PART 2: INVENTORY AND ANALYSIS

"River parkways help revitalize deteriorated urban neighborhoods and provide an anchor for economic development by providing important recreational and scenic amenities"

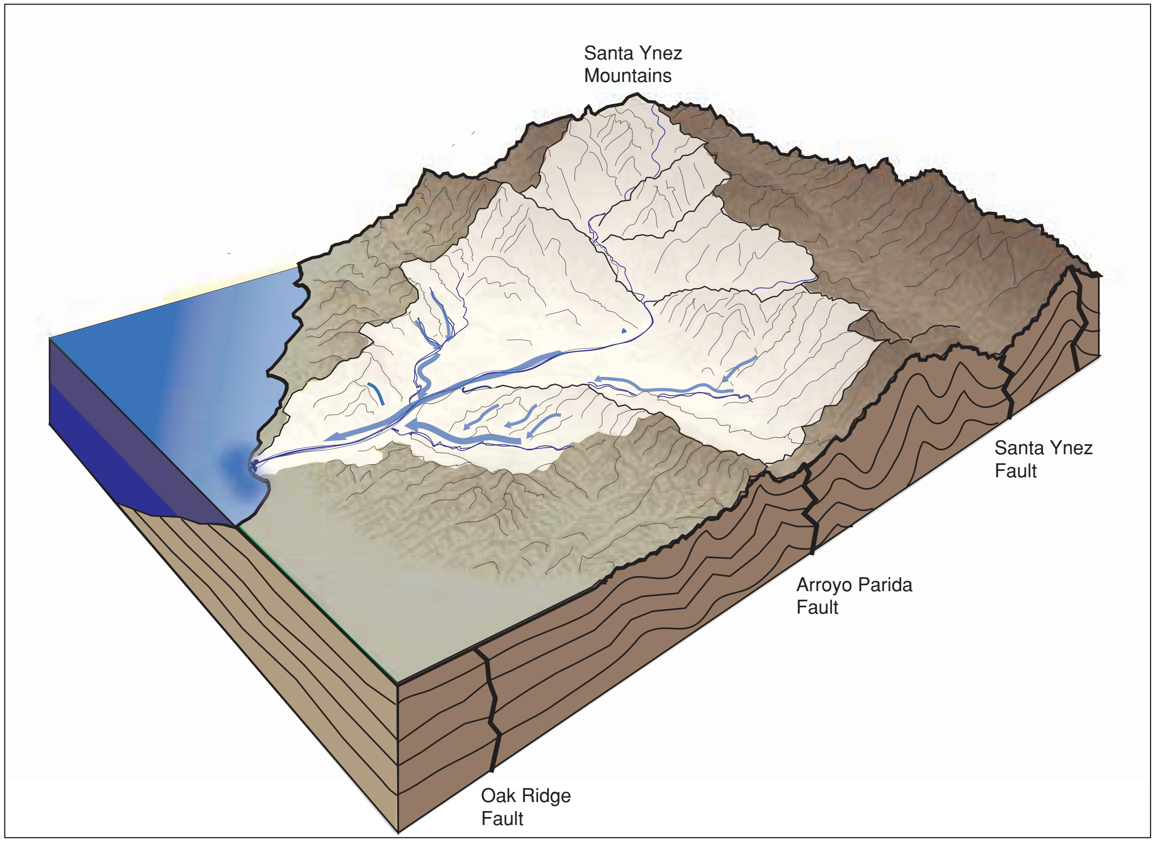
California River Parkways Act of 2004
California Public Resources Code §5751(c)

CHAPTER 2: FOUNDATIONS

Geomorphology

THE WATERSHED

The watershed which is drained by the Ventura River is fan-shaped, wide at the headwaters and narrow at the river mouth, occupying approximately 228 square miles and ranging in elevation from approximately 6,000 feet to sea level. The watershed is characterized by the transition from steep mountain slopes at the headwaters of its streams to a flat, alluvial river valley where the Lower Ventura River runs to the sea. Nearly forty-five percent of the watershed is classified as mountainous, forty percent as foothill, and fifteen percent as valley. More than 90% of the watershed has vegetative cover, either shrub and brush (75%) or forest (20%) (Greimann 2006). Approximately one-half of the watershed, the upper portion, is undeveloped lands lying within Los Padres National Forest. The lower half of the watershed contains a combination of land uses, including the semi-rural City of Ojai, the urban City of San Buenaventura, numerous agricultural and industrial operations, and some pristine hillsides of coastal sage scrub.



