. Given that about 50% of the annual water use of the average household is for irrigation, the potential for conserving domestic irrigation water is considerable. One promising hardware solution is "smart irrigation", use of equipment that incorporates weather and soil moisture information to control irrigation systems. This seems most applicable to larger properties such as condominiums and apartments, institutional sites (e.g. hospital or school campuses), freeways and other regularly-maintained sites, but may appeal to individual homeowners as well. Landscaping choices, such as grouping plants with similar water needs and zoning irrigation to match, minimizing lawn area, and employing native and other climate-appropriate plants, can significantly reduce demand for irrigation water throughout our region. Where municipal reclaimed water is available or becomes available, it will no longer be necessary to use potable water for irrigation. Capturing stormwater on-site, storing it in cisterns or similar devices and using it for irrigation is a proven means of reducing use of potable water for irrigation. Within buildings, expanding the deployment of low-flush toilets, automatically-controlled lavatory faucets and similar technologies will continue to reduce water consumption. Introduction of waterless urinals, not presently approved in the City of Los Angeles, in institutional and commercial buildings will have a significant impact. Graywater systems, using either on-site wastewater from sinks and showers or municipal reclaimed water where available, can be used to flush toilets, further reducing demand for potable water. Finally, consumption-based, tiered pricing, in which basic water needs are met with reasonably-priced water and a higher tiered rate structure applies to excess consumption, can provide a clear motivation to conserve.

Groundwater Contamination

A plume of contaminated groundwater, resulting from aircraft engine manufacturing, is moving through the San Fernando Valley. The plume has caused LADWP to shut down some wells and install treatment facilities at other wellhead locations. Cleanup operations are under way, but the time required to eliminate

the problem is estimated at over fifty years. While the plume overlaps only small portions of the Tujunga watershed, it may impact the feasibility of groundwater recharge in some areas. Because the plume constrains opportunities for recharge and extraction in large areas of the San Fernando Valley outside the Tujunga watershed, it is even more critical to maximize recharge in appropriate areas within the watershed. The Bradley landfill in the Tujunga watershed provides additional constraints on recharge. Water table depth must be maintained a safe distance below the bottom of the landfill to assure that no contact can occur between the aquifer and any potential leakage of toxic contaminants through the membrane beneath the landfill. In the case of some older landfills, no membrane was installed, so additional precautions may be necessary. LADWP and the ULARA Watermaster monitor the aquifer depth.

Reclaimed Water, Nonpotable Uses

Industrial and irrigation uses of reclaimed water are well established, if still a small percentage of total water use. Use of reclaimed water to flush toilets in buildings, which requires double piping, is a technique that has been applied in only a few buildings in the Los Angeles area, but which could become much more widespread in the next few decades. Expanding the main distribution pipelines for reclaimed water, creating “purple corridors” will greatly expand opportunities for individual users to connect “purple pipes” for on-site use of reclaimed water. Because the main lines represent a major public investment, LADWP will need to assess potential demand and coordinate with other public improvements such as street repaving.

Reclaimed Water for Groundwater Recharge

LADWP is presently assessing the feasibility of using reclaimed water (treated wastewater) to recharge groundwater basins. As discussed below under Water Quality, evolving regulatory standards for water released to the Los Angeles River from the Tillman Water Reclamation Plant at Sepulveda Basin may require advanced treatment, likely including reverse osmosis microfiltration and ultraviolet light sterilization, regardless of whether the water is to be reused. Together with a rigorous program of testing and monitoring, and recognizing that recharged water typically migrates slowly underground for a period of months before extraction, water of the quality resulting from the advanced treatment is likely to prove more than sufficient to provide reliable public health protection and secure approvals for groundwater recharge from regulatory agencies such as DHS and LARWQCB. Public confidence will have to be earned and political will developed before such a program could proceed. Other California jurisdictions, such as Orange County, have successfully implemented similar programs, and LADWP is drawing on their experience. A pipeline is in place from Tillman to the Hansen Spreading Grounds, so once the technical, regulatory, public and political concerns have been met, implementation of recharge would be fairly straightforward.

Reclaimed Water for River Habitat

Domestic, landscape and industrial uses, and groundwater recharge, of reclaimed water all combine to remove water from the Los Angeles River. To the extent that the River is to be revitalized and naturalized, it will require year-round flows of water sufficient to maintain habitat. These flows, likely larger than the existing low-flow summer condition, are at present principally supplied from Tillman. Similar concerns for the water regime necessary to maintain habitat will apply as portions of the Tujunga Wash are naturalized. Historically the River had year-round flows, while Tujunga Wash was seasonally dry, at least above ground. Habitat restoration and naturalization along the Wash will need to take into account appropriate water needs.

Stormwater as a Resource

Detaining and infiltrating stormwater where it falls to recharge the aquifer or storing it in cisterns for later use on-site as irrigation water or graywater can significantly reduce the demand for imported water. Individual

private sites of all sizes can contribute to stormwater capture, as can new or reconfigured neighborhood and/or subregional scale public sites. Regulatory issues include adjudication and vector control. Costs for larger public detention sites will be significant, since most projects that detain stormwater will require land acquisition, but opportunities for multiple-objective projects that provide flood protection, habitat and water quality benefits together with water supply augmentation are very great, and costs must be evaluated against both the multiple benefits of such projects and the cost of imported water they replace.

Water Quality

The federal Clean Water Act of 1972, as amended in 1977, established national policies and procedures to protect against water pollution in the waters of the United States (surface water bodies). The federal Environmental Protection Agency (USEPA) is designated to administer the Act, and the individual States are designated to manage and implement it, issuing permits to operators of point sources of pollution, such as industrial plants and publicly-owned treatment works (POTWs, i.e. sewage treatment plants), allowing limited discharges of pollutants to receiving waters, and issuing permits to cities, counties and other local jurisdictions for nonpoint source pollution, such as is found in urban stormwater runoff. In 1969, California enacted the Porter-Cologne Water Quality Control Act, which served as a model for portions of the federal law. The State Water Resources Control Board (SWRCB), a unit of the California state Environmental Protection Agency (CalEPA), jointly administers the federal and state laws, delegating to nine Regional Water Quality Control Boards the responsibility to develop "Basin Plans" for their hydrologic areas, govern requirements, issue waste discharge permits, enforce the law and monitor water quality. The Tujunga watershed lies within the jurisdiction of the Los Angeles Regional Water Quality Control Board (LARWQCB).

The LARWQCB identifies the beneficial uses for a given water body, (e.g. fishing and swimming), then assesses impairments to the water body by pollutants that affect those uses, both geographically, for example by reach (reach = geographic segment of a stream, typically between two tributaries or between a tributary and a confluence with a larger stream), and by pollutant types (e.g. metals, bacteria) and quantities. This information comprises the 303(d) list, which serves as the basis to develop regulations for permissible pollutant discharge levels that will, over time, reduce the pollutants in the water body to safe levels consistent with its designated beneficial uses. The permissible level of a given pollutant is defined as the Total Maximum Daily Load (TMDL) the water body can accept while cleansing itself. The LARWQCB subsequently monitors compliance with the TMDL regulations. Every stage of this process, from designating beneficial uses to defining existing baseline conditions for particular pollutants to establishing time periods for implementing individual TMDLs, has been the subject of litigation, and because the regulations are being developed and enforced regionally, some of the same issues have been litigated in more than one venue. Cities and counties, the permit holders for nonpoint source pollution, are concerned that they may be required to make large public investments in unproven techniques and technologies only to find that the regulatory environment will change in the interim and/or that the TMDLs as defined by the regulators are unattainable at any cost. Environmental groups are concerned that, more than thirty years after passage of the Clean Water Act, very little regulation has been put in place and correspondingly little progress has been made in cleansing our waters.

The LARWQCB's Water Quality Control Plan for the Los Angeles Region, or Basin Plan, was adopted in 1994. It is reviewed every three years and amended as necessary. When TMDLs are adopted, they are incorporated into the Basin Plan as amendments. Two TMDLs have been adopted for the Los Angeles River watershed, which includes Tujunga, the Nitrogen Compounds and Related Effects TMDL for the Los Angeles River Watershed, 2004 and the Los Angeles River and Tributaries Metals TMDL, 2005. The metals TMDL has a 22-year implementation schedule. A Trash TMDL for the Los Angeles River was adopted in

2001, but was set aside in 2006 as a result of a court decision. The court upheld the substance of the TMDL but rejected its California Environmental Quality Act (CEQA) documentation as inadequate. LARWQCB staff are presently revising the CEQA documentation and anticipate resubmitting the TMDL to the Board in fall 2006. A 1999 consent decree between USEPA, Heal the Bay and BayKeeper directs USEPA to complete TMDLs for all impaired waters in the Los Angeles region within 13 years. The LARWQCB is scheduling the preparation of the TMDLs. To facilitate the orderly development of TMDLs, the City of Los Angeles initiated the CREST, "Cleaner Rivers through Effective Stakeholder TMDLs" process in 2004. LARWQCB and USEPA have partnered with the City in the CREST effort.

In addition to setting standards for surface water, the Basin Plan establishes beneficial uses for groundwater and sets objectives that must be maintained or attained to protect the beneficial uses. Under its Drinking Water Source Assessment and Protection Program, the California Department of Health Services (DHS) has regulatory oversight of groundwater extraction and recharge. DHS works cooperatively with LARWQCB and USEPA to protect drinking water supplies. The California Department of Toxic Substances Control (DTSC) has regulatory authority over toxic substances and environmental cleanup of such substances. Widespread contamination of formerly industrial sites adjacent to the streams of the Los Angeles region has resulted in many "brownfield" sites needing cleanup.

Water Quality Issues

TMDL Implementation

Piecemeal adoption of TMDLs may lead to piecemeal implementation of remedial actions and Best Management Practices (BMPs). Holistic solutions and cost-effective investments in both structural (e.g. trash separators) and nonstructural BMPs (e.g. sand filters and infiltration trenches) depend on orderly establishment of a suite of TMDLs, so that integrated remedial actions, addressing several pollutants simultaneously, may be taken.

Advanced Treatment of Wastewater

The impact of TMDLs may lead to advanced treatment of wastewater released into the Los Angeles River at the City's Tillman Water Reclamation Plant, a POTW. Both reverse osmosis microfiltration and ultraviolet light sterilization are likely to be required, resulting in very high quality water. This water would be suitable for groundwater recharge if the regulatory obstacles and public health concerns can be addressed. Some observers have questioned the appropriateness and cost-effectiveness of treating water to an advanced level and then releasing it into concrete channels.

Evolving Technical Standards

With advances in science and technology, especially the ability to measure increasingly small quantities, new pollutants are being identified and more restrictive standards of purity are being defined. Some pollutants are now measured in parts per billion as opposed to parts per million. Identification of a toxic substance of concern may precede, by years, the definition of acceptable safe levels in water. These evolving standards impact the feasibility of extracting and recharging groundwater. Both recharge programs employing stormwater and treated wastewater may be impacted.

Superfund Site

A toxic plume, resulting from aircraft engine manufacturing, affects a significant portion of the large aquifer under the San Fernando Valley. While the plume underlies only small portions of the Tujunga watershed, it

can impact the feasibility of groundwater recharge efforts throughout the Valley. Cleanup efforts are under way, but the time required for the cleanup is estimated at over fifty years, so effective groundwater recharge must be limited to areas that will not be affected by the slow movement of the toxics through the aquifer. A more extensive and aggressive approach to cleaning the toxic plume may shorten the time this extraordinary natural resource is underutilized.

Overview of Agencies with General Policy and Funding Authority

In addition to the specific jurisdictional responsibilities discussed above, agencies and elected officials at federal, state, regional and local levels have broad authority over policy and funding related to watershed management.

The USACE, under its Water Resources program, works in the areas of flood protection, water supply and recreation. Under its Environment program, the Corps works in the areas of ecosystem restoration and toxics cleanup. The Corps provides both planning and project development assistance, including land acquisition. The Corps is presently working on ecosystem restoration planning for the Tujunga Wash, Arroyo Seco, Los Angeles River and Ballona Creek. Corps planning and projects are done with local agency sponsors, who share in the costs, and define the project. Scope of the Tujunga Wash project could potentially be revised to include a broader watershed approach that would include additional projects proposed in the final Tujunga Wash Watershed Management Plan rather than being limited to the two projects it currently includes. As with other federal programs, Corps priorities are set by Congress and reflected in the federal budget. Senators and Members of Congress play key roles, not only in establishing programs and priorities, but in earmarking funds for specific projects. The Rivers, Trails and Conservation Assistance Program of the National Park Service, while it does not provide direct grants, assists and facilitates a variety of conservation and recreation projects. The US Bureau of Reclamation works in the areas of land and water resource management, and has made local grants within the Los Angeles area. The federal Department of Transportation, in addition to its highway and mass transit programs, provides funding for bicycle paths and related improvements.

A number of state agencies have ongoing programs and funding to acquire and develop open space and water-related improvements. California State Parks, as noted above, has recently been emphasizing urban parks. The Wildlife Conservation Board (WCB) is an independent board with authority and funding to acquire and develop sites for wildlife conservation. The Resources Agency, which now oversees the CalFed program and the state conservancies (see below), has broad responsibilities for land and water. The Department of Water Resources (DWR) has ongoing funding for water management and planning. Caltrans, through its Bicycle Facilities Unit funding and technical assistance in bicycle transportation.

In recent years, Californians have passed a series of bond measures for parks, open space and watershed-related projects. Typically these multibillion dollar bonds include funding specific to an area, (e.g. Los Angeles River watershed) together with competitive funding, targeted at particular project types and allocated to a handful of state agencies that evaluate proposals and award and administer grants. The Resources Agency, DWR, SWRCB, CalFed, and the conservancies are among the agencies managing bond fund grants. On the November 2006 ballot a related \$5.4 billion bond issue, Proposition 84, will be before the voters. It includes substantial funding designated for the Los Angeles region as well as competitive funding in a range of areas related to watershed management. Future bond issues have the potential to greatly impact our region.

The California Coastal Conservancy, SMMC and RMC all have jurisdiction and ongoing involvement in the larger Los Angeles River watershed and can each play a significant role in the Tujunga. Through their bond

fund grants as well as their own acquisitions, the conservancies have the potential to develop multiple-objective projects that greatly increase the amount of public open space, improve habitat and recreation opportunities, create bicycle and walking trail connections, improve water quality and flood protection and augment water supply. Each conservancy was established under state statute, with specific objectives and constraints. Each is governed by a board of directors, and they are all under the general oversight of the Resources Agency.

The Southern California Association of Governments (SCAG), a regional council of governments which functions as the metropolitan planning organization for six counties, Los Angeles, Orange, San Bernardino, Riverside, Ventura and Imperial, serves an area of over 38,000 square miles and a population of over 18 million persons. While SCAG does not provide grant funding nor exercise direct authority over watershed matters, its population projections, Regional Transportation Plan and Regional Transportation Improvement Program and its role in reviewing environmental impact reports, as well as its continuing activity as a facilitator of intergovernmental cooperation, make it an important potential partner in watershed planning and projects.

Los Angeles County can acquire land and develop multiple-objective watershed projects through its Department of Public Works and its Department of Parks and Recreation, using either grant funds or general funds. The County can also issue bonds for capital projects. The County has been the local agency sponsor for several Corps efforts, and as the sponsor it plays the lead role in defining the project scope. As a large landholder with a variety of facilities, including parks, the County's decisions on location, design, operations and maintenance of all of its facilities can positively affect the watersheds in which it operates. The County can also plan and construct bikeways. The County operates a significant public education and outreach campaign to increase public understanding of watershed issues. For several years, the County has also been testing a variety of structural Best Management Practices (BMPs) such as catch basin inserts to retain trash. Through its Regional Planning department the County regulates land use, and through LACDPW it regulates building. The five County Supervisors develop policy and set priorities, and they are in a position to advance projects within their individual districts and to coordinate with officials of other agencies. During the last year, the LACDPW and the American Society of Civil Engineers (ASCE) have been exploring options for long term financing of watershed management, including both capital and operating funds.

With the County as lead agency in an exemplary intergovernmental cooperative effort, the region is presently developing the Greater Los Angeles Integrated Regional Water Management Plan (IRWMP). The plan will qualify the Los Angeles region for major state funding, and possibly federal funding, to develop multiple-objective projects meeting water quality, water resources and habitat objectives. While the plan is still in process, it is likely to recommend acquisition of many sites distributed throughout the region for projects that can detain, cleanse and, where appropriate, infiltrate stormwater. These projects will also have the capacity to significantly increase public open space for both recreation and habitat. In an early draft the plan calls for public acquisition of over 8,000 acres. This Tujunga Watershed Project is coordinating with the IRWMP planning team.

