EXHIBIT "B"

# Proposed Antelope Valley Area of Adjudication and Jurisdictional Boundary

Prepared on behalf of

Bolthouse Properties LLC and

Wm. Bolthouse Farms, Inc.

*For the*

**Antelope Valley Groundwater Cases**
Santa Clara Case No. 1-05-CV-049053

June 28, 2006

*Prepared by*

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Project No. 8029.001.0

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June 28, 2006
Project No. 8029.001.0-Task 6

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**Subject: Submittal of Report,**
**Proposed Antelope Valley Area of Adjudication and Jurisdictional Boundary prepared on behalf of Bolthouse Properties LLC and Wm. Bolthouse Farms, Inc. for the Antelope Valley Groundwater Cases**
**Santa Clara Case No. 1-05-CV-049053**

Dear Mr. Zimmer:

In response to your request, Geomatrix Consultants, Inc. (Geomatrix), is pleased to submit our report Proposed Antelope Valley Area of Adjudication and Jurisdictional Boundary, prepared at your direction. Geomatrix has taken into consideration the geology, hydrogeology, and other aspects of the Antelope Valley pertinent to this water rights matter. Based on our studies, we are recommending an Area of Adjudication and a Jurisdictional Boundary for the court to use in pursuing the Antelope Valley Groundwater Cases.

I trust that the enclosed report will meet your needs. It has been our pleasure to provide these consulting services to you. If you have any comments, or if we can be of additional service, please call.

Sincerely yours,
**GEOMATRIX CONSULTANTS, INC.**

N. Thomas Sheahan, PG, CEG, CHG, PGP, CPG
Vice President and Principal Hydrogeologist

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NTS/s

Enclosure: **Report: Proposed Area of Adjudication and Jurisdictional Boundary for the Antelope Valley Groundwater Cases, July 28, 2006**

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Geomatrix

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# PROPOSED ANTELOPE VALLEY AREA OF ADJUDICATION AND JURISDICTIONAL BOUNDARY

Prepared on behalf of
Bolthouse Properties LLC and Wm. Bolthouse Farms, Inc.,
for the
Antelope Valley Groundwater Cases, Santa Clara Case No. 1-05-CV-049053

June 28, 2006

## 1.0 INTRODUCTION

Geomatrix Consultants, Inc. (Geomatrix), has conducted studies to provide a recommended Area of Adjudication for the Antelope Valley Groundwater Cases, the boundary of which would serve as the basis for establishing the Jurisdictional Boundary for use in the subject Antelope Valley water rights matter. Our studies have taken into consideration the geology and hydrogeology of the Antelope Valley, areas of current and potential groundwater development, the area of surface drainage into the Antelope Valley (Antelope Valley watershed), sources of recharge to the groundwater system, the aerial extent of unconsolidated alluvial deposits and fractured bedrock suitable for current and future groundwater extraction and recharge, and other aspects of the Antelope Valley pertinent to this water rights matter. This report is organized into the following sections to assist the reader in understanding our recommendations.

- Objectives
- General Description of Antelope Valley
- Geology
- Hydrogeology
- Groundwater Occurrence
- Sources of Groundwater Recharge
- Areas of Groundwater Production and Surface Water Capture
- Recommended Area of Adjudication
- Definition of Jurisdictional Boundary
- Closure

In addition to the text of this report, we have incorporated Attachments at the end of the report. Each Attachment is identified and discussed in this report, and incorporated herein by reference.

- Attachment A, References, presents a list of references cited in this report.

- Attachment B, Figures, presents all of the figures referenced in this report.

To understand the various aspects of the Antelope Valley and the bases for our recommended Area of Adjudication and Jurisdictional Boundary, it is important to have definitions of certain key terms and phrases. Where each of the key terms or phrases first appears in the text below, we have included a definition of that term as a footnote.

## 2.0 OBJECTIVES

The primary objective of this report is to delineate an Area of Adjudication[1] for the Antelope Valley water-rights matter that includes all of the parcels of land that currently use the groundwater[2] and surface water[3] resources of the Antelope Valley or could utilize those water resources in the future. The Area of Adjudication must be sufficiently large to include the full lateral extent of the groundwater basin[4] that is to be later defined as the Antelope Valley Groundwater Basin. Furthermore, the Area of Adjudication must be limited in size such that it does not overlap areas where water rights have been previously adjudicated.

An additional objective of this report is to delineate a Jurisdictional Boundary[5] for the Area of Adjudication. The Jurisdictional Boundary is a line surrounding and incorporating the Area of

[1] **Area of Adjudication**. The area of the Antelope Valley that includes all of the parcels of land that currently use the water resources of the Antelope Valley or could utilize those water resources in the future, which does not overlap areas that have been previously adjudicated, but which is sufficiently large to include the full surface area of the Antelope Valley Groundwater Basin, which is to be defined later.