[FACING PAGE] FIGURE 2.1 *The Ventura River Watershed.*

FIGURE 2.2 *The Ventura River Watershed was formed by marine sedimentary layers that were uplifted, folded and faulted by tectonic processes (vertically exaggerated). Data from USGS , Norris and Webb 1990, Bing Yen Assoc. 2000.*

FORMATION OF THE LAND

Geomorphology is the science dealing with the nature and origin of the earth's topographic features (Webster's 1980).

The Ventura Watershed lies within two larger geologic structures. The first of these is the Ventura Basin, a depression approximately 120 miles long that includes the area between the Channel Islands (including the Santa Barbara Channel) and the Santa Ynez Mountains. The Basin, in turn, lies within the Transverse Range geomorphic province which consists of many overlapping east-west mountain ranges with intervening valleys, reaching across Southern California from the seacoast nearly to the Colorado River (Norris and Webb 1990).

The land that underlies this region was formed from flat layers of marine sediment – now more than 58,000 feet thick – while seas repeatedly advanced and receded across much of what is now California between the Cretaceous Period (144 million years ago) and the Pleistocene Epoch (1.4 million years ago). At a relatively recent time in geological history, perhaps as late as 29 million years ago, these layers were uplifted, folded and faulted by tectonic forces, forming the Santa Ynez Mountains (Norris and Webb 1990).

Thus, in geologic terms, the mountains of the watershed are young and the ongoing folding and faulting produces uplift that has been estimated at up to 0.59 inches per year (Rockwell et al. 1984). The relative youth of these mountains is manifested in steep slopes throughout the upper watershed. The combination of steep slopes, unconsolidated marine sediments (sandstone), and active uplift produces one of the highest rates of debris and sediment production in North America (Greimann 2006). For a discussion of the impacts of heavy sediment production on the form and function of the Ventura River, see chapter 4, Hydrology.

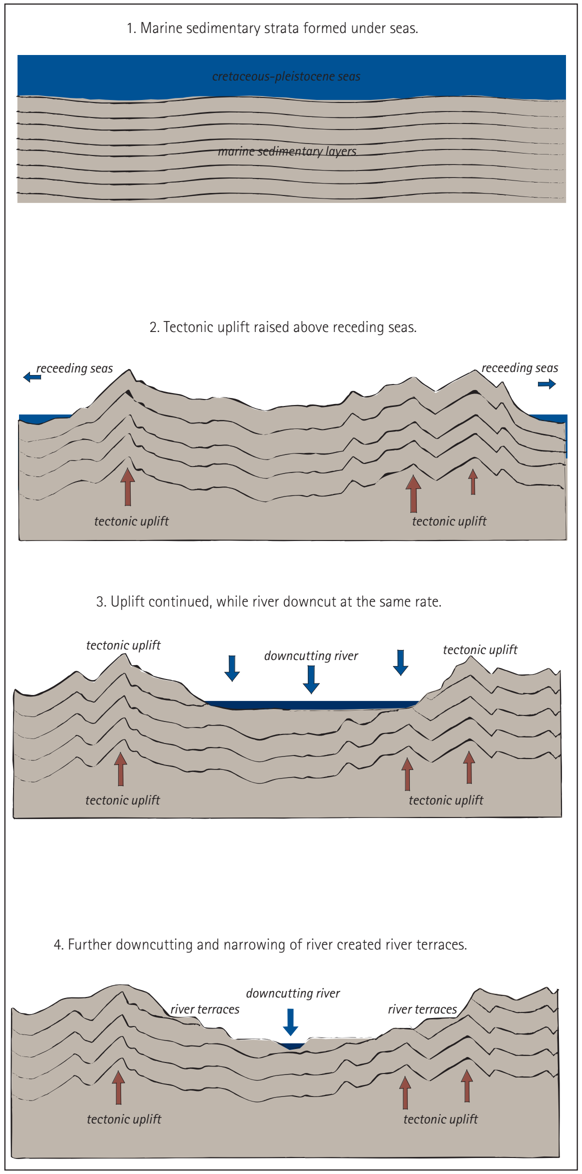


FIGURE 2.3 *This series of schematic diagrams suggests the geomorphic processes that resulted, in the project area, in the formation of a river valley with abandoned floodplain terraces.*

THE VENTURA RIVER VALLEY

The valley that encloses the Lower Ventura River acquired its form through a combination of tectonic uplift and the downcutting of the river itself which took place at approximately the same rate. Floodplain terraces along the sides of the valley today hint at the former levels of the river, as shown in figure 2.3 (Rockwell et al. 1984).