The City of Los Angeles can acquire land and develop multiple-objective watershed projects through its Bureau of Engineering, Department of Sanitation, and Department of Recreation and Parks. City voters approved, in November 2005, Proposition O, a \$500 million-dollar local general obligation bond issue for that purpose, with a requirement that each project contribute to improved water quality. The initial projects are presently being planned and constructed. Like the County, the City has large, distributed landholdings, including parks. The City can adopt design, operations and management policies to positively affect its watersheds, and has already taken steps in that direction, such as requiring that all new City buildings will be LEED (Leadership in Energy and Environmental Design, a national standard administered by a nonprofit

organization) certified as sustainable. The Mayor's Million Tree initiative, presently in the planning stage, will call for tree planting in City parks, along streets and other public and private settings. The City, through its Department of Transportation, has been planning and building a bikeway along the Los Angeles River. This could be linked to bikeways along the tributaries. Like the County, the City has a continuing public education and outreach program for watershed issues. Internally, the City Department of Sanitation developed and implemented an exemplary training program to educate thousands of city staff on stormwater issues and thereby reduce, among other pollutants, City facilities' contributions of metals, oil and grease to the storm drains, creeks, River and ocean. The City has also been testing and installing BMPs of various types. The City is presently conducting the Los Angeles River Revitalization Master Plan, and will cooperate with the USACE on studies following its completion in 2007. The plan at present does not encompass tributaries, and additional work will be needed to integrate them with the River. Some City planning and building regulations and policies, such as the Landscape Ordinance, support watershed goals, and others, such as the ban on waterless urinals, do not. A comprehensive review of policies would likely yield real benefits to the watersheds of the City, including Tujunga.

Beginning in 2001, the City of Los Angeles established Neighborhood Councils to empower local residents and provide a forum for civic issues. As of July 2006, there are now 86 certified Neighborhood Councils, of which 83 have locally-elected boards of directors. Elections are scheduled in the coming months for the others. The City's Department of City Planning includes meetings with the local Neighborhood Council as one of the key early steps in its process for public participation in community planning. The Neighborhood Councils, as they reflect local community concerns and values, are significant venues for watershed planning. They have the potential to lead community understanding of watershed issues. Nineteen Neighborhood Councils overlap the Tujunga watershed.

General Policy and Funding Issues

Political Will

If political will means a clear mandate from the electorate, sufficient to enable legislators to enact a policy and fund and carry out the program to realize it, then political will depends on public values and understandings. Public understanding of watershed issues is necessary before major funding will become available for land acquisition and development of multiple-objective projects. An indicator of the magnitude of the education task: in a 2000 public opinion survey in southern California, conducted on behalf of the California Resources Agency, SMMC and RMC, a majority of respondents thought "watershed" was another word for "outhouse". An indicator of progress: in June 2006, a front page article in the Los Angeles Downtown News pictured an unidentified business improvement district worker sweeping trash into a storm drain, expressed outrage that this could occur and called for an overhaul of the training and supervision that the BID provides. Once the connections have been made, and people begin to understand the water regime, political will for watershed management grows. The large majority of 76% of voters for City of Los Angeles Proposition O in 2005 evidences strong public support for parks and clean water, and for bond issues that include these elements.

One Voice

Los Angeles is the second largest city in America. It is the largest city in the most populous state. Yet the Los Angeles region does not receive its fair share of either federal or state funding, due largely to the fact that neither our Congressional delegation nor our state representatives present a unified voice. In the areas related to watershed management they do not work together to secure funding for our region. While individual elected officials, including both US Senators from California and a number of other federal and

state legislators, have been involved to some extent in watershed issues, their involvement has generally been individual, ad hoc and episodic. The interrelated issues of public open space, flood protection, water quality and water supply have not been a high priority for some of our elected officials, and those who are concerned with watershed matters may need to redouble efforts to engage our Assemblymembers, State Senators, Members of Congress and US Senators and encourage them to present a unified regional perspective in Washington and Sacramento, in much the way that the elected officials who represent the Lake Tahoe area and the Santa Ana watershed have been able to do. These areas have secured hundreds of millions of dollars in both federal and state grants for watershed improvements, while Los Angeles has received comparatively little.

Interagency Cooperation

Interagency cooperation in developing plans and projects can lead not only to efficiencies at every stage, but to more comprehensive, better integrated and more effective multiple-objective projects. But at present cooperation is still the exception, competition the rule. Bond measures and TMDL development processes that include requirements for stakeholder participation have improved communication. Continuing efforts to improve interagency communication and coordination, by SCAG, the Los Angeles and San Gabriel Rivers Watershed Council, ASCE and others and outreach efforts by elements of the Los Angeles County Department of Public Works and the Los Angeles City Sanitation Department have improved the situation over the last ten years, but much remains to be done. A focused program of watershed education for municipal officials could assist coordination by expanding the cohort of knowledgeable elected and appointed officials. Not only among agencies, but even within the large bureaucracies of Los Angeles County and the City of Los Angeles, individual departments often do not cooperate, or even communicate adequately, with each other. Among many examples of the inefficiencies caused by the lack of coordination is the present situation with regard to Geographic Information Systems (GIS) mapping and data. Every major agency employs GIS but files are not often shared. Some are proprietary, even though paid for by taxpayers, some are technically incompatible, some require cumbersome user agreements. This situation has led to considerable duplication of effort and has hampered watershed planning.

Long Term Funding

Bond funds and other capital improvement funding do not include funding for ongoing operation and maintenance. Lack of funds to maintain new facilities is a strong disincentive to agencies who might otherwise wish to develop them. Multiple-objective projects, particularly those that involve interagency cooperation, may further complicate the question of who is responsible for which aspects of maintenance. And bond funding is dependent on a public sense of urgency: as the urgency fades and public indebtedness increases, support for new capital projects may not be forthcoming. While significant funds can be redirected by means of repurposing our region's routine expenditures for infrastructure development and maintenance, the watershed approach to water supply, water quality, flood protection, habitat enhancement and recreational open space and trails is likely to require billions of new dollars over a period of 25 or more years in the region. To secure the needed funding, apart from state and federal support, and to minimize competition among subwatersheds (e.g. Tujunga vs. Arroyo Seco), local sources of stable long term funding are needed. This is most likely to take the form of some combination of property and use taxes, and will require a vote or votes of the people. (See Political Will above.)

Recommendations

Density of Development

TW Goal: Implement Watershed-based Planning and Projects

Action: Refine policies to concentrate development along transit corridors, in existing centers and along active transit corridors, particularly at transit stations, while discouraging development of greenfield sites.

Action by: City of Los Angeles, County of Los Angeles, City of San Fernando

Distribution of Development

TW Goal: Implement Watershed-based Planning and Projects

Action: Refine criteria to restrict development in sensitive areas such as existing native habitat, potential habitat restoration areas, hillsides, pervious soil areas and historic floodways.

Action by: City of Los Angeles, County of Los Angeles, City of San Fernando

Parks and Open Space

TW Goals: Improve and Increase a Network of Public Open Space
Create Green Trail Linkages and Recreational Access
Enhance, Quality, Quantity and Connectivity of Native Terrestrial and Riparian Habitats
Implement Watershed-based Planning and Projects

Action: Establish a regional open space plan with acreage targets, location criteria, timelines and funding mechanisms to increase public open space and improve walking access to it, especially in underserved areas. Coordinate City and County efforts with those of regional, state and federal agencies to develop an integrated strategy. Balance recreation and habitat uses (see next item below). Develop new parks as multiple-objective projects to reduce peak flood flows and detain, cleanse and infiltrate stormwater. Revise open space elements of general plans to reflect the strategy.

Action by: County of Los Angeles, City of Los Angeles, City of Los Angeles Neighborhood Councils, City of San Fernando, California State Parks, SMMC, RMC, Coastal Conservancy, USACE, TPL

Habitat-Recreation Balance

TW Goals: Enhance, Quality, Quantity and Connectivity of Native Terrestrial and Riparian Habitats
Improve and Increase a Network of Public Open Space
Create Green Transit Linkages and Recreational Access

Action: Establish priorities for designating habitat areas based on sensitivity, connectivity, habitat quality and related criteria. Establish priorities for recreational uses based on demographics and access. Establish priorities for green, nonmotorized transit linkages based on connectivity and access. Develop a policy to balance these uses by means of a stakeholder process and incorporate the results into the regional public open space plan (see above).

Action by: County of Los Angeles, City of Los Angeles, City of San Fernando, California State Parks, SMMC, RMC, Coastal Conservancy, USACE, TPL

Design Standards

TW Goals: Optimize Local Water Resources to Reduce Dependence on Imported Water
Improve Surface Water and Groundwater Quality
Restore Hydrologic Function to the Watershed while Maintaining Public Safety

Action: Review and revise building and planning codes to encourage retaining stormwater on-site where feasible and to encourage infiltration or storage and use of stormwater for irrigation or graywater. Review and revise building and planning codes to encourage a range of water conservation measures and reduce water use for irrigation.

Action by: City of Los Angeles, County of Los Angeles, City of San Fernando

Joint Use of School and College Campus Sites

TW Goals: Optimize Local Water Resources to Reduce Dependence on Imported Water
Improve Surface Water and Groundwater Quality
Restore Hydrologic Function to the Watershed while Maintaining Public Safety
Improve Collaboration among all Agencies, Organizations and Communities in TW

Action: Engage LAUSD and the Los Angeles Community College District in partnerships to retrofit campuses to manage stormwater on-site and infiltrate it where feasible or store and reuse it for irrigation. Where feasible incorporate detention and storage from both campus and surrounding community.

Action by: County of Los Angeles

Joint Use of Caltrans Sites

TW Goals: Improve Surface Water and Groundwater Quality
Restore Hydrologic Function to the Watershed while Maintaining Public Safety
Improve Collaboration among all Agencies, Organizations and Communities in TW

Action: Form partnerships to jointly develop stormwater detention and infiltration or storage projects on Caltrans rights-of-way.

Action by: County of Los Angeles, Caltrans, City of Los Angeles

Joint Use of LADWP and Edison Corridors

TW Goals: Restore Hydrologic Function to the Watershed while Maintaining Public Safety
Create Green Transit Linkages and Recreational Access
Enhance Quality, Quantity and Connectivity of Native Terrestrial and Riparian Habitats
Improve Collaboration among all Agencies, Organizations and Communities in TW

Action: Form partnerships to jointly develop multiple-objective stormwater detention and infiltration, bikeway and habitat restoration projects along LADWP and Edison rights-of-way.

Action by: County of Los Angeles, City of Los Angeles, LADWP, Southern California Edison

Plant Palettes

TW Goals: Optimize Local Water Resources to Reduce Dependence on Imported Water
Enhance Quality, Quantity and Connectivity of Native Terrestrial and Riparian Habitats

Action: Mandate predominant use of native plants with “smart irrigation” for public properties;

encourage use of native and other climate-appropriate plants in private properties through incentives.

Action by: City of Los Angeles, County of Los Angeles, City of San Fernando, Caltrans

Peak Flood Flows, Tujunga Wash and Los Angeles River

TW Goal: Restore Hydrologic Function to the Watershed while Maintaining Public Safety

Action: Reduce peak flood flows in the Tujunga Wash by enhancing upstream detention at Hansen and Big Tujunga Dams, through reconfiguration and dam operations, and by adding a network of detention sites at public schools and colleges, along utility corridors and along freeway rights-of-way. Provide mandates and/or incentives to capture and infiltrate stormwater on private sites or store and reuse it for irrigation. Enhance detention capacity by acquiring sites along by Tujunga and Pacoima Washes for use as multiple-objective projects including habitat, recreation, stormwater management for water quality and detention.

Action by: City of Los Angeles, County of Los Angeles, City of San Fernando, Caltrans

Hansen Dam Area

TW Goals: Optimize Local Water Resources to Reduce Dependence on Imported Water
Restore Hydrologic Function to the Watershed while Maintaining Public Safety

Action: Enhance stormwater detention at Hansen Dam by reconfiguring the area above the dam. Acquire gravel pits as their operations phase out, and incorporate them as detention, and, where feasible, infiltration facilities.

Action by: City of Los Angeles, County of Los Angeles, USACE

Dam Operations

TW Goals: Restore Hydrologic Function to the Watershed while Maintaining Public Safety
Optimize Local Water Resources to Reduce Dependence on Imported Water

Action: Conduct a comprehensive review of dam operations at Hansen, Big Tujunga, Pacoima and Lopez Dams, taking into account availability of live satellite weather information, refined hydrologic information and modeling and other relevant factors. Operate dams to reduce peak flood flows while enhancing infiltration.

Action by: County of Los Angeles, USACE

Nonstructural Flood Protection and Land Acquisition

TW Goals: Restore Hydrologic Function to the Watershed while Maintaining Public Safety
Improve and Increase a Network of Public Open Space
Optimize Local Water Resources to Reduce Dependence on Imported Water
Enhance Quality, Quantity and Connectivity of Native Terrestrial and Riparian Habitat
Create Green Transit Linkages and Recreational Access

Action: Establish a long-term program to acquire floodways along Tujunga Wash, Pacoima Wash and tributaries. Acquire land from willing sellers at fair market value. Maintain neighborhood integrity while assembling parcels for multiple benefit public uses: maintain acquired properties and maintain their uses. Establish funding mechanisms to support acquisitions. Integrate the floodway acquisition program with the regional open space plan (see above,

Parks and Open Space). Provide mandates and/or incentives to capture and infiltrate stormwater on private sites or store and reuse it for irrigation. Reconfigure/retrofit public parks and other public sites to detain, cleanse and infiltrate stormwater, or where appropriate store it in cisterns for later use. Develop neighborhood scale multiple-objective projects to detain, cleanse and infiltrate stormwater, using public rights-of-way, available surplus public sites or newly acquired sites. Implement joint-use, multiple-objective projects to detain, cleanse and infiltrate stormwater with public schools and colleges, Caltrans, LADWP and Edison. (See recommendations above.)

Action by: County of Los Angeles, City of Los Angeles, City of San Fernando, California State Parks, SMMC, RMC, Coastal Conservancy, USACE, TPL

Mountain Debris Basins

TW Goals: Restore Hydrologic Function to the Watershed while Maintaining Public Safety
Optimize Local Water Resources to Reduce Dependence on Imported Water

Action: Conduct a comprehensive assessment of the debris basins and check dams in the Tujunga watershed as to their condition and functionality. Determine feasibility of improvements to enhance flood protection and capture and infiltration of stormwater by reducing peak flows.

Action by: County of Los Angeles

Safety, Security and Liability

TW Goals: Improve and Increase a Network of Public Open Space
Restore Hydrologic Function to the Watershed while Maintaining Public Safety
Promote Watershed Awareness and Stewardship through Public Outreach & Education

Action: Integrate call boxes, warning signs and horns or similar devices into multiple objective streambed and floodway open spaces. Augment and redeploy public safety officers to publicly-accessible floodways. Designate floodways as public open space or parkland rather than infrastructure to address liability concerns. Augment existing public outreach and education efforts, both in structured K-12 school programs and in media campaigns targeting the general public.

Action by: County of Los Angeles, City of Los Angeles, USACE

Maintenance

TW Goals: Improve and Increase a Network of Public Open Space
Improve Collaboration among all Agencies, Organizations & Communities in TW

Action: Secure long term funding for maintenance of floodways and streams. (See Long Term Funding below.) Develop interagency agreements establishing maintenance responsibilities for multiple-objective projects. Recognize and make provisions for periodic maintenance of sacrificial vegetation and repairs of recreational facilities and trails in floodways.

Action by: County of Los Angeles, City of Los Angeles, City of San Fernando, California State Parks, SMMC, RMC, Coastal Conservancy, USACE

Sacrificial Vegetation

TW Goals: Enhance Quality, Quantity and Connectivity of Native Terrestrial and Riparian Habitat

Improve and Increase a Network of Public Open Space

- Action: Develop criteria for incorporation of native vegetation of different species and sizes within streambed and floodways, allowing for periodic inundation and uprooting under flood conditions at various intervals (i.e. 2-year, 5-year, 10-year, 25-year events). Incorporate vegetation that may be sacrificed periodically when heavy maintenance equipment is used. Incorporate sacrificial vegetation in multiple-objective projects in streambeds and floodways. Plan for maintenance of sacrificial vegetation (see item above).
- Action by: County of Los Angeles, City of Los Angeles, City of San Fernando, California State Parks, SMMC, RMC, Coastal Conservancy, USACE

Sediment Transport

- TW Goals: Restore Hydrologic Function to the Watershed while Maintaining Public Safety
Improve Surface Water and Groundwater Quality
- Action: Develop a sediment management strategy and maintenance plan. Plan for and conduct periodic releases of sediment from Big Tujunga, Pacoima and Hansen Dams. Integrate Tujunga Wash sediment management with Los Angeles River sediment management while protecting the harbor area by means of periodic sand and gravel extraction at appropriate location(s) along the Wash or River.
- Action by: County of Los Angeles, USACE

Stream Daylighting

- TW Goals: Restore Hydrologic Function to the Watershed while Maintaining Public Safety
Improve Surface Water and Groundwater Quality
Optimize Local Water Resources to Reduce Dependence on Imported Water
Enhance Quality, Quantity and Connectivity of Native Terrestrial and Riparian Habitat
- Action: Assess tributary storm drains and streams to establish feasibility of daylighting. Daylight/reestablish tributary streams where feasible. Configure restored streams to reduce volume and velocity of runoff, cleanse stormwater and, where feasible, infiltrate it to groundwater. Incorporate native vegetation to create habitat value.
- Action by: County of Los Angeles, City of Los Angeles, City of San Fernando

Adjudication

- TW Goals: Optimize Local Water Resources to Reduce Dependence on Imported Water
Improve Collaboration among all Agencies, Organizations & Communities in TW
- Action: Develop collaborative interagency agreements and procedures to augment local water resources taking into account adjudicated water rights.
- Action by: County of Los Angeles, City of Los Angeles, LADWP, ULARA Watermaster

Conservation

- TW Goals: Optimize Local Water Resources to Reduce Dependence on Imported Water
Enhance Quality, Quantity and Connectivity of Native Terrestrial and Riparian Habitat
- Action: Intensify and sustain public outreach and education programs to encourage water conservation. Provide incentives and/or mandates to accelerate installation of water-

conserving hardware in buildings, including low-flow toilets and showerheads in residences and low-flow toilets, automatic faucets and waterless urinals in commercial and institutional buildings. Provide incentives to retrofit older buildings with water-conserving fixtures. Provide incentives to use reclaimed water and/or on-site graywater for toilets in larger buildings. Reduce use of potable water for irrigation by (1) providing incentives to use smart irrigation systems where applicable, (2) mandating public facilities and encouraging private facilities to use predominantly native and other climate-appropriate plants, grouping them according to water use, (3) replacing lawn areas in public facilities and on street medians and parkways with native, low-water-use plants, (4) providing mandates and/or incentives to capture and store stormwater on-site and reuse it for irrigation, (5) extend the distribution of reclaimed wastewater and provide mandates and/or incentives for its use in irrigation. Employ consumption-based tiered pricing to discourage excessive water use.

Action by: County of Los Angeles, City of Los Angeles, LADWP, City of San Fernando

Groundwater Contamination

TW Goals: Optimize Local Water Resources to Reduce Dependence on Imported Water
Improve Surface Water and Groundwater Quality

Action: Reassess groundwater cleanup strategy and procedures in the San Fernando Valley to effectuate faster return to serviceability of the large Valley groundwater basin. Employ cost-benefit analysis to measure cleanup costs against water supply benefits, taking into account the large quantities of stormwater and treated wastewater that could potentially be recharged, vs. the incremental cost of imported water.

Action by: LADWP, DTSC, DHS, ULARA Watermaster

Reclaimed Water, Nonpotable Uses

TW Goal: Optimize Local Water Resources to Reduce Dependence on Imported Water

Action: Expand distribution of reclaimed water via main distribution “purple corridors” and provide incentives for new developments to incorporate its use and existing developments to retrofit.

Action by: LADWP

Reclaimed Water for Groundwater Recharge

TW Goal: Optimize Local Water Resources to Reduce Dependence on Imported Water

Action: Verify feasibility of using reclaimed water for groundwater recharge, including technical and regulatory concerns. Develop public support by means of a vigorous outreach and education effort. Implement groundwater recharge at Hansen spreading grounds with appropriate monitoring to protect public health. Over time, as the Valley aquifer is restored to service (see Groundwater Contamination above) expand the program beyond Hansen.

Action by: LADWP, DHS, ULARA Watermaster

Reclaimed Water for River Habitat

TW Goals: Enhance Quality, Quantity and Connectivity of Native Terrestrial and Riparian Habitat
Restore Hydrologic Function to the Watershed while Maintaining Public Safety

Action: Incorporate provision for adequate reclaimed water from Tillman Water Reclamation Plant to

remain in the Los Angeles River to support habitat restoration. Develop habitat restoration along Tujunga Wash and Pacoima Wash taking into account historic seasonal flows and the plant communities adapted to those conditions. As necessary, provide reclaimed water to the washes to support restoration.

Action by: LADWP, City of Los Angeles, County of Los Angeles, USACE

Stormwater as a Resource

TW Goals: Optimize Local Water Resources to Reduce Dependence on Imported Water
Restore Hydrologic Function to the Watershed while Maintaining Public Safety
Improve and Increase a Network of Public Open Space
Enhance Quality, Quantity and Connectivity of Native Terrestrial and Riparian Habitat
Implement Watershed-based Planning and Projects
Improve Surface Water and Groundwater Quality

Action: Provide mandates and/or incentives to capture and infiltrate stormwater on private sites or store and reuse it for irrigation. Reconfigure/retrofit public parks and other public sites to detain, cleanse and infiltrate stormwater, or where appropriate store it in cisterns for later use. Develop neighborhood scale multiple-objective projects to detain, cleanse and infiltrate stormwater, using public rights-of-way, available surplus public sites or newly acquired sites. Implement joint-use, multiple-objective projects to detain, cleanse and infiltrate stormwater with public schools and colleges, Caltrans, LADWP and Edison. (See recommendations above.) Acquire sites along the Washes and throughout the watershed for multiple-objective projects to increase public open space for habitat and recreation while detaining, cleansing and infiltrating stormwater. (See Nonstructural Flood Protection and Land Acquisition and Parks and Open Space above.)

Action by: County of Los Angeles, City of Los Angeles, City of San Fernando, California State Parks, SMMC, RMC, Coastal Conservancy, USACE, TPL

Advanced Treatment of Wastewater

TW Goals: Improve Surface Water and Groundwater Quality
Optimize Local Water Resources to Reduce Dependence on Imported Water

Action: Evaluate standards and treatment options for treated wastewater to be released to the Los Angeles River vs. treated wastewater to be recharged to groundwater.

Action by: LARWQCB, City of Los Angeles, County of Los Angeles

TMDL Implementation

TW Goals: Improve Surface Water and Groundwater Quality
Implement Watershed-based Planning and Projects

Action: Coordinate development of a suite of TMDL regulations to foster integrated remedial actions, as opposed to single-purpose BMPs. Continue the CREST stakeholder process. Reduce sources of pollution by encouraging on-site stormwater management.

Action by: LARWQCB, County of Los Angeles, City of Los Angeles, City of San Fernando

Political Will

TW Goals: Promote Watershed Awareness and Stewardship through Public Outreach & Education
Improve Collaboration among all Agencies, Organizations & Communities in TW

Action: Build public understanding and support for watershed management by intensifying public outreach and education efforts, employing targeted programs for elected and appointed officials, the general public (ratepayers and voters) and K-12 schoolchildren.

Action by: County of Los Angeles, City of Los Angeles

One Voice

TW Goals: Improve Collaboration among all Agencies, Organizations & Communities in TW
Implement Watershed-based Planning and Projects
Restore Hydrologic Function to the Watershed while Maintaining Public Safety
Improve and Increase a Network of Public Open Space
Enhance Quality, Quantity and Connectivity of Native Terrestrial and Riparian Habitat
Optimize Local Water Resources to Reduce Dependence on Imported Water
Improve Surface Water and Groundwater Quality

Action: Work closely with senior staff of US Senators and Representatives, state Senators and Assemblymembers to build a clear consensus on watershed issues and funding priorities at state and federal level. Coordinate a regional approach dealing with the interrelated issues of public open space, flood protection, water quality and water supply, providing assistance to elected officials and staff to facilitate their understanding and communication of the approach.

Action by: County of Los Angeles, City of Los Angeles

Interagency Cooperation

TW Goal: Improve Collaboration among all Agencies, Organizations & Communities in TW

Action: Establish a regular ongoing process for interagency communication, cooperation and collaboration. Extend the TW technical advisory group through implementation of the watershed plan. Establish a parallel process for community involvement, as a continuation of the existing Steering Committee.

Action by: The River Project, County of Los Angeles, City of Los Angeles

Long Term Funding

TW Goals: Improve Collaboration among all Agencies, Organizations & Communities in TW
Implement Watershed-based Planning and Projects

Action: Develop stable long term funding for land acquisition, capital improvements and maintenance and operations of multiple-objective watershed projects. Consider user fees and property taxes. Prepare a public outreach and education campaign to build understanding and support (see Political Will above). Develop ballot measures as necessary to bring the funding plan to the voters and implement it.

Action by: County of Los Angeles, City of Los Angeles

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Appendices

Tujunga Watershed Project – Goals, Subgoals & Objectives

Overarching goal: To revitalize the Tujunga Watershed, balancing water supply, water quality, community open space needs, environmental protection and restoration, and public safety.

Optimize Local Water Resources to Reduce Dependence on Imported Water

- Improve groundwater infiltration
 - Develop groundwater management strategy for optimum use of local water resources
 - Improve quality and quantity of on-site water recharge to the SFV Groundwater Basin
 - Restore natural streams, washes, and floodplains in areas of high soils permeability
- Reduce dependence on imported water
 - Facilitate on-site collection systems for stormwater and greywater
 - Expand water conservation programs
 - Extend the distribution and range of uses for reclaimed water
- Integrate groundwater infiltration with other public and/or beneficial uses
 - Provide for compatible public activities and uses in infiltration areas
 - Restore natural streams, washes and floodplains and associated habitats

Improve Surface Water & Groundwater Quality

- Reduce pollutant loads
 - Expand source reduction programs
 - Implement Best Management Practices
 - Implement institutional controls such as water quality zones, urban forestry, product substitution/source control, and public outreach and education
- Maximize “nature’s services” before utilizing manufactured solutions
 - Reinstate sediment transport to support assimilative capacity
 - Increase permeable surfaces throughout the watershed area
- Implement a citizen-based water quality monitoring program

Restore Hydrologic Function to the Watershed while Maintaining Public Safety

- Reestablish functional streams
 - Restore/acquire functional floodplains
 - Restore natural, bioengineered streambanks
 - Daylight/reestablish tributary streams where feasible
 - Develop sediment management strategy
 - Establish meanders as needed to facilitate dynamic equilibrium of sediment transport
- Design restoration projects to maintain flood protection
 - Capture and infiltrate stormwater where it falls to reduce runoff volume in streams
 - Acquire gravel pits for stormwater detention
 - Remove or elevate structures in floodways
 - Implement a flood hazard warning system

Enhance Quality, Quantity and Connectivity of Native Terrestrial and Riparian Habitats

- Restore, protect and augment terrestrial and aquatic species habitat
 - Create habitat corridors along Tujunga and Pacoima washes
 - Restore riparian habitat along historic tributaries where feasible
 - Identify, enhance and restore natural habitat and wildlife corridor between Verdugo and San Gabriel mountains
 - Acquire land or conservation easements in ecologically sensitive areas, including along streams
- Integrate fire and vector management strategies into native vegetation zones
- Reduce extent of invasive, non-native species
- Expand use of native plants in landscaping through mandate on publicly-owned lands and through incentives on private lands

Improve and Increase a Network of Public Open Space

- Augment overall open space network to meet the national standard for park space per capita ratio
 - Protect existing open spaces
 - Implement a targeted, prioritized program to utilize surplus properties and acquire land from willing sellers
- Improve connectivity and access to Tujunga and Pacoima washes and the Angeles National Forest using tools such as easements and greenway linkages
- Develop a design standard for open space that integrates natural resources management with various recreational needs
- Provide for maintenance and security of parks, open space, and trails

Create Green Transit Linkages and Recreational Access

- Improve multi-modal transit
 - Create a watershed-wide network of pedestrian, equestrian and bicycle routes utilizing BMP's in design
 - Connect multi-modal transportation routes to communities, public facilities, transit focal points, greenways and other open spaces
 - Design multi-modal routes for user safety
- Enhance and expand recreational opportunities to meet needs of local communities
 - Determine appropriate recreational uses with local community guidance
 - Group activities according to use compatibility
 - Provide a diversity of recreational opportunities and experiences within each community

Promote Watershed Awareness & Increase Stewardship through Public Outreach and Education

- Conduct education and outreach programs to expand appreciation of the natural character of Tujunga and Pacoima Washes and the importance of watershed restoration
 - Identify and understand target audiences to develop and deliver most effective outreach and educational programs
 - Focus on local eco-system, groundwater/water supply issues, flood safety, sustainable living, and environmental justice
 - Develop and deliver an educational curriculum for grades K-12
 - Partner with community colleges to gather data, monitor conditions, and implement plan development and also encourage continued participation of local universities
 - Use the internet as an informative outreach tool
- Engage community interest through participation in restoration activities
 - Include youth and community groups in watershed restoration activities
 - Involve the business community
 - Provide opportunities and resources for individuals to participate on their property
- Protect and interpret natural, cultural and historic resources

Implement Watershed-based Planning and Projects

- Implement ordinances and incentives to protect watersheds and streams:
 - Require "no net gain" of stormwater runoff on developed sites, based on natural conditions
 - Create a River Overlay Zone to acquire floodplains opportunistically or through long term programs
 - Incentivize multiple-objective developments and BMP integration in private-sector projects
 - Develop alternative approaches to land use designations in order to integrate, preserve, and protect natural systems within urban environments
- Require integrated open space in mixed use, live/work developments
 - Recycle underused sites along Tujunga & Pacoima Washes
 - Leverage Quimby and other park funds to acquire parkland in developed areas
 - Increase park acreage required by General Plan
- Preserve agricultural zones

Improve Collaboration among all Agencies, Organizations & Communities in the Watershed

- Institute a comprehensive program to facilitate communication and collaboration
 - Involve elected officials and their staff, governmental, regulatory and infrastructure agencies, NGO's, CBO's, professional and business organizations and individuals in a cooperative watershed stewardship program
 - Assign a liaison with decision-level capability from each agency to communicate with each other and the stakeholders
 - Develop a system that fosters early notification and cooperation amongst all stakeholders prior to all project planning
- Encourage mutual understanding of the goals, objectives and roles of each individual agency and organization involved
- Partner with existing local programs and projects where appropriate
- Develop a collaborative strategy to finance implementation of the Plan

TUJUNGA WATERSHED PROJECT - GOALS, SUBGOALS & OBJECTIVES

	CLIMATE	GEOMORPHOLOGY	HYDROLOGY	WATER SUPPLY	WATER QUALITY	HABITAT	LAND USE	CULTURAL HISTORY	COMMUNITY/ECONOMIC	MANAGEMENT/POLICY
Optimize Local Water Resources to Reduce Dependence on Imported Water										
<i>Improve groundwater infiltration WS</i>	○	○		●						
• Develop groundwater management strategy for optimum use of local water resources	○			●						●
• Improve quality and quantity of on-site water recharge to the SFV Groundwater Basin	○			●			●			●
• Restore natural streams, washes, and floodplains in areas of high soils permeability		○		●						●
<i>Reduce dependence on imported water</i>	○			●						●
• Facilitate on-site collection systems for stormwater and greywater	○			●			●			●
• Expand water conservation programs	○			●						●
• Extend the distribution and range of uses for reclaimed water	○			●			●			●
<i>Integrate groundwater infiltration with other public and/or beneficial uses</i>	○						●			●
• Provide for compatible public activities and uses in infiltration areas							●		●	●
• Restore natural streams, washes and floodplains and associated habitats		○		●		●				●
Improve Surface Water & Groundwater Quality										
<i>Reduce pollutant loads</i>					●					●
• Expand source reduction programs					●		●			●
• Implement Best Management Practices					●					●
• Implement institutional controls such as water quality zones, urban forestry, product substitution/source control, and public outreach and education					●					●
<i>Maximize "nature's services" before utilizing manufactured solutions</i>		○			●		●			●
• Reinstate sediment transport to support assimilative capacity		○			●					●
• Increase permeable surfaces throughout the watershed area		○		●	●		●			●
<i>Implement a citizen-based water quality monitoring program</i>					●					●
Restore Hydrologic Function to the Watershed while Maintaining Public Safety										
<i>Reestablish functional streams</i>		○	○							●
• Restore/acquire functional floodplains		○	○							●
• Restore natural, bioengineered streambanks		○	○			●	●			●
• Daylight/reestablish tributary streams where feasible		○	○							●
• Develop sediment management strategy		○	○							●
• Establish meanders as needed to facilitate dynamic equilibrium of sediment transport		○	○							●
<i>Design restoration projects to maintain flood protection</i>	○	○	○				●			●
• Capture and infiltrate stormwater where it falls to reduce runoff volume in streams	○	○	○				●			●
• Acquire gravel pits for stormwater detention	○	○	○				●			●
• Remove or elevate structures in floodways	○	○	○							●
• Implement a flood hazard warning system	○	○	○							●
Enhance Quality, Quantity and Connectivity of Native Terrestrial and Riparian Habitats										
<i>Restore, protect and augment terrestrial and aquatic species habitat</i>						●	●	●		●
• Create habitat corridors along Tujunga and Pacoima washes						●	●	●		●
• Restore riparian habitat along historic tributaries where feasible						●	●	●		●
• Identify, enhance and restore natural habitat and wildlife corridor between Verdugo and San Gabriel mountains						●	●	●		●
• Acquire land or conservation easements in ecologically sensitive areas, including along streams						●	●	●		●
<i>Integrate fire and vector management strategies into native vegetation zones</i>						●	●	●		●
<i>Reduce extent of invasive, non-native species</i>						●	●	●		●
• Expand use of native plants in landscaping through mandate on publicly-owned lands and through incentives on private lands						●	●	●		●
Improve and Increase a Network of Public Open Space										
<i>Augment overall open space network to meet the national standard for park space per capita ratio</i>						●	●	●	●	●
• Protect existing open spaces						●	●	●	●	●
• Implement a targeted, prioritized program to utilize surplus properties and acquire land from willing sellers						●	●	●	●	●
<i>Improve connectivity and access to Tujunga and Pacoima washes and the Angeles National Forest using tools such as easements and greenway linkages</i>						●	●	●	●	●
<i>Develop a design standard for open space that integrates natural resources management with various recreational needs</i>						●	●	●		●
<i>Provide for maintenance and security of parks, open space, and trails</i>						●	●	●	●	●