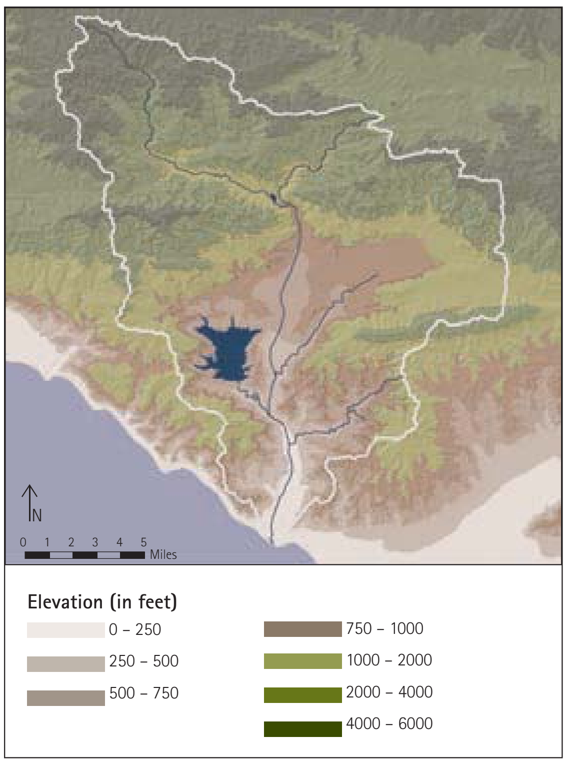


FIGURE 2.4 *Elevation in the Ventura River Watershed. Data from USGS National Elevation Dataset .*