TUJUNGA WATERSHED PROJECT - GOALS, SUBGOALS & OBJECTIVES

	CLIMATE	GEOMORPHOLOGY	HYDROLOGY	WATER SUPPLY	WATER QUALITY	HABITAT	LAND USE	CULTURAL HISTORY	COMMUNITY/ECONOMIC	MANAGEMENT/POLICY
Create Green Transit Linkages and Recreational Access										
<i>Improve multi-modal transit</i>	○						●	●	●	●
• Create a watershed-wide network of pedestrian, equestrian and bicycle routes utilizing BMPs in design	○						●	●	●	●
• Connect multi-modal transportation routes to communities, public facilities, transit focal points, greenways and other open spaces	○						●	●	●	●
• Design multi-modal routes for user safety							●	●	●	●
<i>Enhance and expand recreational opportunities to meet needs of local communities</i>							●	●	●	●
• Determine appropriate recreational uses with local community guidance							●	●	●	●
• Group activities according to use compatibility							●	●	●	●
• Provide a diversity of recreational opportunities and experiences within each community							●	●	●	●
Promote Watershed Awareness & Increase Stewardship through Public Outreach and Education										
<i>Conduct education and outreach programs to expand appreciation of the natural character of Tujunga & Pacoima Washes and the importance of watershed restoration</i>						●		●		
• Identify and understand target audiences to develop and deliver most effective outreach and educational programs								●		●
• Focus on local eco-system, groundwater/water supply issues, flood safety, sustainable living, and environmental justice				●	●	●		●		●
• Develop and deliver an educational curriculum for grades K-12								●		●
• Partner with community colleges to gather data, monitor conditions, and implement plan development and also encourage continued participation of local universities								●		●
• Use the internet as an informative outreach tool								●		●
<i>Engage community interest through participation in restoration activities</i>								●		●
• Include youth and community groups in watershed restoration activities								●		●
• Involve the business community								●		●
• Provide opportunities and resources for individuals to participate on their property								●		●
<i>Protect and interpret natural, cultural and historic resources</i>						●	●	●		●
Implement Watershed-based Planning and Projects										
<i>Implement ordinances and incentives to protect watersheds and streams</i>	○							●		●
• Require "no net gain" of stormwater runoff on developed sites, based on natural conditions	○		●	●				●		●
• Create a River Overlay Zone to acquire floodplains opportunistically or through long term programs	○							●		●
• Incentivize multiple-objective developments and BMP integration in private-sector projects								●		●
• Develop alternative approaches to land use designations in order to integrate, preserve, and protect natural systems within urban environments						●		●		●
<i>Require integrated open space in mixed use, live/work developments</i>							●	●		●
• Recycle underused sites along Tujunga & Pacoima Washes							●	●		●
• Leverage Quimby and other park funds to acquire parkland in developed areas							●	●		●
• Increase park acreage required by General Plan							●	●		●
<i>Preserve agricultural zones</i>							●	●		●
Improve Collaboration among all Agencies, Organizations & Communities in the Watershed										
<i>Institute a comprehensive program to facilitate communication and collaboration</i>										●
• Involve elected officials and their staff, governmental, regulatory and infrastructure agencies, NGO's, CBO's, professional and business organizations and individuals in a cooperative watershed stewardship program										●
• Assign a liaison with decision-level capability from each agency to communicate with each other and the stakeholders										●
• Develop a system that fosters early notification and cooperation amongst all stakeholders prior to all project planning									●	●
<i>Encourage mutual understanding of the goals, objectives and roles of each individual agency and organization involved</i>									●	●
<i>Partner with existing local programs and projects where appropriate</i>									●	●
<i>Develop a collaborative strategy to finance implementation of the Plan</i>									●	●

Appendix 3 ~ Tujunga Watershed Project Spatial Metadata Summary - 2006

Data Category	Name	Source (Contact)	Date	Resolution	Type	Format	Security	Extent (Original)	Version Availability	Full Metadata	DSA	Short Description
Cadastral	Parcels	City of LA - Engineering (Randy Price)	2005	Unknown	Polygon	Shapefile		City of Los Angeles	1.2	No	X	Lots or tracts delineating legal ownership boundaries within the City of LA
Cadastral	Right-Of-Way	City of LA - Engineering (Randy Price)	2005	Unknown	Line	Shapefile		City of Los Angeles	1.2	No	X	Government designated corridors over which public transportation or conveyance facilities are built
Cadastral	Freeways	City of LA - Engineering (Randy Price)	2005	Unknown	Line	Shapefile		City of Los Angeles	1.2	No	X	Freeway extent within the City of Los Angeles
Cadastral	Parcels	Office of the Assessor - Los Angeles County	Mar 2006	Unknown	Polygon	Shapefile		LA County	2.0	No		Lots or tracts delineating legal ownership boundaries within the County of LA
Climate	Alert83 - Rainfall Gage	LACDPW - Water Resources Div. (Rodney Brown)	2005	Unknown	Point	Shapefile		LA County	1.3	No	X	Automatic rain gages monitored by LACDPW
Climate	Stand83 - Rainfall Gage	LACDPW - Water Resources Div. (Rodney Brown)	2005	Unknown	Point	Shapefile		LA County	1.3	No	X	Standard or manual rain gages monitored by LACDPW
Climate	ASOG - Climate Station	National Climatic Data Center - NOAA	2005	Unknown	Point	Shapefile		U.S.	1.4	No		Automated NCDC climate station that collects precipitation and temperature
Climate	COOP - Climate Station	National Climatic Data Center - NOAA	2005	Unknown	Point	Shapefile		U.S.	1.4	No		Manual NCDC climate station operated by local observers that collect precipitation and temperature
Climate	Average Rainfall Isolines	USGS (Teale Data Center)	Jan 1994	1:1,000,000	Polygon	Shapefile		State	1.8	No		Isolines representing average rainfall from 1900-1960
Civic	Airports	GDT, Inc.	Mar 2004	1:100,000	Polygon	Shapefile		U.S.	1.0	Yes		Airport boundaries and runways within United States
Civic	Parks	GDT, Inc.	Mar 2004	1:100,000	Polygon	Shapefile		U.S.	1.0	Yes		Parks and forests within U.S. at National, State, and local levels
Civic	Schools	USGS	Mar 2004	1:100,000	Point	Shapefile		U.S.	1.0	Yes		School locations extracted from the GNIS
Civic	City Facilities	City of LA - Engineering (Randy Price)	2005	Unknown	Point	Shapefile		City of Los Angeles	1.2	No	X	Owned & managed properties for City of LA
Civic	Landfills w/ 300 ft buffer	City of LA - Engineering (Randy Price)	2005	Unknown	Polygon	Shapefile		City of Los Angeles	1.2	No	X	Landfill point locations buffered with a 300ft polygon within the City of Los Angeles
Civic	Landfills & Transfer Stations	California Integrated Waste Management Board	Dec 2005	Unknown	Point	Shapefile		State	1.4	No		Landfills and transfer stations generated from the Solid Waste Information System (SWIS) database
Civic	Landfills	LASGRWC (Jason Casanova)	Jan 2006	1:5,000	Polygon	Shapefile		Watershed	1.5	Yes		Known landfill areas within the project area - derived from point locations and online resources
Civic	Brownfields	California Dept. of Toxic Substances Control	Feb 2006	Unknown	Point	Shapefile		State	1.7	No		Known sites that have confirmed or potential hazardous contamination issues
Civic	Transmission Corridors	LASGRWC (Jason Casanova)	Jan 2006	1:5,000	Polygon	Shapefile		Los Angeles County	1.6	Yes		Potential open space opportunities located under transmission (power phone etc.) lines
Civic	Gravel Pits	The River Project (Koe Lavery)	Mar 2006	1:2,500	Polygon	Shapefile		Lower (urban) Watershed	1.6	No		Current gravel pits located in and around the lower watershed
Demographics	Census Tracts	U.S. Census Bureau	2000	1:100,000	Polygon	Shapefile		U.S.	1.1	Yes		2000 census tracts w/ related SF 1 and PL94 tables
Demographics	Census Block Groups	U.S. Census Bureau	2000	1:100,000	Polygon	Shapefile		U.S.	1.1	Yes		2000 census block groups w/ related SF 1 table
Demographics	Census Blocks	U.S. Census Bureau	2000	1:100,000	Polygon	Shapefile		U.S.	1.1	Yes		2000 census blocks w/ related SF 1 and PL94 tables
Demographics	80 Results - % American Eskimo	UC Davis (Dr. Fraser Shilling)	2000	1/4 meter	Raster	GRID		Watershed	1.1	No		Results derived from U.S. Census block group data
Demographics	80 Results - % Asian	UC Davis (Dr. Fraser Shilling)	2000	1/4 meter	Raster	GRID		Watershed	1.1	No		Results derived from U.S. Census block group data
Demographics	80 Results - % Black	UC Davis (Dr. Fraser Shilling)	2000	1/4 meter	Raster	GRID		Watershed	1.1	No		Results derived from U.S. Census block group data
Demographics	80 Results - % Caucasian	UC Davis (Dr. Fraser Shilling)	2000	1/4 meter	Raster	GRID		Watershed	1.1	No		Results derived from U.S. Census block group data
Demographics	80 Results - % Hispanic	UC Davis (Dr. Fraser Shilling)	2000	1/4 meter	Raster	GRID		Watershed	1.1	No		Results derived from U.S. Census block group data
Demographics	80 Results - % Hawaiian/Pacific Islander	UC Davis (Dr. Fraser Shilling)	2000	1/4 meter	Raster	GRID		Watershed	1.1	No		Results derived from U.S. Census block group data
Demographics	80 Results - % Multiple Races	UC Davis (Dr. Fraser Shilling)	2000	1/4 meter	Raster	GRID		Watershed	1.1	No		Results derived from U.S. Census block group data
Demographics	80 Results - % Other	UC Davis (Dr. Fraser Shilling)	2000	1/4 meter	Raster	GRID		Watershed	1.1	No		Results derived from U.S. Census block group data
Demographics	80 Results - % Owners	UC Davis (Dr. Fraser Shilling)	2000	1/4 meter	Raster	GRID		Watershed	1.1	No		Results derived from U.S. Census block group data
Demographics	80 Results - % Renters	UC Davis (Dr. Fraser Shilling)	2000	1/4 meter	Raster	GRID		Watershed	1.1	No		Results derived from U.S. Census block group data
Demographics	80 Results - % Under the Age of 18	UC Davis (Dr. Fraser Shilling)	2000	1/4 meter	Raster	GRID		Watershed	1.1	No		Results derived from U.S. Census block group data
Demographics	80 Results - % Vacant	UC Davis (Dr. Fraser Shilling)	2000	1/4 meter	Raster	GRID		Watershed	1.1	No		Results derived from U.S. Census block group data
DRG	7.5 minute quadrangles	USGS	Mar 1999	1:24,000	Raster	Imagine		U.S.	1.0	Yes		Digital 1:100,000 USGS quad sheet mosaic - (topographic maps)
DRG	30x60 minute quadrangles	USGS	May 1999	1:100,000	Raster	Imagine		U.S.	1.0	Yes		Digital 7.5 USGS quad sheet mosaic - (topographic maps)
DRG	Historic quadrangles	USGS	1890s	1:62,500	Raster	GeoTIFF		Los Angeles Basin	1.7	No		Mosaic of quad sheets from the 1890s depicting historic wetlands
Elevation	Contours - 1:24,000	City of LA - Engineering (Randy Price)	Unknown	1:24,000	Line	Shapefile		City of Los Angeles	1.2	No		Contour lines defining the elevation/topography of the land as derived by the USGS
Elevation	Contours - 1:100,000	USGS		1:100,000	Line	Shapefile		U.S.	1.9	Yes		Contour lines defining the elevation/topography of the land as derived by the USGS
Elevation	DEM	USGS	2001	10 meter	Raster	GRID		U.S.	1.0	No		Mosaic of 7.5' DEMs (10 meter) - (contours delineating elevation/topography of the land)
Elevation	Hillshade	USGS	2001	10 meter	Raster	GRID		U.S.	1.0	No		Hillshade of DEM Mosaic (10 meter) - (contours delineating elevation/topography of the land)
Elevation	River Corridor LIDAR (Raw Data)	USACE	Unknown	Unknown	Point	ASCII	X	LA River & Lower Tujunga Wa	1.2	No		Main stem LA River corridor and Lower Tujunga Wash high-resolution elevation data
Elevation	River Corridor LIDAR (Contours)	USACE	Unknown	Unknown	Line	Coverage	X	LA River & Lower Tujunga Wa	1.2	No		Contours (derived from raw LIDAR) defining the topography for the LA River Corridor and Lower Tujunga Wash
Elevation	River Corridor LIDAR (TIN)	USACE	Unknown	Unknown	Polygon	TIN	X	LA River & Lower Tujunga Wa	1.2	No		Main stem LA River corridor and Lower Tujunga Wash high-resolution elevation data (derived from raw LIDAR)
Geology	Faults	USGS	2003	1:250,000	Line	Shapefile		U.S.	1.0	Yes		U.S. faults & associated folds that are sources of significant earthquakes (mag > 6) during the Quaternary
Geology	Liquefaction Zones	California Geological Survey (Barbara Wanish)	2003	1:24,000	Polygon	Shapefile		State	1.0	Yes		Seismic Hazard Zone Map presenting areas where liquefaction may occur during a strong earthquake
Geology	Quake Landslide Zones	California Geological Survey (Barbara Wanish)	2003	1:24,000	Polygon	Shapefile		State	1.0	Yes		Seismic Hazard Zone Map presenting areas where landslides may occur during a strong earthquake
Geology	Soils	LACDPW (Francis A. Calasanz)	Unknown	Unknown	Polygon	Shapefile		LA County	1.3	No		Various soil types in LA County as they apply to hydrology. Representative runoff coefficient curves
Geology	Soils	USFS (Angeles Fire GIS Lab - Marilyn Porter)	Unknown	Unknown	Polygon	Shapefile		Angeles National Forest	1.0	No		Various soil types w/ slopes in the Angeles National Forest
Geology	Geology	USGS	2005	1:100,000	Polygon	Shapefile		U.S.	1.8	Yes		Underlying geology of the Los Angeles region
Habitat	Habitat Occurrences	USFS (Angeles Fire GIS Lab - Marilyn Porter)	May 2002	Unknown	Point	Shapefile	X	Angeles National Forest	1.1	No		Observed occurrences of all fauna from 1908-2001
Habitat	Threatened/Endangered/Sensitive Species	USFS (Angeles Fire GIS Lab - Marilyn Porter)	May 2002	Unknown	Point	Shapefile	X	Angeles National Forest	1.1	No		Observed occurrences of sensitive, threatened, and endangered fauna from 1908-2001
Habitat	Sensitive Plants	USFS (Angeles Fire GIS Lab - Marilyn Porter)	1992	Unknown	Point	Shapefile	X	Angeles National Forest	1.1	No		Observed occurrences of sensitive plants from 1987-1992
Habitat	Fire History	USFS (Angeles Fire GIS Lab - Marilyn Porter)	1870-1965	1:24,000	Polygon	Shapefile		LA County	1.1	No		Historical fires derived from LA County 1:24K fire map book
Habitat	Fire History	LACDPW (Francis Calasanz)	1878-1996	Unknown	Polygon	Shapefile		LA County	1.3	No	X	Historical fires derived by LACDPW. Source unknown.
Habitat	Land Cover - CWHR Classification	CDP-FRAP	2002	150 meter	Raster	GRID		State	1.0	Yes		Land cover data compiled for the 2002 Forest and Range Assessment
Habitat	Land Cover - CNDD/CWHR Classification	CDPG	1998	Varies	Polygon	Shapefile		State	1.0	Yes		Land coverland use data compiled for the California Gap Analysis Project
Habitat	Land Cover - NOAA Classification	NOAA (CSG)	2000	30 meter	Raster	Imagine		Coastal Watersheds	1.0	Yes		Land cover classification based on Landsat TM for the California NOAA C-GAP program
Hydrology	Groundwater Basins	LACDPW (Francis Calasanz)	Unknown	Unknown	Polygon	Shapefile		LA County	1.3	Yes		Groundwater basins designated on the basis of geological and hydrological conditions
Hydrology	Storm Drains	City of LA - Engineering (Randy Price)	2005	Unknown	Line	Shapefile	X	City of Los Angeles	1.0	No	X	Storm drain network (closed channel) within the City of LA
Hydrology	Storm Drains	LACDPW (Paul Spiz)	Unknown	Unknown	Line	Shapefile	X	LA County	1.0	No		Storm drain network within Los Angeles County
Hydrology	Storm Drains	City of San Fernando (Manuel Fabian)	Unknown	Unknown	Line	Shapefile	X	City of San Fernando	1.5	No		Storm drain network within City of San Fernando
Hydrology	Storm Drain Flow Direction	City of LA - Engineering (Randy Price)	2005	Unknown	Line	Shapefile		City of Los Angeles	1.2	No	X	Arrows representing directional flow of runoff through the City of LA's storm drain network
Hydrology	Storm Drain Inlets	City of LA - Engineering (Randy Price)	2005	Unknown	Point	Shapefile	X	City of Los Angeles	1.2	No	X	Entry points of runoff into the City of LA storm drain network (i.e. catch basins, culverts, siphons, etc.)
Hydrology	Storm Drain Inlets	LACDPW (Francis Calasanz)	June 2005	Unknown	Point	Shapefile	X	LA County	1.3	No	X	Entry points of runoff into the county storm drain network (i.e. catch basins, culverts, siphons, etc.)
Hydrology	Storm Drain Inlets	City of San Fernando (Manuel Fabian)	Unknown	Unknown	Point	Shapefile	X	City of San Fernando	1.5	No		Entry points of runoff into the City of San Fernando drain network (i.e. catch basins, culverts, siphons, etc.)
Hydrology	Storm Drain Outlets	City of LA - Engineering (Randy Price)	2005	Unknown	Point	Shapefile	X	City of Los Angeles	1.2	No	X	Exit points of runoff from the City of LA storm drain network into the open river channels
Hydrology	Storm Water Outfalls	CalTrans (Bob Wu)	2000	Survey	Point	Shapefile		State	1.4	No		Outfall locations (incl. BMP's, Maintenance Stations, and Park & Ride Areas) along CalTrans right-of-way
Hydrology	Runoff Gages	LACDPW (Francis Calasanz)	Varies	Unknown	Point	Shapefile		LA County	1.0	No		Past & present LACDPW runoff gaging sites (Measuring flow and/or stage)
Hydrology	Stream Gages	USACE	2000-2005	Unknown	Point	Shapefile		LA County	1.0	No		USACE telemetry gages on the Los Angeles Telemetry System (Measuring flow and/or stage)
Hydrology	Stream Gages	USGS	Varies	Unknown	Point	Shapefile		U.S.	1.0	No		Past & present USGS gaging sites (Measuring flow and/or stage)
Hydrology	Spreading Grounds	LACDPW (Francis Calasanz)	Unknown	Unknown	Polygon	Shapefile		LA County	1.3	No	X	Spreading grounds within Los Angeles County
Hydrology	Debris Basins	LACDPW (Francis Calasanz)	June 2005	Unknown	Polygon	Shapefile		LA County	1.3	No	X	Earth dam or other barrier constructed for collecting sediment within Los Angeles County
Hydrology	Waterbodies - Poly	USGS (Teale Data Center - Virginia Wong-Coppin)	1998	1:100,000	Polygon	Shapefile		State	1.0	Yes		Waterbodies such as lakes, wide river segments, or swamps
Hydrology	Waterbodies - Line	USGS (Teale Data Center - Virginia Wong-Coppin)	1998	1:100,000	Line	Shapefile		State	1.0	Yes		Waterbodies such as streams or shorelines
Hydrology	Historic Waterbodies - Poly	USGS	c. 1890s	1:62,500	Line	Shapefile		State	1.9	No		Digitized polygon waterbodies from historic DRGs
Hydrology	Historic Waterbodies - Line	USGS	c. 1890s	1:62,500	Polygon	Shapefile		State	1.9	No		Digitized line waterbodies from historic DRGs
Hydrology	Floodplain	FEMA	May 1996	1:24,000	Polygon	Shapefile		U.S.	1.6	Yes		FEMA flood zones depicting 100 and 500 year events
Hydrology	Water Quality Sampling Sites	RWQCB	Unknown	Unknown	Point	Shapefile		LA County	1.0	No		Past & present WQ sampling sites
Hydrology	NPDES Permit Sites - Construction	RWQCB	Unknown	Address	Point	Shapefile		State	1.3	No		Active industrial NPDES permit locations geocoded by address. Includes facility size
Hydrology	NPDES Permit Sites - Industrial	RWQCB	Unknown	Address	Point	Shapefile		State	1.3	No		Active construction NPDES permit locations geocoded by address. Includes facility size
Hydrology	Catch Basin Trash Study - Cleaning Data	City of LA - Sanitation (Morad Sedrak)	1999-2004	Unknown	Point	Shapefile		City of Los Angeles	1.4	No	X	LA Trash Study - Average concentration of trash over a 5 yr period within designated catch basins
Hydrology	Catch Basin Trash Study - Results	City of LA - Sanitation (Morad Sedrak)	1999-2004	Unknown	Polygon	Shapefile		City of Los Angeles	1.4	No	X	Results from the catch basin cleaning data representing areas of trash concentration within the City of LA
Hydrology	Septic Tanks - residential	City of LA - DWP	April 2005	Address	Point	Shapefile		City of Los Angeles	1.6	No		Residential septic tank locations (unconfirmed) within the City of Los Angeles
Hydrology	Septic Tanks - commercial	City of LA - DWP	April 2005	Address	Point	Shapefile		City of Los Angeles	1.6	No		Commercial septic tank locations (unconfirmed) within the City of Los Angeles
Hydrology	Septic Tanks - industrial	City of LA - DWP	April 2005	Address	Point	Shapefile		City of Los Angeles	1.6	No		Industrial septic tank locations (unconfirmed) within the City of Los Angeles
Hydrology	Septic Tanks - government	City of LA - DWP	April 2005	Address	Point	Shapefile		City of Los Angeles	1.6	No		City owned septic tank locations (unconfirmed) within the City of Los Angeles
Hydrology	Septic Tanks - other	City of LA - DWP	April 2005	Address	Point	Shapefile		City of Los Angeles	1.6	No		Septic tank locations (unconfirmed) other than residential, commercial, industrial or governmental - LA
Hydrology	Catch Basins w/ Inserts	LACDPW	Jan 2006	Unknown	Point	Shapefile	X	LA County	1.6	No	X	Catch basins maintained by LACDPW that have inserts
Hydrology	Hazardous Waste/Chemical Sites	USEPA	1987-1995	Unknown	Point	Shapefile	X	LA County	1.0	No		Hazardous waste and chemical sites data from the Toxics Release Inventory Program
Hydrology	Underground Storage Tank Sites	RWQCB	Jan 2004	Unknown	Point	Shapefile		RWQCB - Region IV	1.0	No		Leaking underground storage tank sites - active cases
Hydrology	Watershed	LACDPW (Paul Spiz)	Unknown	Unknown	Polygon	Shapefile		Watershed	1.0	No		Tujunga Wash watershed boundary (based on engineering of the land and topography)
Hydrology	Subwatersheds	LACDPW (Paul Spiz)	Unknown	Unknown	Polygon	Shapefile		Watershed	1.0	No	X	Tujunga Wash subwatershed boundaries (based on engineering of the land and topography)

Appendix 3 ~ Tujunga Watershed Project Spatial Metadata Summary - 2006

Hydrology	Stormwater Permits	SWRCB	Unknown	Address	Point	Shpfile	State	1.3	No	Geocoded stormwater permit locations for industrial and construction sites
Hydrology	Trichloroethylene (TCE) Plume - Shallow		2004	Unknown	Polygon	Shpfile	San Fernando Valley	1.9	No	TCE plume in the shallow zone of San Fernando Groundwater Basin
Hydrology	Trichloroethylene (TCE) Plume - Deep		2004	Unknown	Polygon	Shpfile	San Fernando Valley	1.9	No	TCE plume in the deep zone of the San Fernando Groundwater Basin
Hydrology	Perchloroethylene (PCE) Plume - Shallow		2004	Unknown	Polygon	Shpfile	San Fernando Valley	1.9	No	PCE plume in the shallow zone of the San Fernando Groundwater Basin
Hydrology	Perchloroethylene (PCE) Plume - Deep		2004	Unknown	Polygon	Shpfile	San Fernando Valley	1.9	No	PCE plume in the deep zone of the San Fernando Groundwater Basin
Hydrology	Nitrate (NO3) Plume - Shallow		2004	Unknown	Polygon	Shpfile	San Fernando Valley	1.9	No	NO3 plume in the shallow zone of the San Fernando Groundwater Basin
Hydrology	Nitrate (NO3) Plume - Deep		2004	Unknown	Polygon	Shpfile	San Fernando Valley	1.9	No	NO3 plume in the deep zone of the San Fernando Groundwater Basin
Hydrology	CrI Plume - Shallow		2004	Unknown	Polygon	Shpfile	San Fernando Valley	1.9	No	CrI plume in the shallow zone of the San Fernando Groundwater Basin
Hydrology	Remedial Investigation (RI) Monitoring Wells		2004	Unknown	Point	Shpfile	San Fernando Valley	1.9	No	
Imagery	SW DOQs	USGS	1994	1 meter	Raster	Image	State	1.0	No	1994 USGS 1/4 degree digital orthophoto quarter-quadrangles (aerial photography)
Imagery	Landset 7	USGS	Mar 2002	Bands vary	Raster	GeoTIFF	State	1.1	No	Landset 7 imagery containing the following bands (10, 20, 30, 40, 50, 61, 62, 70, 80)
Imagery	SW Aerial Photography	City of LA - Engineering (Randy Price)	Unknown	Unknown	Raster	GeoTIFF	City of Los Angeles	1.2	No	X High resolution color aerial photography for the lower urbanized portion of the watershed
Imagery	Color Aerial Photography	J. K. Curtis	2001	1 meter	Raster	GeoTIFF	Lower (urban) Watershed	1.3	No	X High resolution 1/4 degree aerial photography for the City of Los Angeles
Imagery	CR DOQs	USFS - Department of Agriculture	2002	1 meter	Raster	BIP	Angeles National Forest	1.0	No	USFS color infrared digital orthophoto quarter-quadrangles (aerial photography)
Jurisdictions	State Assembly Districts	California Resources Agency (CaSRL)	2001	1,100,000	Polygon	Shpfile	State	1.0	Yes	State assembly districts and assemblymembers
Jurisdictions	State Senate Districts	California Resources Agency (CaSRL)	2001	1,100,000	Polygon	Shpfile	State	1.0	Yes	State senate districts and senators
Jurisdictions	U.S. Congressional Districts	California Resources Agency (CaSRL)	2001	1,100,000	Polygon	Shpfile	State	1.0	Yes	U.S. congressional districts and congresspersons
Jurisdictions	LA County Supervisorial Districts	LACDPW (Paul Spor)	2000	Unknown	Polygon	Shpfile	LA County	1.0	No	Supervisorial districts and supervisors for LA County
Jurisdictions	RMC Territory	RMC	2002	Unknown	Polygon	Shpfile	RMC Region	1.0	No	2002 RMC territory
Jurisdictions	SMMC Territory	SMMC	2001	Unknown	Polygon	Shpfile	SMMC Region	1.0	No	2001 SMMC territory
Jurisdictions	ANF Boundaries	USFS (Angeles Fire GIS Lab - Marilyn Porter)	Unknown	Unknown	Polygon	Shpfile	Angeles National Forest	1.1	No	Angeles National Forest boundary
Jurisdictions	City Boundaries	SCAG	Unknown	Unknown	Polygon	Shpfile	SCAG Region	1.0	No	City boundaries within the SCAG region
Jurisdictions	LA City Council Districts	City of LA - Engineering	2004	Unknown	Polygon	Shpfile	City of Los Angeles	1.0	No	City of LA council districts and members
Jurisdictions	LA City Neighborhood Councils	City of LA - Neighborhood Empowerment	2006	Unknown	Polygon	Shpfile	City of Los Angeles	1.0	No	Established city of LA neighborhood council districts
Miscellaneous	City of LA Aerial Index	City of LA - Engineering (Randy Price)	2005	Unknown	Polygon	Shpfile	City of Los Angeles	1.2	No	X Index of City of Los Angeles 1/4 degree aerial photography
Miscellaneous	USGS DOQ Index	USGS	2002	1,24,000	Polygon	Shpfile	State	1.0	No	Index for the State set USGS DOQs (aerial photography)
Miscellaneous	USGS 7.5 Minute Quad Index	USGS	2002	1,24,000	Polygon	Shpfile	State	1.0	No	Index for the State set of 7.5 minute quadrangle sheets (topographic maps)
Miscellaneous	Extent	LASGRWC (Jason Casanova)	2005	1,350,000	Polygon	Shpfile	Watershed	1.0	No	Data boundary for the Tujunga Wash WMP
Miscellaneous	Mask	LASGRWC (Jason Casanova)	2005	1,350,000	Polygon	Shpfile	Watershed	1.0	No	Mask for data outside of the Tujunga Wash WMP boundary
Planning	Los Angeles Specific Plans	City of LA - Engineering (Randy Price)	2005	Unknown	Polygon	Shpfile	City of Los Angeles	1.2	No	X Project-level planning efforts within the City of Los Angeles
Planning	Los Angeles Community Plan Areas	City of LA - Engineering (Randy Price)	2005	Unknown	Polygon	Shpfile	City of Los Angeles	1.2	No	X Land use element (1 of 11 elements) of the General Plan for the City of LA
Planning	Vacant Surplus Properties	City of LA - Engineering (Randy Price)	2005	Unknown	Polygon	Shpfile	City of Los Angeles	1.2	No	X Vacant properties owned by the City of Los Angeles
Planning	Zoning - LA	City of LA - Engineering (Randy Price)	2005	Unknown	Polygon	Shpfile	City of Los Angeles	1.2	No	X Zoning boundaries within the City of Los Angeles (NOTE: Zone Knequestrian use)
Planning	SCAG Land Use	SCAG	2000	1 ac/2.5 ac	Polygon	Shpfile	LA County	1.0	No	Land use based on photography done at 1m res. for urban areas; 2m res. for the non-urban
Planning	Significant Ecological Areas (SEAs)	LA County Regional Planning (Nick Franchino)	2005	Unknown	Polygon	Shpfile	LA County	1.5	No	X Areas in which development may have significant impacts on the natural habitat as deemed by LACRP
Planning	Antelope Valley Area Plan	LA County Regional Planning (Nick Franchino)	2005	Unknown	Polygon	Shpfile	Antelope Valley	1.5	No	X Area Plan for the unincorporated areas within the Antelope Valley
Planning	Santa Clara Valley Area Plan	LA County Regional Planning (Nick Franchino)	2005	Unknown	Polygon	Shpfile	Santa Clara Valley	1.5	No	X Area Plan for the unincorporated areas within the Santa Clara Valley
Planning	Countywide Land Use Policy	LA County Regional Planning (Nick Franchino)	2005	Unknown	Polygon	Shpfile	LA County	1.5	No	X Land use policy for other unincorporated areas not covered by Area, Community or Neighborhood Plans
Planning	Zoning - Unincorp County	LA County Regional Planning (Nick Franchino)	2005	Unknown	Polygon	Shpfile	LA County	1.5	No	X Zoning boundaries within unincorporated areas of Los Angeles County
Planning	Angeles National Forest Land Use Zones	Angeles National Forest (Carlo Gavina)	2006	Unknown	Polygon	Shpfile	Angeles National Forest	1.9	No	Designated land use zones for recently updated ANF Land Management Plan
Planning	Impervious Surfaces	USGS	Sep 2003	30 meters	Raster	GRID	U.S.	1.2	Yes	NLCD subset of landuse depicting percent imperviousness
Planning	Parking Lots	The River Project (Koa Lavery)	Apr 2006	1,10,000	Polygon	Shpfile	Lower (urban) Watershed	1.9	No	Parking lot areas digitized from January 2005 28 color aerial photography
Transportation	Bikeways (Present & Future)	City of LA - Engineering (Randy Price)	Unknown	Unknown	Line	Shpfile	City of Los Angeles	1.2	No	Bikeways (Class I, II, III) and future (planned) bikeways (Class I, II) located within the City of LA
Transportation	Bikeways	CalTrans (Thao Van Le)	Dec 1994	Unknown	Line	Shpfile	State	1.1	Yes	Alternate bike routes located on local roads where bike travel is prohibited on the State Highway System
Transportation	State Bridges	CalTrans (Thao Van Le)	Oct 2001	Unknown	Point	Shpfile	X LA County	1.1	Yes	Bridges located on the State Highway System
Transportation	Local Bridges	CalTrans (Thao Van Le)	Nov 2000	Unknown	Point	Shpfile	X LA County	1.1	Yes	State maintained bridges not on the State Highway System
Transportation	Bikeways	MTA	Unknown	Unknown	Line	Shpfile	LA County	1.0	No	Countywide bikeways (Class I, II, III)
Transportation	Railroads	U.S. Census Bureau	2000	1,100,000	Line	Shpfile	U.S.	1.0	Yes	Railroads derived from the US Census Bureau TIGER 2K data
Transportation	Freeway Shields	LASGRWC (Jason Casanova)	2005	1,350,000	Point	Shpfile	Watershed	1.0	No	Freeway shield point locations created for mapping/biology purposes
Transportation	Highways	U.S. Bureau of Transportation Statistics	2004	1,250,000	Line	Shpfile	U.S.	1.0	Yes	U.S. National Transportation Atlas Interstate Highways represents rural & urban interstate highways
Transportation	Major Roads	GDT, Inc.	2004	1,50,000	Line	Shpfile	U.S.	1.0	Yes	Major roads containing interstate, U.S. and state highways, major streets, and other major thoroughfares
Transportation	Local Roads	U.S. Census Bureau	2000	1,100,000	Line	Shpfile	U.S.	1.0	Yes	Roads derived from the US Census Bureau TIGER 2K data
Transportation	Trails - Equestrian	City of Los Angeles	1997	Unknown	Line	Shpfile	City of Los Angeles	1.8	No	Proposed and existing trails from City of LA community plan hardcopy roadside maps
Transportation	Trails - Equestrian Designated ROWs	City of Los Angeles	2003	Unknown	Line	Shpfile	City of Los Angeles	1.8	No	Dedicated easements for equestrian trails within the City of LA
Utilities	Substructure Index	City of LA - Engineering (Randy Price)	2005	Unknown	Polygon	Shpfile	City of Los Angeles	1.2	No	X Index of City of Los Angeles substructure diagrams
Utilities	Substructure Diagrams	City of LA - Engineering (Randy Price)	2005	Unknown	Raster	GeoTIFF	X City of Los Angeles	1.2	No	X CAD diagrams delineating underground utilities (pipelines, drains, etc.)