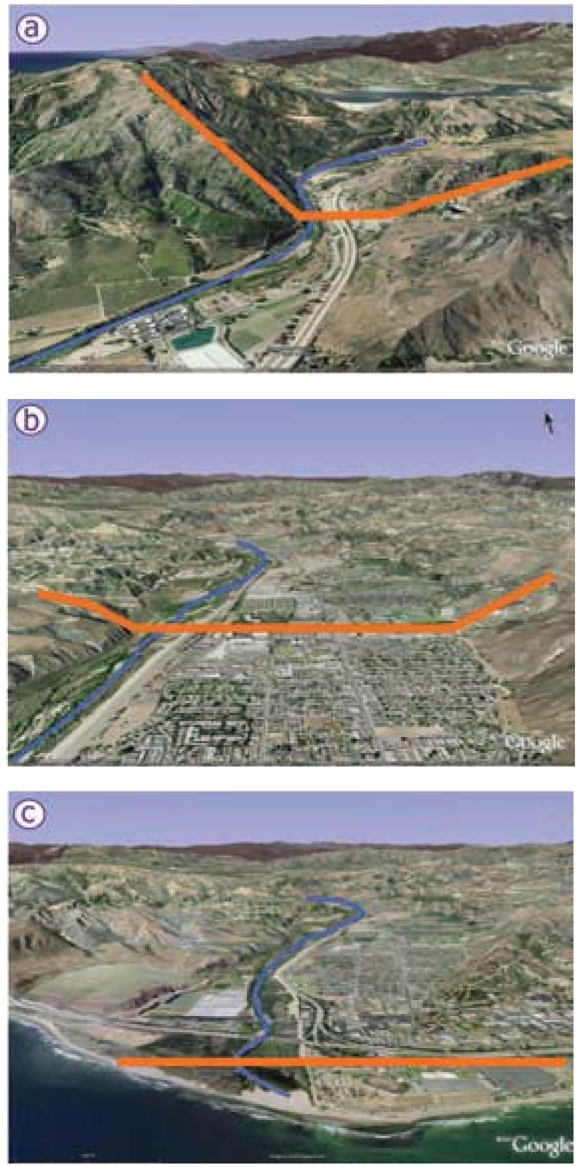


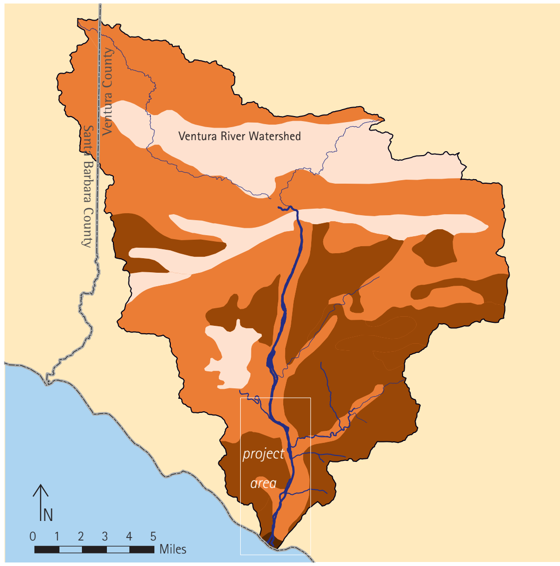
FIGURE 2.5 *Three sections through the Lower Ventura River Valley show the wide variety of topography in the Vision Plan area. Photo from Google Earth.*

Soils

The most prominent soils in the Ventura River Watershed are loams, clay loams, fine sandy loam, and fine sand (USDA, NRCS 2008). Loam soil is well suited for agriculture because it retains nutrients well and retains water while still allowing the water to flow freely. Much of the soil underlying the proposed parkway area is riverwash, consisting of coarse sediments.

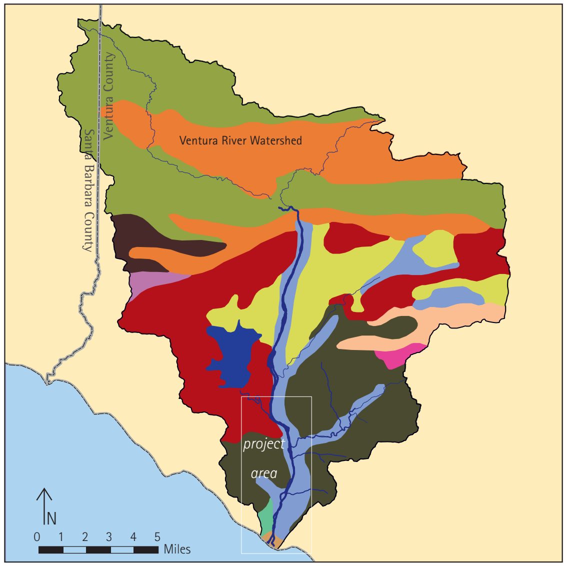
The soils of the watershed are well-drained, with permeability ranging from slow to rapid. Soil permeability describes the rate at which water moves through it. Soils with slow permeability are fine textured, like clays, that permit only slow water movement. Moderately or highly permeable soils are coarse-textured, like sands, and permit rapid water movement.

For slow permeability soils, rainwater will either accumulate on or flow across the surface, while in highly permeable soils rainwater will easily soak into the soil. The permeability of soils is the most important factor for determining the characteristics and frequency of landslides (ACOE 2004). Along the Lower Ventura River in the proposed parkway zone, soils are primarily permeable, with infiltration rates ranging from 0.2 to 6 inches per hour (figure 2.6).



Maximum Permeability in Inches Per Hour

0 Inches
.2-.6 Inches
6 Inches
20 Inches



Soil Series

Aramburu Variant
Millerton
Los Osos
Calodo
Baywood
Riverwash
Rock outcropping
Calleguas
San Benito
San Andreas
Lodo
Lake Casistas
Balcom

[ABOVE] FIGURE 2.6 *Soil permeability in the Ventura River Watershed. Data from U.S.D.A. NRCS STATSGO Soil Data.*
[RIGHT] FIGURE 2.7 *Soil series in the Ventura River Watershed. Data from U.S.D.A. NRCS STATSGO Soil Data.*

SOIL TYPE	DRAINAGE	RUNOFF	PERMEABILITY
Millerton Fine Sandy Loam Series	well to somewhat excessively drained	medium to rapid runoff	moderately rapid permeability
Aramburu Clay Loam Series	well drained	low to high runoff	moderate permeability
Calodo Clay Loam Series	well drained	medium to very rapid runoff	moderately slow permeability
Los Osos Loam Series	well drained	very high runoff	slow permeability
Balcom Loam Series	well drained	low to high runoff	moderate to moderately slow permeability
Calleguas Clay Loam Series	well drained	medium or high runoff	moderate permeability
Baywood Fine Sand Series	somewhat excessively drained	slow runoff	rapid permeability

Natural hazards

FAULTS

Multiple fault zones cross the Ventura River Watershed. The largest active fault is the Santa Ynez Fault, which is over ninety miles long (ACOE 2004). Other active faults of the watershed include the Tule Creek Fault, the Red Mountain Fault, the Arroyo Parida Fault, and the Ventura Fault.