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¹ Data is for internal use only; not available to public due to security risks or privacy issues

² The extent "Watershed" refers to the TWMP project boundaries as defined by the shapefile "extent.shp"

³ This attribute describes the database (DB) version a particular dataset is available

⁴ Availability of full-documentation metadata

⁵ Data Sharing Agreements in place - no third party sharing

Acronyms:

DEM	Digital Elevation Model
DOQ	Digital Orthophoto Quarter-Quadrangle
DWG	Digital Raster Graphic
DTSC	Department of Toxic Substances Control
DWR	Department of Water Resources
GDT	Geographic Data Technology
GNIS	Geographic Names Information System
LACDPW	County of Los Angeles Department of Public Works
LACRP	Los Angeles County Regional Planning
LADWP	City of Los Angeles Department of Water & Power
LASGRWC	Los Angeles & San Gabriel Rivers Watershed Council
LIDAR	Light Detection and Ranging
MTA	Metropolitan Transportation Authority
NCDC	National Climatic Data Center
NLCD	National Land Cover Data
NOAA	National Oceanic and Atmospheric Administration
RMC	San Gabriel and Lower Los Angeles Rivers & Mountains Conservancy
RWQCB	Regional Water Quality Control Board
SCAG	Southern California Association of Governments
SMMC	Santa Monica Mountains Conservancy
SWIS	Solid Waste Information System
SWRCB	State Water Resources Control Board
TIGER	Topologically Integrated Geographic Encoding and Referencing system
TN	Thematic Network
TM	Thematic Mapper
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USGS	United States Geological Survey
WMP	Watershed Management Plan



Demographic Summary of the Tujunga Watershed



Summary

The primary purpose of the demographics report is to provide assistance for the Tujunga Watershed Project team to identify and target typically underserved communities for inclusion in the Watershed Management Plan (WMP) process. Demographic, economic, and housing data for watershed communities at multiple geographic scales helps to achieve our goal of a comprehensive initial outreach program and ensure that a representative selection of stakeholders participates on the WMP Steering Committee.



Tujunga Watershed Project

Communities of the Tujunga Watershed exemplify the diversity of Los Angeles County. Population estimates (US Census Bureau 2005) indicate 525,000 people live within the 204 square mile watershed. Most of the population lives within communities that are part of the City of Los Angeles. The City of San Fernando, entirely within the watershed, is surrounded by Los Angeles. More than half of the upper watershed lies within the Angeles National Forest (ANF), a very sparsely populated region in which the natural community has retained a significant presence. The ANF receives more visitors than any other US National Forest. Forest recreation sites located within the Tujunga Watershed are heavily used, extremely popular weekend destinations for local residents.

The lower watershed is highly urbanized, but population densities within residential communities are quite variable. Originally an area of single-family residences surrounding long-established neighborhood centers, infill housing has been built at higher densities. Multiple-unit housing tends to be clustered, often near business districts. Highest population densities occur in the central part of the lower watershed (Figure 1) in the communities of Panorama City, North Hills, and North Hollywood. Rental vs. owner occupancy of households in the watershed is an indicator of the relative permanence of the population and tends to correlate with the density of housing units, because rentals tend to be apartments or mobile homes; this is true for these communities. Parts of the City of San Fernando and the community of Tujunga have higher than average levels of renter-occupied housing, as do some neighborhoods in the southern watershed, from Valley Glen through Valley Village and Studio City. Highest proportions of owned housing tend to be in the middle to upper section of the lower watershed, in Arleta, Pacoima, Sylmar, and Sunland. Household size is largest in these communities and lowest in the southern watershed. Household size does not correlate with population density, but does reflect a high percentage of children. Children are an important part of community life. The intent of the WMP is to support enhancement of local water supply while also meeting unmet needs of communities for recreation in open spaces and mend the broken connections between children, communities, and natural landscapes and processes.



Figure 1 Lower Tujunga Watershed.

Population density and home ownership sometimes correlate with economic data, as they do in parts of the urbanized watershed, but special circumstances of the Los Angeles housing market preclude generalization. High levels of home ownership occur in areas of comparatively low median household income in sections of Arleta and Pacoima; conversely, high levels of renter-occupied housing exist in many communities with the high incomes. All economic indicators, including median household income, are quite variable. The percentage of individuals whose incomes are below the poverty line averages 18.1%, and ranges from 0% to over 54% in parts of some neighborhoods. Highest rates occur in high-density areas of Panorama City, North Hills, and North Hollywood, and in Pacoima. Ethnic enclaves and concentrations of specific races dominate particular neighborhoods but the Tujunga Watershed, as a whole, is representative of many portions of Los Angeles County. Residents

who identify themselves as of Hispanic or Latino ethnicity (of any race) are a comparatively small percentage of the population in Sherman Oaks and Studio City, at the southern end of the watershed, but predominate throughout the northern and central section of the lower watershed. Arleta, Mission Hills, Pacoima, Panorama City, Van Nuys, and the City of San Fernando have census block groups ranging from 80% to over 97% Hispanic/Latino residents. In Los Angeles County, 44.6% identify themselves as Hispanic or Latino; in the Tujunga Watershed, that figure is 60.7%. Neighborhoods with a high percentage of Hispanic/Latino residents also tend to have a higher percentage of children. Demographic figures from the Los Angeles Unified School District (LAUSD) substantiate this. Spanish-language translation of all outreach materials to specifically encourage the participation of these community members is a critical component of the WMP process.

In Census 2000, separate questions were asked about Hispanic/Latino ethnicity and race. To attempt to capture the increasing diversity of the population, census forms requested that respondents identify themselves as being of one race or two or more races. Choices given were White, Black or African American, Asian, American Indian and Alaska Native, Native Hawaiian and Pacific Islander, or Some Other Race. In Los Angeles County, a relatively high percentage (23.5%) of people chose Some Other Race, which may indicate some confusion over the race and/or ethnicity questions; in the watershed, this figure was 33%. In the lower watershed, primarily white communities are clustered at the confluence of the lower Tujunga Wash with the Los Angeles River. In the populated regions above Hansen Dam, white neighborhoods predominate. Other watershed communities are somewhat better-integrated, with Black or African American and Asian residents present throughout the region, but at lower percentages than in LA County. Communities with higher than average percentages of Black/African American residents tend to be neighborhoods where the percentage of Hispanic/Latino residents is lower than average, including parts of Sylmar, Mission Hills, and North Hills. This is also true for Asian residents, scattered through the watershed, with concentrations in various Arleta, Sun Valley, North Hills, and North Hollywood neighborhoods. Percentages of other races, American Indian and Alaska Native, and Native Hawaiian and Pacific Islander are low except in a very few locations.

Methods of Analysis

Data was obtained from the US Census Bureau, Los Angeles County, and the City of Los Angeles. Spatial data were displayed and analyzed in geographic information systems (GIS) using ESRI ArcGIS 8.3 and ArcView 3.2. Some base maps use US Geological Survey 10 meter digital elevation models.

Census data is available at varying levels of detail. Preliminary analysis of watershed communities was done at the Census Tract level. Analyses at the Census block group level used Census 2000 Summary File 1 (SF1) 100 percent data for demographic data and Census 2000 Summary File 3 (SF3) sample data weighted to represent the entire population for economic data. Percentage of the population self-identifying as a specific race, ethnicity, or age group, and the percentage of individuals below the poverty line and living in renter-occupied housing was calculated from the SF1 and SF3 files; total population, population density, and median household income data are directly from SF1 and SF3 files. Distributions were analyzed, summarized, and mapped; portions within block groups analyzed but outside the watershed boundary appear lighter in color.

Neighborhood Council boundaries were digitized from maps available online from the City of Los Angeles Department of Neighborhood Empowerment (DONE); population figures were provided by DONE. Subwatershed-level analyses were made using finer-scale US Census block level data available for SF1 files only. Data was resampled and gridded before mapping. Data used in compiling this report are available from The River Project upon request in their original form as .xls or .dbf files, or as GIS shapefiles in State Plane (NAD1927 or NAD 1983) projection.

Findings

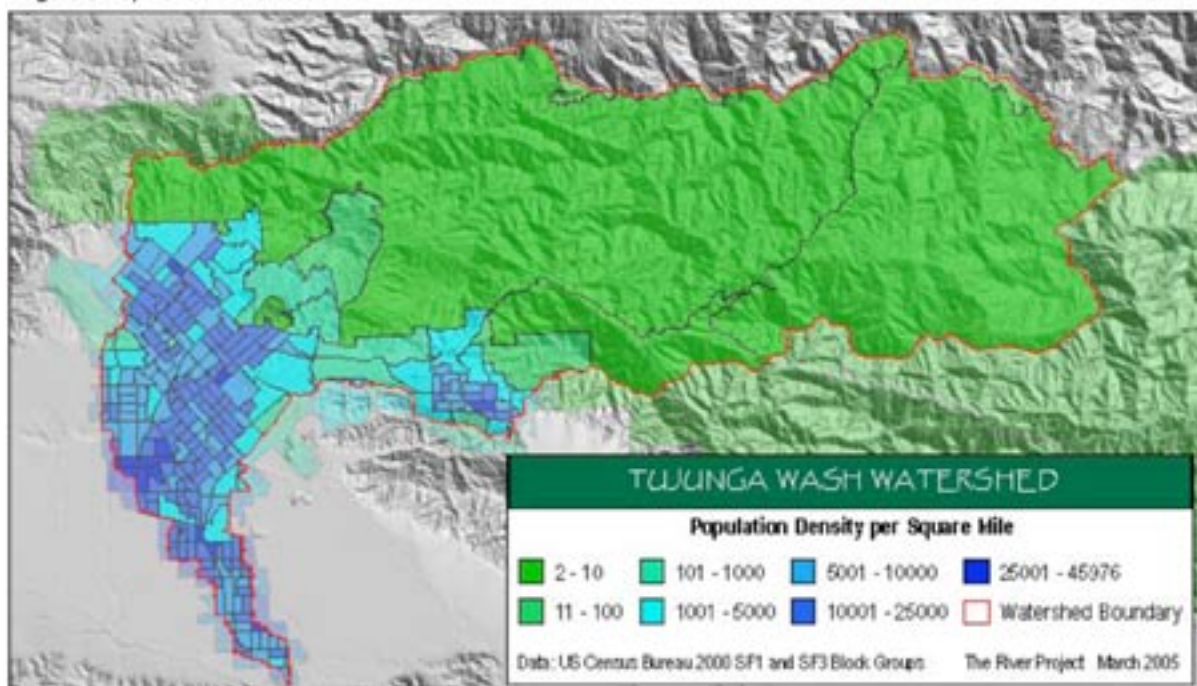
Census Block Groups

US Census Block Groups are used as a common enumeration unit for demographic and economic data (Figure 2). Generally (but not always) smaller than Census Tracts and larger than Census Blocks, Block Groups within the Tujunga Watershed are variable in both areal extent and population. The largest, geographically, occurs in the thinly populated upper watershed, within the Angeles National Forest. In contrast, densely populated block groups in the central part of the lower watershed are orders of magnitude smaller with a population several orders of magnitude larger (Figure 3).

Figure 2 Summary Table, Socio-Economic Data, Tujunga Watershed, Population Density, Average Household Size, Percentage of People Below the Poverty Line, Median Household Income, and Percentage of Renter-Occupied Housing.

Census 2000 Block Group Data	Tujunga Watershed Range	Tujunga Watershed Mean	Los Angeles County Mean
Population Density	2 - 45976 persons / square mile	10829.65 / sq mile	
Average Household Size	1 - 6.05 persons / household	3.56	2.98
Percentage of People living below the Poverty Level	0.0% - 54.16%	18.12 %	17.19 %
Median Household Income	\$0 - \$126,491 / household	\$44,885	\$42,189
Percentage of Renter-Occupied Housing	0.0% - 54.55%	46.35 %	52.1 %

Figure 3 Population Densities.



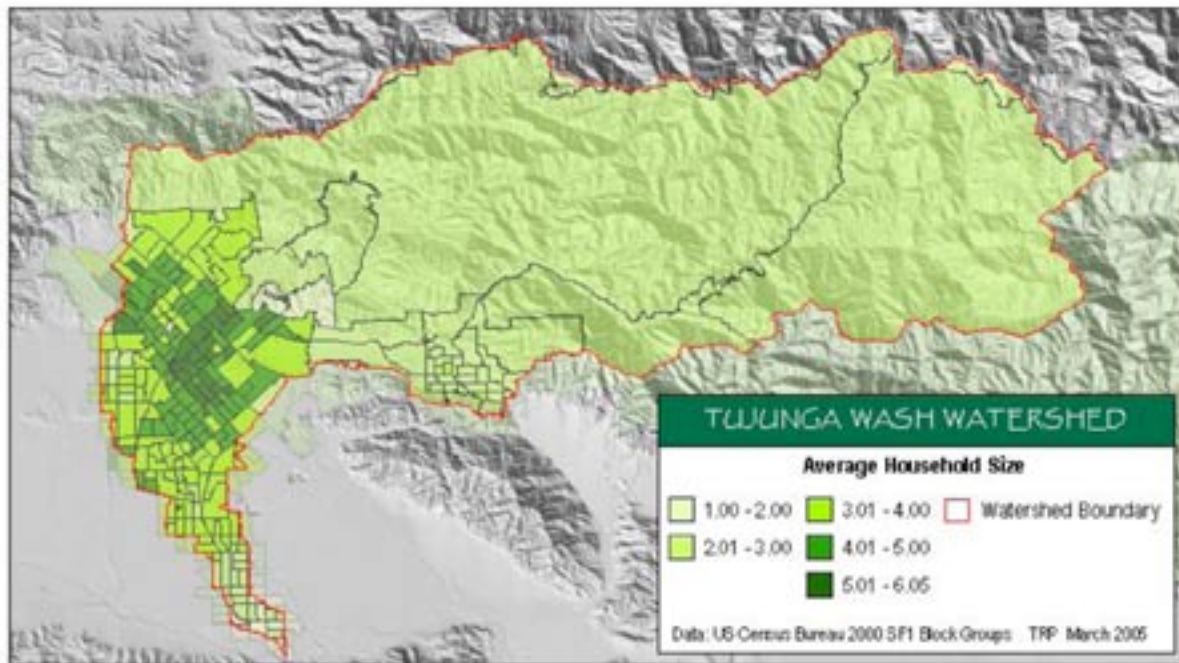


Figure 4 Average Household Size.

Largest household sizes (Figure 4) occur in urbanized watershed communities with a high percentage of young children. Most of these block groups also have a high percentage of owner-occupied housing, which encourages a strong commitment to the immediate neighborhood and a sense of community pride. The percentage of people living below poverty level (Figure 5) naturally correlates with median income levels, with a similar pattern of northwest to southeast diagonal bands of blocks.

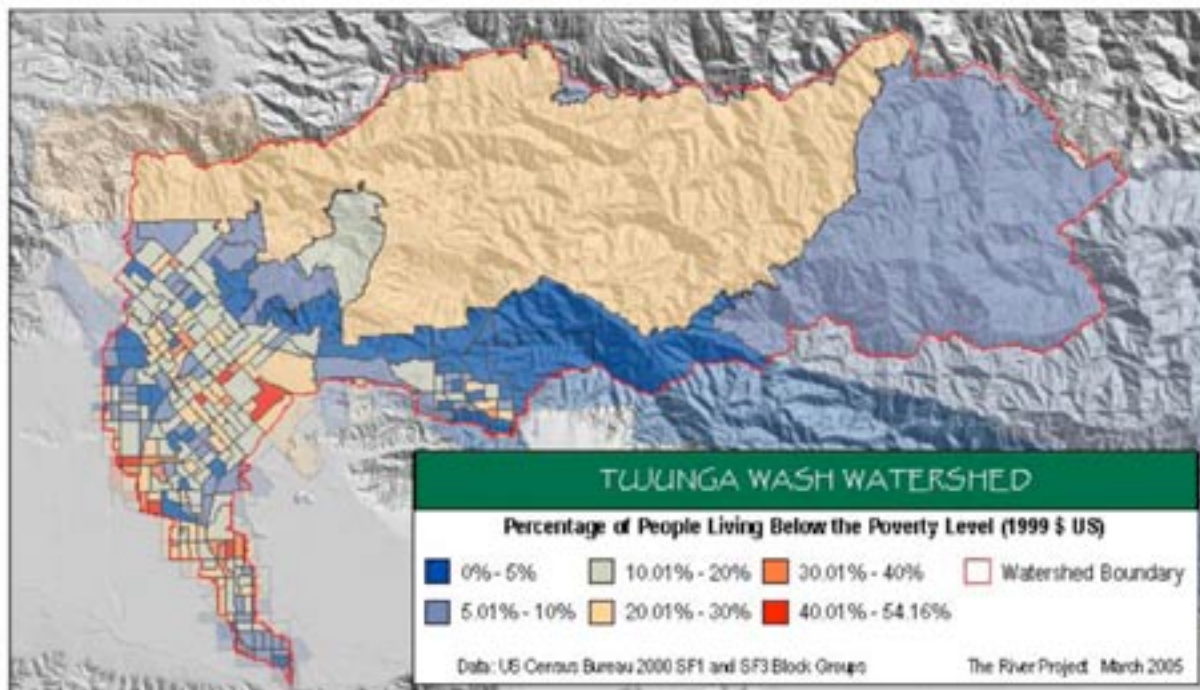


Figure 5 Percentages of People Living Below the Poverty Line.