LIQUEFACTION

The steep and highly erodible Santa Ynez Mountains contribute alluvial soils to the Ventura River Valley. Alluvial soils are highly susceptible to liquefaction-related hazards when saturated (Hitchcock 2000). Liquefaction, the process in which loose soils temporarily lose strength due to strong ground shaking, can cause considerable damage to structures and utilities during a major earthquake. The highest rates of liquefaction hazards in the Ventura River Watershed are along the floodplain of the Ventura River.

LANDSLIDES

A landslide is defined as the movement of a mass of rock, debris, or earth down a slope (Cruden 1991). Landslides commonly occur in connection with other major natural disasters such as earthquakes, wildfires, and floods the primary cause of a landslide is gravity acting on an over-steepened slope. Other factors that contribute to landslides include earthquakes and steep slopes that are saturated by heavy rains (USGS 2008).

FIGURE 2.8 *Major faults of the Ventura River Watershed. Data from Norris and Webb,1990; Bing Yen Associates, 2000.*

FIGURE 2.9 *Seismic Hazard Zones within the watershed. Data from California Geological Survey Seismic Hazard Mapping Program.*

FIRE

In Southern California, wildland fires are a common occurrence and have been for thousands of years, as a result of both human and natural factors. Most of the project area along the Lower Ventura River is on a wildland/urban interface with moderate to very high fire hazard (figure 2.10) The recurrent pattern of fire in a particular place is called a fire regime. Fire regimes are often an essential feature of plant and animal ecosystems, which have adapted to and benefit from fire disturbances. (For more on ecosystems of the Ventura River Watershed, see chapter 4.) Wildfires occur most often during the driest time of the year, late summer and early fall (Quinn and Keeley 2006).

On the sea floor of the Santa Barbara Channel, sediment deposits carried from the Santa Ynez Mountains reveal patterns of fire and floods that go back several centuries. These sediment deposits, known as varves, show that in the Santa Ynez Mountains, two very large fire-flood episodes occurred in the period between 1400 and 1550 CE. The varves also reveal the occurrence of large fires approximately once every sixty-five years over the past six hundred years (Quinn and Keeley 2006).

Areas burned by wildfires are particularly susceptible to landslides, since wildfires increase the erodibility of land surfaces by clearing away vegetation, and transforming soil properties, which alters the permeability of soil and increases vulnerability to raveling. The largest wildfire of 1985 in the State of California occurred in the Ventura River Watershed, burning 90,000 acres (U.S. Bureau of Reclamation 1995).

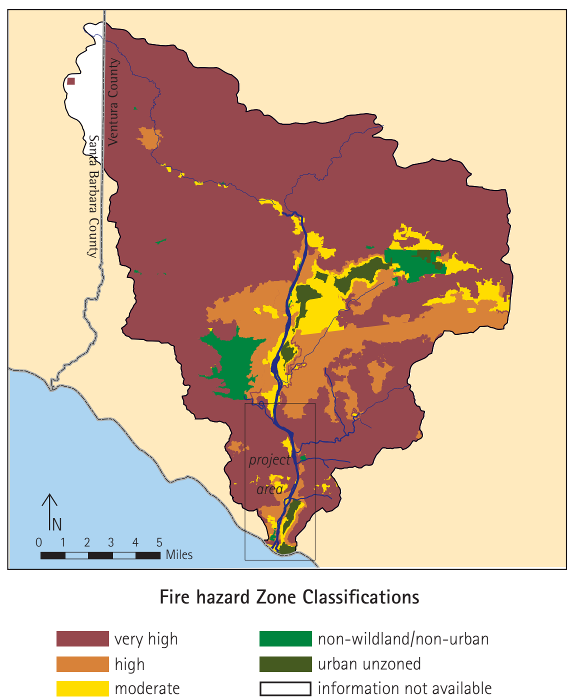


FIGURE 2.10 *Wildfire risk in the Ventura River Watershed. Data from California Department of Forestry and Fire Protection.*

Climate

The Ventura River Watershed has a Mediterranean climate with mild winters and generally rainless summers (ACOE 2004). Figure 2.13 shows the average annual and monthly high and low temperatures, which hover in the range between 50 and 70 degrees Fahrenheit (Western Regional Climate Center 2008). Among the watersheds of Ventura County, the Ventura River Watershed has the highest amount of rain (Watersheds Coalition of Ventura County 2008).