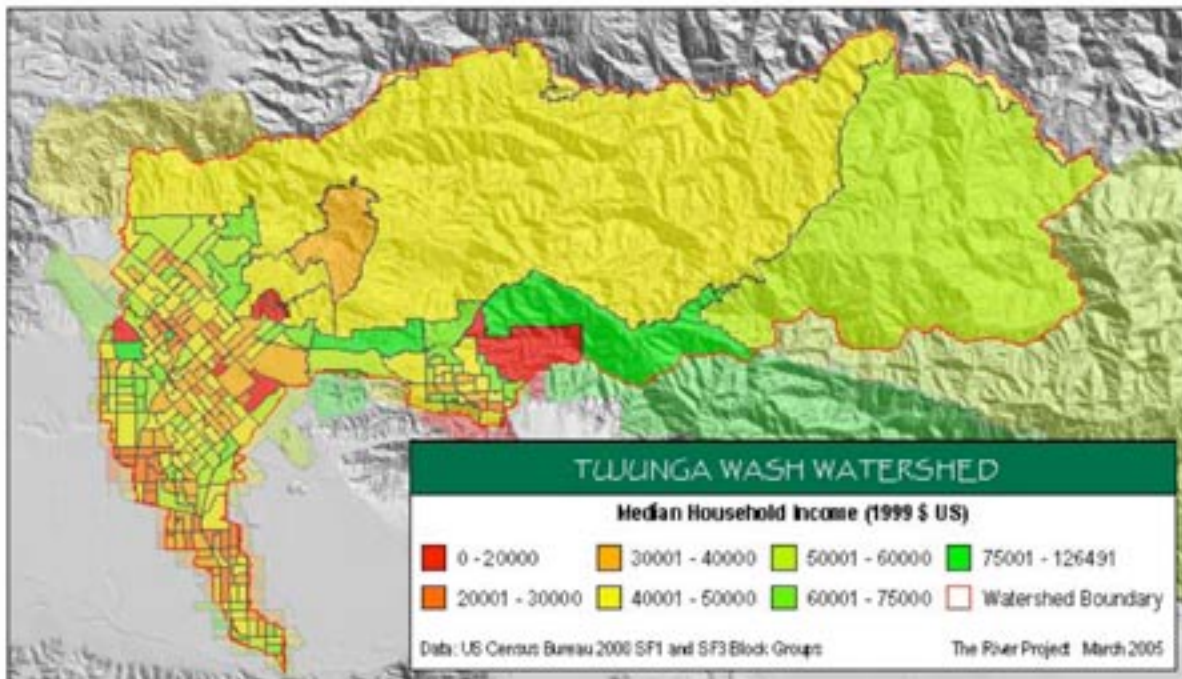


Figure 6 Median Household Income.

Median household income (Figure 6) correlates best with the percentage of persons living below the poverty level. Bands of higher income communities run diagonally across the northern, central, and southern portions of the lower watershed, with lower income communities in between. The cost of living in Los Angeles County is high, which affects household size, population density and other residential patterns. Highest proportions of rental housing (Figure 7) are in the southern watershed.

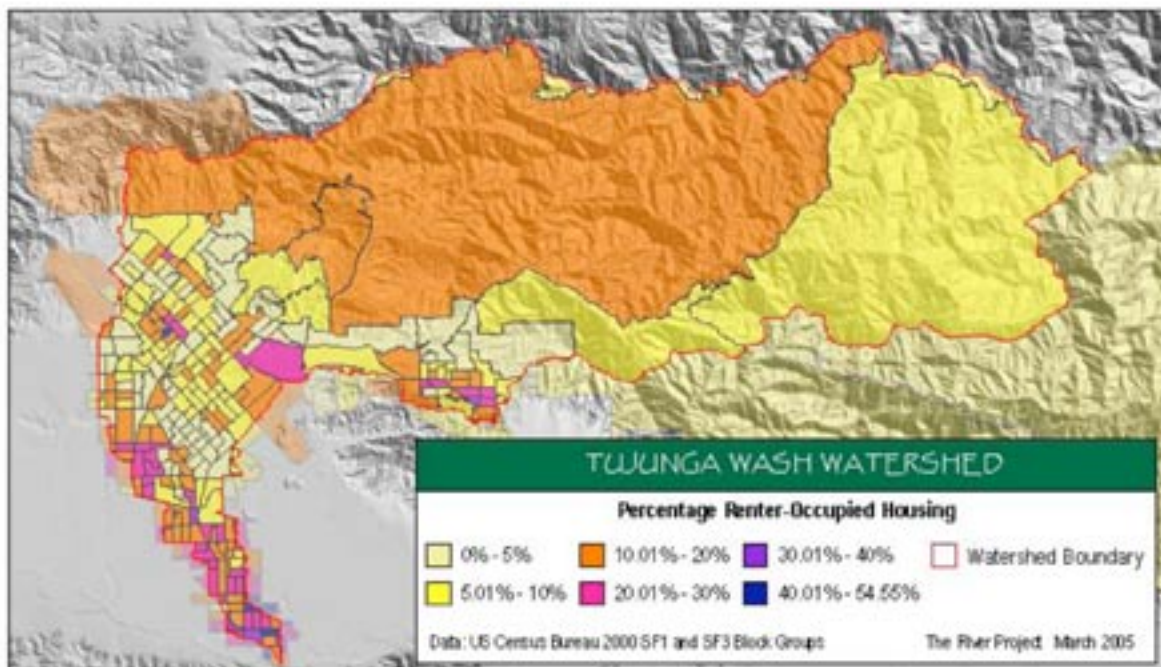


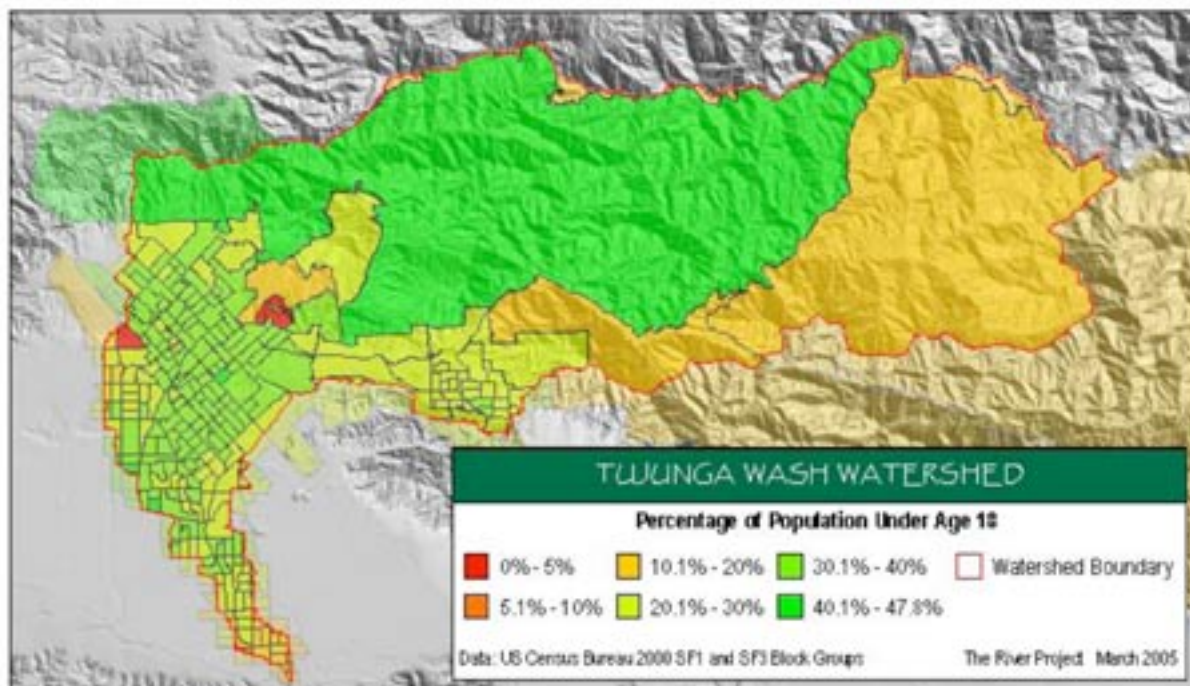
Figure 7 Percentage Renter-Occupied housing.

Census 2000 SF1 Block Group Data	Tujunga Watershed Range	Tujunga Watershed Mean	Los Angeles County Mean
Population Percentages:			
Under Age 18	0.0 % - 47.8 %	30.9 %	27.7 %
Ethnicity Hispanic or Latino	0.0 % - 97.2 %	60.7 %	44.6 %
Race White	0.0 % - 96.5 %	49.1 %	48.7 %
Race Black or African American	0.0 % - 25.6 %	4.7 %	9.8 %
Race Asian	0.0 % - 100 %	6.7 %	11.9 %
Race AIAN or NHPI*	0.0 % - 9.1 %	1.1 %	1.1 %

Figure 8 Summary Table, Demographic data, Tujunga Watershed. Population Percentages per Block Group: Under Age 18, Ethnicity Hispanic or Latino, Race White, Race Black or African American, Race Asian, Race AIAN or NHPI*American Indian or Alaskan Native or Native Hawaiian or Pacific Islander.

The percentage of the population under 18 (Figure 9) is positively correlated in most block groups of the northern and central urbanized watershed with larger household sizes and with a higher level of owner-occupied housing. More densely populated block groups with a high proportion of multiple-family rental housing in communities also have a high percentage of children. The southern tip of the watershed, with a high percentage of rental units, has the lowest percentage of children. The area may not necessarily favor large families; residential options tend to be small and expensive.

Figure 9 Percentage of Population Under Age 18.



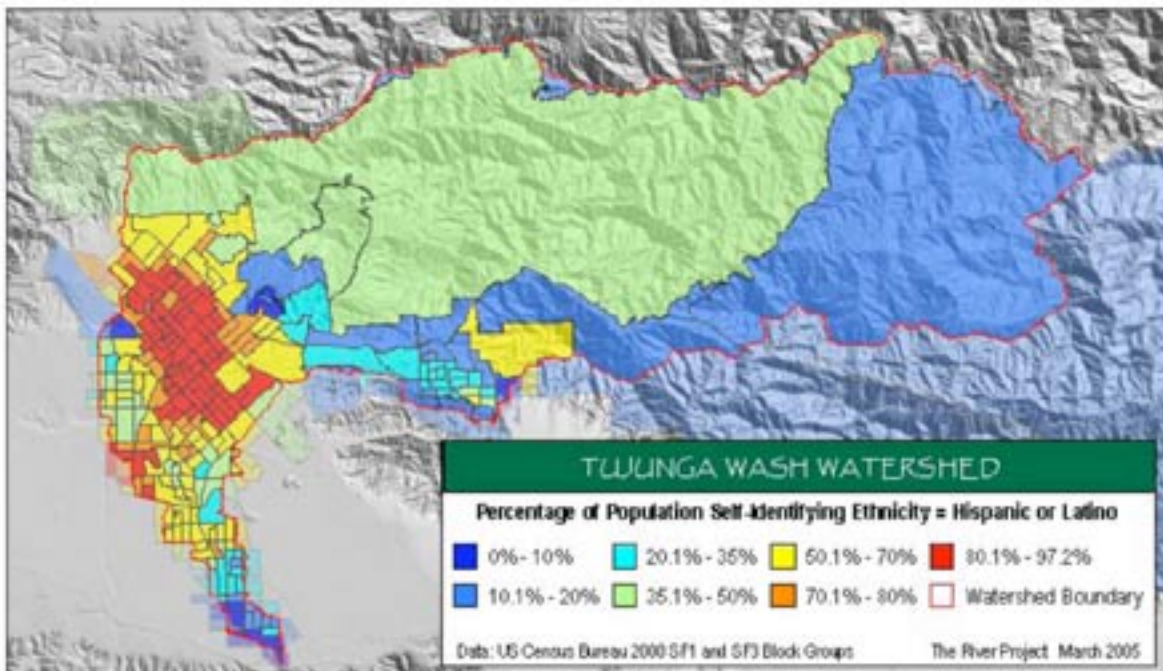
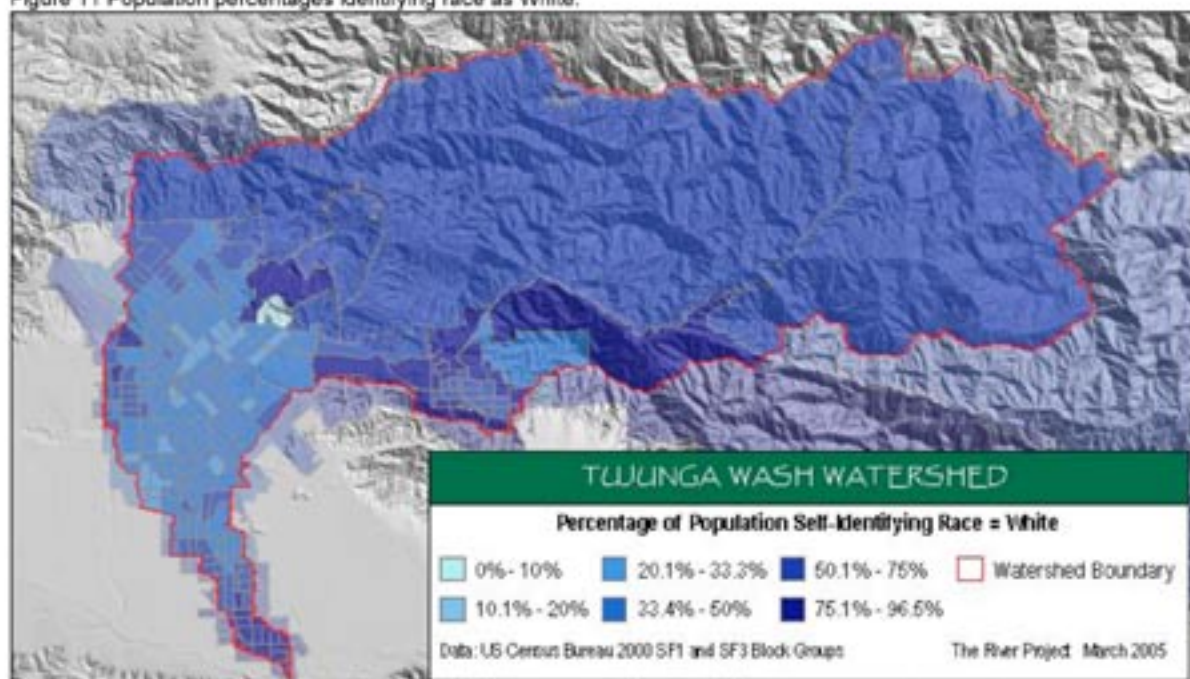


Figure 10 Percentage of the population self-identifying as Ethnicity = Hispanic or Latino.

The predominant ethnicity is Hispanic/Latino. Many families have lived here for generations, and others are recent immigrants. In many homes, Spanish is spoken rather than English. A marked geographic pattern is evident (Figure 10). Percentages are low in the southern watershed, and rise steadily, surpassing 90% in northern urbanized communities. Individuals who identify their race as White (Figure 11) are clustered at the south end of the watershed, and in the upper watershed.

Figure 11 Population percentages identifying race as White.