In an average year, the project area receives approximately nineteen inches of rain, although drier than average years are also common. Cooler than normal ocean temperatures, dubbed La Niña, lead to a decrease in evaporation and rain, which contributes to drier years. Despite arid to semi-arid conditions being the norm, warm ocean temperatures, known as El Niño, bring wet winters when the maximum average rainfall year approaches forty-six inches of precipitation (Watershed Protection District, 2008). The heaviest rain falls in the upper watershed, and it is not uncommon for winter storm events and their cumulative impact to be quite dramatic, causing flooding and erosion. (For a detailed discussion of flooding, see chapter 3, Hydrology.)

In addition to rain, the climate of the Ventura River Watershed is also influenced by fog. Low clouds and fog are most prevalent from mid-May to mid-July, particularly during the night and morning hours. Drizzle frequently falls in the morning when the low clouds and fog are the thickest. Fog begins to decrease in intensity and duration from mid-July through mid-September. August and September are typically the hottest months with only occasional low clouds and fog during the early morning hours (Ventura County Air Pollution Control Board 1998).

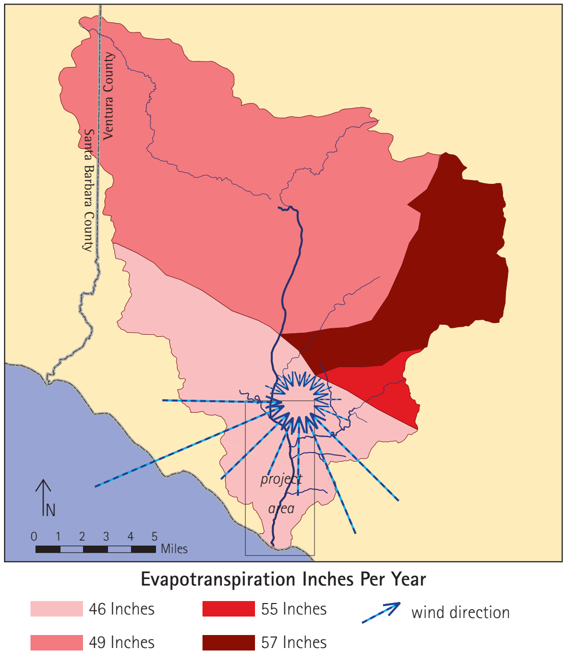


FIGURE 2.11 *Evapotranspiration and prevailing wind direction in the Ventura River Watershed. Data from Western Regional Climate Center and California Irrigation Management Information System.*

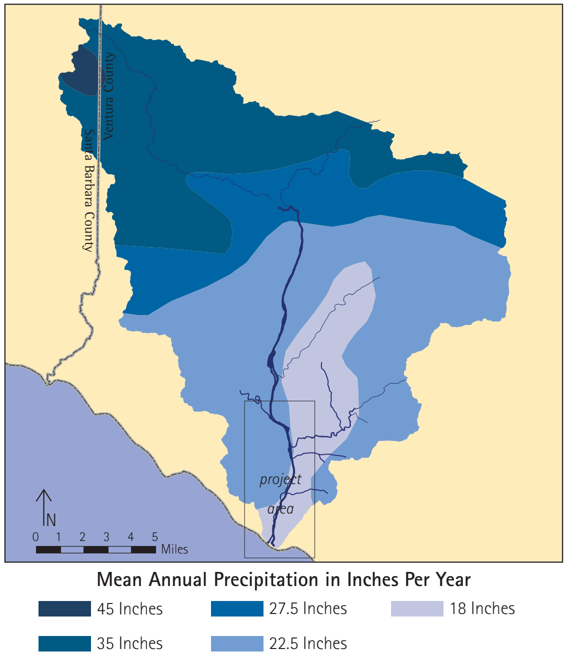


FIGURE 2.12. *Mean annual precipitation in the Ventura River Watershed. Data from California Fire Resource Assessment Program.*

The Ventura River valley acts as a corridor through which moisture-laden marine air moves inland. As ocean temperatures increase during the summer, the occurrence of fog decreases (Ferren Jr. et al1990).