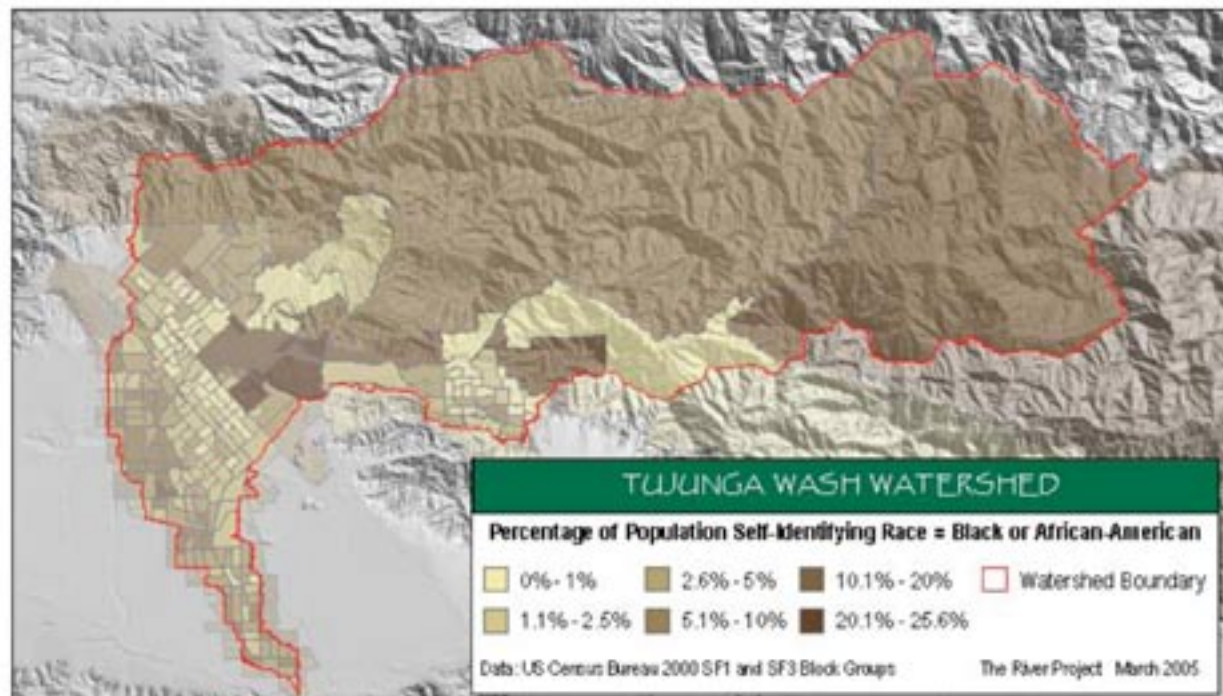
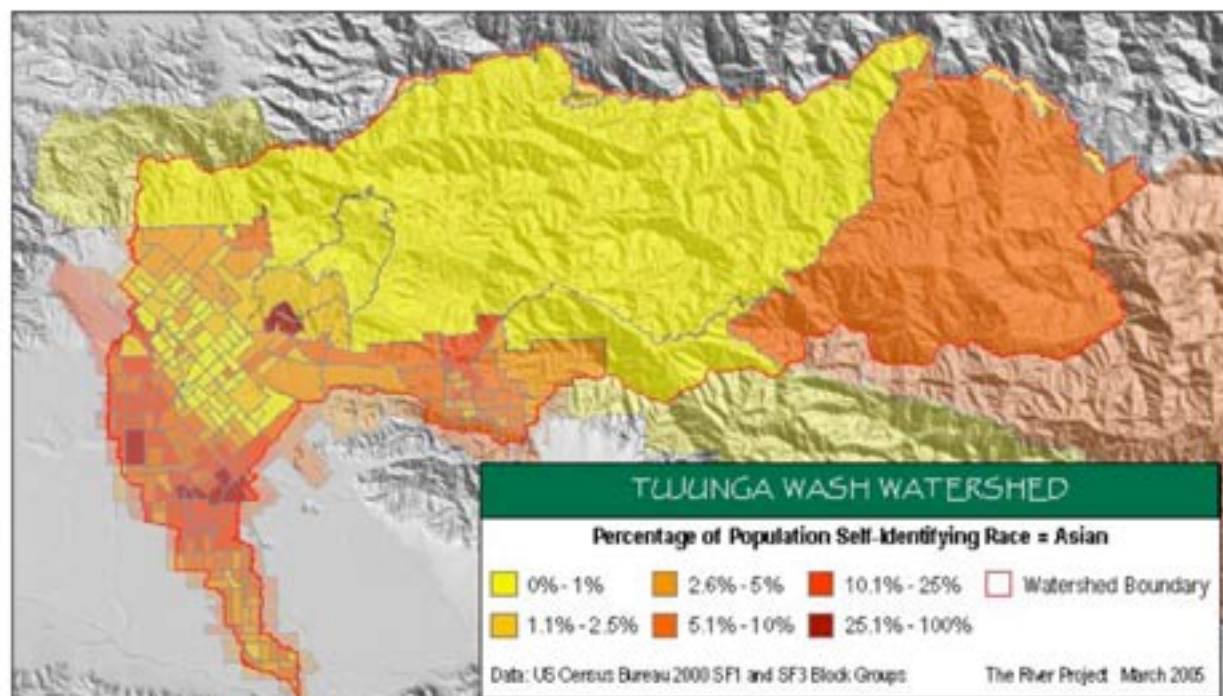


Figure 12 Population percentages identifying race as Black or African American.

For both Black (Figure 12) and Asian (Figure 13) races, population percentages within the watershed are lower by about 50% than in Los Angeles County, even though many block groups exceed the average. Neither group, nor the Native American/Native Hawaiian/Pacific Islander group (Figure 14), has a large presence in areas where the Hispanic/Latino population is most predominant, in the northern urbanized watershed.

Figure 13 Population percentages identifying race as Asian.



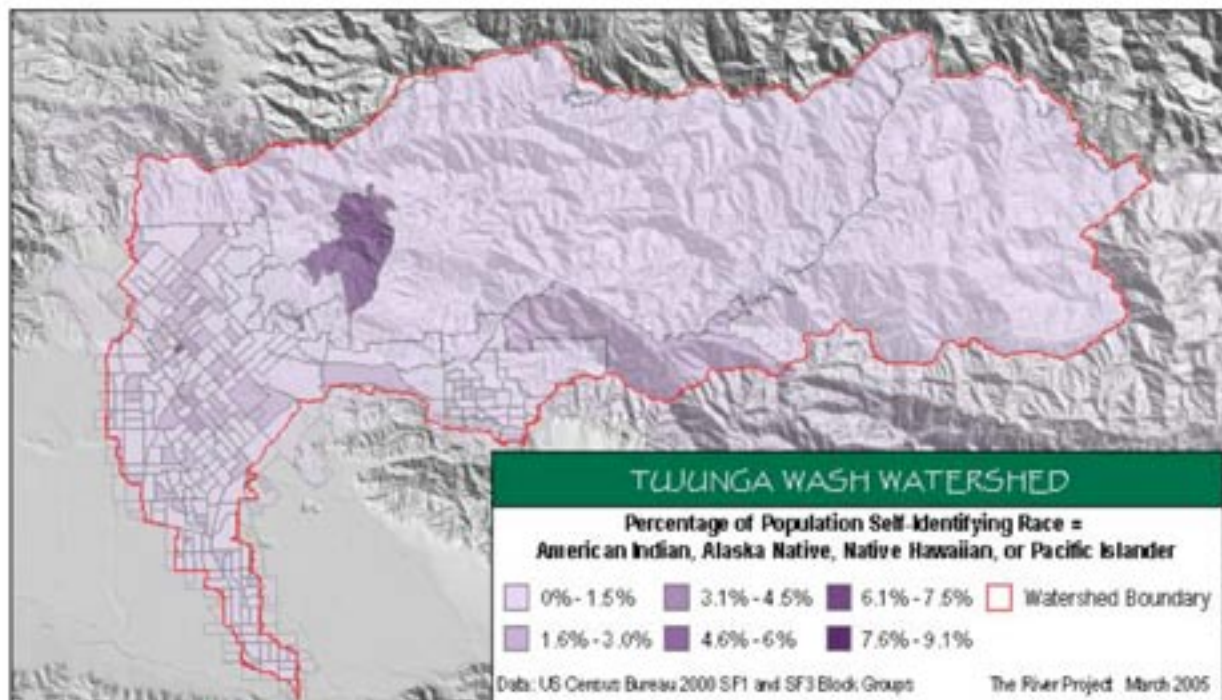


Figure 14 Percentage of the Population Identifying Race as American Indian, Alaska Native, Native Hawaiian, or Pacific Islander.

Alternative Demographic Analyses Neighborhood Council Areas

There are 13 Neighborhood Councils (Figure 15) recognized by the City of Los Angeles that have portions of their district within the Tujunga Watershed. They are Arleta, Foothills Trails District, Granada Hills North, Greater Valley Glen, North Hills West, Pacoima, Sherman Oaks, Studio City, Sun Valley, Sunland - Tujunga, Sylmar, and Valley Village. Mission Hills will become certified at the end of March, 2005, and 4 additional Neighborhood Councils within the watershed were at the formation stage as of March 8, 2005: Granada Hills South, North Hills East, North Hollywood West, and Panorama City.

Neighborhood Council areas were created by the City of Los Angeles to increase involvement of citizens and neighborhoods in citywide policies and decision-making. In most instances, the boundaries of the neighborhood councils do not correspond with other political boundaries, including City of Los Angeles City Council Districts, nor to any US Census Bureau enumeration units, or to natural features such as sub-watershed boundaries. The incorporated City of San Fernando, entirely within the Tujunga Watershed, is surrounded by the City of Los Angeles.

The City of Los Angeles provides population figures for Neighborhood Councils which have held elections and been certified. Summary data (Figure 16) are useful for identifying communities that are constituencies in particular parts of the watershed, at a general scale. The neighborhood-council scale is where general watershed management goals could be established. Initial outreach efforts have been concentrated here because Neighborhood Councils hold regular monthly meetings.

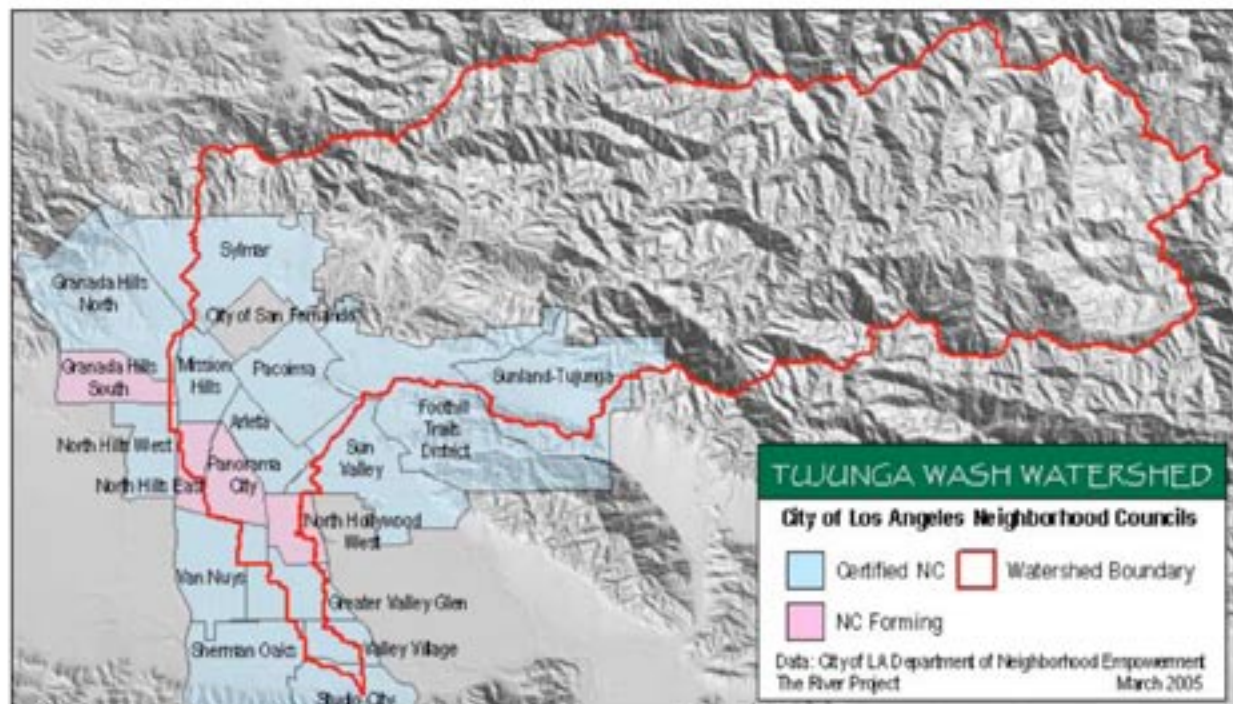


Figure 15 City of Los Angeles Neighborhood Councils

City of Los Angeles Certified Neighborhood Councils as of March 2005			
NC Number	Council Name	Total Population	
6	Arleta *		32,586
9	Foothill Trails District		18,899
4	Granada Hills North		28,563
21	Greater Valley Glen *		47,520
101	Mission Hills *	Certification as of 3/29/05	
111	North Hills West		19,381
7	Pacoima *		73,966
26	Sherman Oaks		60,921
27	Studio City		32,227
8	Sun Valley		30,085
10	Sunland-Tujunga *		42,319
5	Sylmar *		69,624
25	Valley Village *		22,967
20	Van Nuys		78,210
Los Angeles Neighborhood Councils not yet certified as of March 2005			
118	Granada Hills South		
112	North Hills East		
22	North Hollywood West		
100	Panorama City *		
	City of San Fernando *		24,564
* asterisks indicate the neighborhood is entirely or almost entirely within the watershed			

Figure 16 Neighborhood jurisdictions within the Tujunga Watershed and population figures where available from the City of Los Angeles Department of Neighborhood Empowerment (Neighborhood Councils) and the City of San Fernando.

Sub-watersheds

The Tujunga Watershed is a sub-watershed of the Los Angeles River. There are 171 sub-watersheds in the Tujunga Watershed. A sub-watershed here is the area of land that delivers water to a creek or storm-drain system that in turn feeds into the Pacoima Wash, Little Tujunga, Big Tujunga, or directly into the lower Tujunga Wash. The sub-watersheds in the upper watershed in the Angeles National Forest function relatively naturally. About half of the sub-watersheds are in the lower watershed below the foothills. Storm drain systems are above-ground and below-ground facilities that capture water from vegetated ground, streets, driveways, and parking lots, which then deliver water into a single channel or pipe.

Many of these systems include areas of the landscape that were once natural creek drainages. You can still see this in the gradual sloping of streets in the urban neighborhoods. As we progress through the WMP, hydrologic analyses will be conducted by sub-watershed. Since our project grid may be broken down to this level, it is useful for us to investigate demographics at this scale as well. In a transformed landscape, the human connection to natural processes is remote and tenuous. For watershed residents, visualizing the "natural" divisions instead of political boundaries may help them to consider that that before the watershed was engineered for flood control, residents historically were dependent upon the creeks and the groundwater.

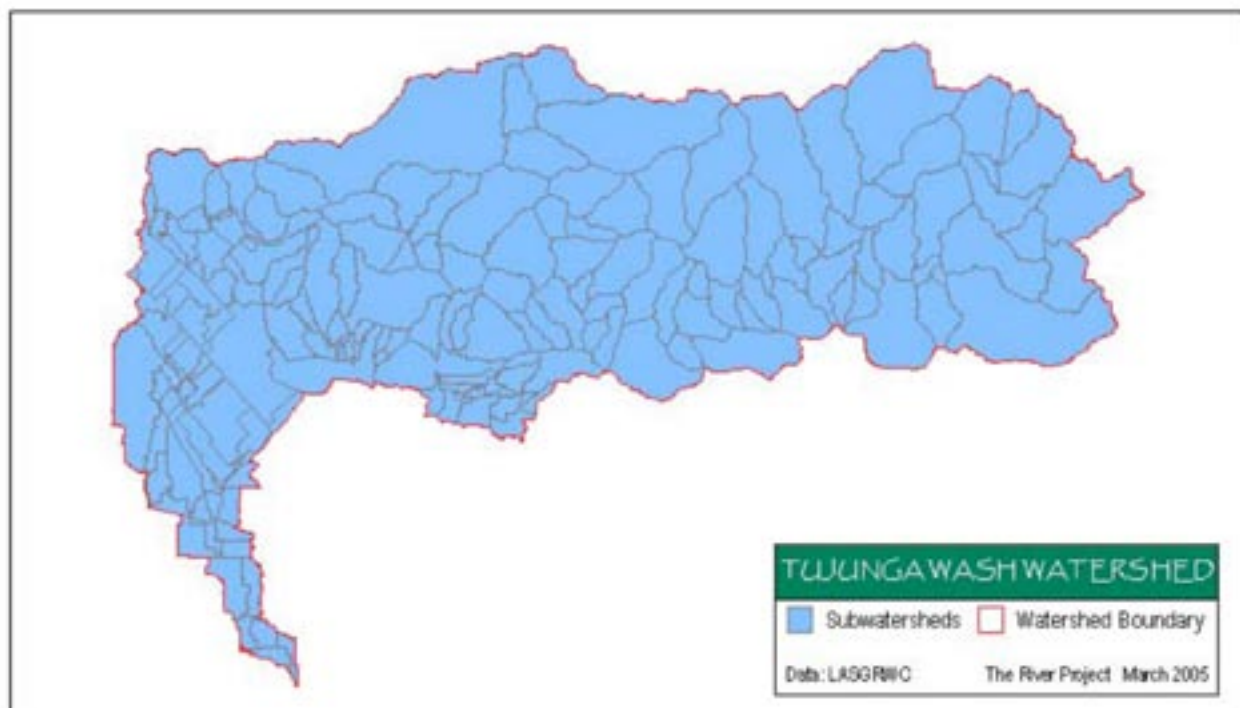


Figure 17 Sub-watersheds of the Tujunga Watershed.

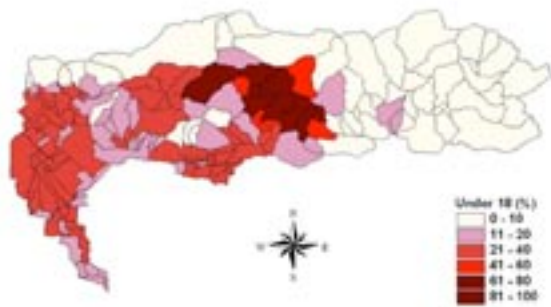


Figure 18 Percentage of children (age < 18) per subwatershed.

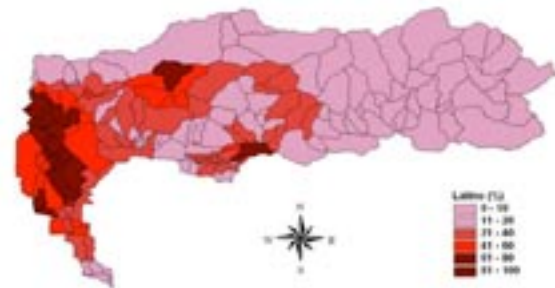


Figure 19 Percentage Latino/Hispanic ethnicity per subwatershed.



A



B



C



D

Figure 20 Percentage of the population per subwatershed self-identifying as one specific race. A = Black/African-American; B = Asian; C = White/Caucasian; D = Native American, Alaska Native, Native Hawaiian, or Pacific Islander.

Additional Maps