Figure 2.11 illustrates wind inputs, evaporation from soils and other surfaces, and moisture inputs to the atmosphere through the transpiration of plants, a process known collectively as evapotranspiration. In comparing the distribution of precipitation with evapotranspiration, a direct correlation between areas with the highest rainfall and the highest evapotranspiration rates is apparent. In general, these areas also tend to have the highest temperatures.

Climatic considerations, temperature, sun and shade, the availability of water through rain and fog, wind speeds and frequency, and evapotranspiration paint a particular picture for the parkway area in terms of design opportunities and considerations. For humans, the dominant weather pattern of warm, sunny days with offshore winds provides a prime opportunity for outdoor recreation and education. Though less frequent than sunny days, foggy and rainy days provide additional opportunities for observation of natural processes and outdoor recreation with an experiential quality that is distinct from sunny days.

Climatic conditions are also an important indicator of the planting palette best suited for this region. Plants which are able to utilize fog, are not overly sensitive to wind, do not need regular rain, and are also able to tolerate and even thrive in years of inundation are best suited for this area.

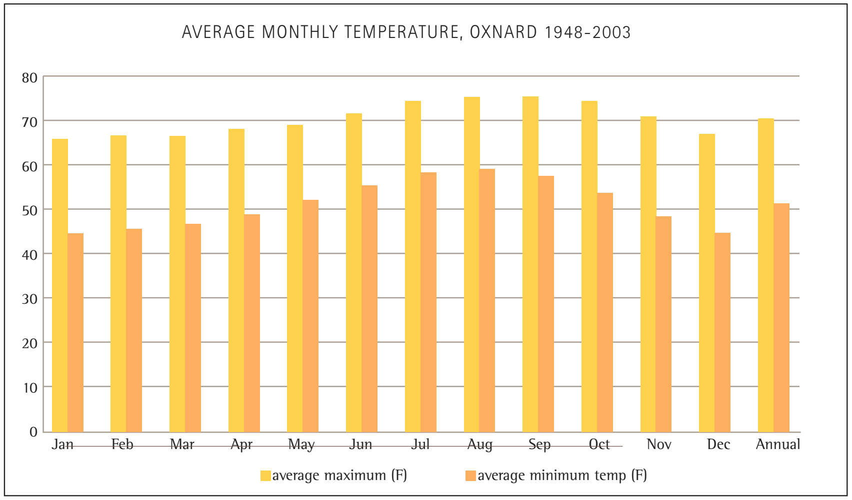


FIGURE 2.13 *Average monthly temperature, 1948-2003 Data from WRCC 2008.*

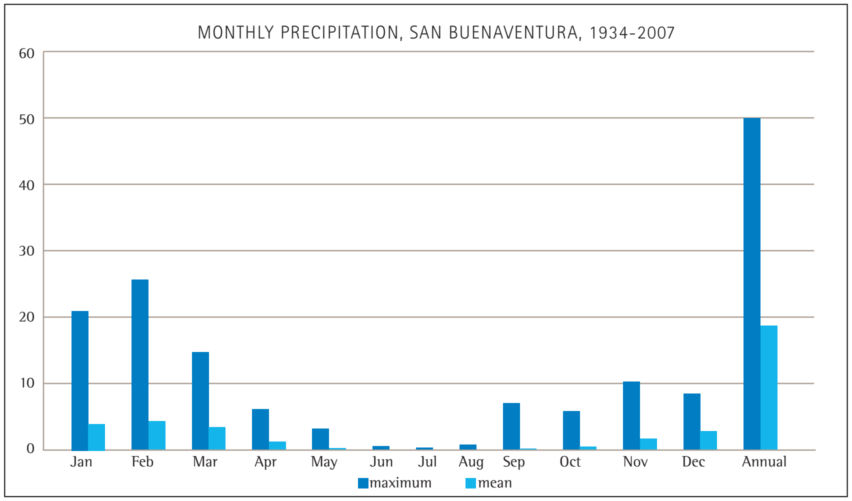


FIGURE 2.14 *Monthly precipitation, San Buenaventura, 1934-2007. Data from Ventura County Watershed Protection District, 2008.*