[2] **Groundwater.** All subsurface water, as distinct from surface water (Bates, 1984), the subsurface occurrence of which may be divided into zones of aeration and zones of saturation (Todd, 1980).

[3] **Surface Water.** Water at or above the surface of the ground found in ponds, lakes, inland seas, streams, rivers, and reservoirs (Fetter, 1994).

[4] **Groundwater Basin.** A hydrogeologic unit containing one or more aquifers that are connected and interrelated (Todd, 1960). An aquifer or system of aquifers, whether basin-shaped or not, with reasonably well-defined boundaries and more-or-less definite areas of recharge and discharge (Bates, 1984). A rather vague designation pertaining to groundwater reservoir that is more-or-less separate from neighboring groundwater reservoirs (Fetter, 1994).

[5] **Jurisdictional Boundary.** A boundary line surrounding and incorporating the Antelope Valley Area of Adjudication that can be specifically defined and surveyed using commonly-applied land-surveying techniques.

Adjudication, but which can be specifically defined and surveyed using commonly-applied land-surveying techniques.

It is not an objective of this report to specifically define the Antelope Valley Groundwater Basin or to delineate either its surface area or vertical extent. Defining the Antelope Valley Groundwater Basin is a task that we understand will be addressed by the court at a later time. In defining the Area of Adjudication, however, it is important to consider certain of the elements that will eventually be used to define that Groundwater Basin, such that the Area of Adjudication will be sufficiently large to incorporate all of the surface area of the to-be-defined Antelope Valley Groundwater Basin. This report addresses those elements.

## 3.0 GENERAL DESCRIPTION OF ANTELOPE VALLEY

The Antelope Valley is a generally triangular-shaped area that is principally located in the northeastern portion of Los Angeles County and the southeastern portion of Kern County, California. Figure 1 is a topographic map of the Antelope Valley and its general vicinity. The Antelope Valley is bounded by the Tehachapi Mountains along its northwestern border and by the San Gabriel Mountains along its southwestern border. The county line separating Los Angeles and Kern Counties to the west from San Bernardino County to the east roughly approximates the eastern boundary of the generally triangular-shaped Antelope Valley. The western boundary of the Mojave Basin Area, the area east of the Antelope Valley where water rights have been previously adjudicated in the Judgment,[6] is also shown on Figure 1.

The topography of the Antelope Valley extends from the highest elevations, along the crest line or watershed[7] boundary located in the San Gabriel and Tehachapi Mountains, down to the lower elevations in the dry lake bed near the center of the Valley. The watershed boundary of the Antelope Valley, shown on Figure 1, represents the line within which all surface water that enters the Antelope Valley as precipitation will flow into and the Valley.[8] Surface water from precipitation falling outside of this watershed boundary does not drain into the Valley. The

[6] The term "Judgment" refers to the decision in the case of *City of Barstow, et al. v. City of Adelanto, et al.* Case No. 208568, Riverside Superior Court, June 2003 (Judgment).

[7] **Watershed.** The land area from which water drains into a stream, river, or reservoir (DWR, 2003).

[8] The watershed boundary shown on Figure 1 and other figures in this report, and used consistently throughout this report, is based on detailed analysis of topography, drainage patterns, and drainage areas in the Antelope Valley vicinity using more detailed topographic maps than the base map shown on Figure 1 and other figures in this report. Maps used for this detailed analysis were USGS Quadrangles, 7.5-Minute Series, Scale 1:24,000. Based on the detailed topography and drainage patterns shown on the Burnt Peak, Lake Hughes, Sleepy Valley, and Del Sur Quadrangles, USGS 7.5-Minute Series, 1995, the watershed boundary in the Leona Valley area is south of

watershed boundary shown on Figure 1 includes the western part of the Leona Valley and Pine Canyon because precipitation in these areas infiltrates into the ground and flows underground into the main Valley area.

Precipitation in the central and eastern portions of the Antelope Valley is relatively small, and evaporation in this area is relatively large. Most of the precipitation that falls within the central portion of the Antelope Valley is consumed by evaporation or surface vegetation before it has the opportunity to infiltrate deeper into the soil. By contrast, there is a significant amount of precipitation that occurs in the mountainous areas along the southwestern and northwestern boundaries of the Antelope Valley. In winter months, heavy precipitation occurs principally in the San Gabriel Mountains. In summer months, monsoon storms moving from southeast to northwest produce a considerable amount of precipitation in the Tehachapi Mountains along the northwestern border of the Valley.

While some of this precipitation is consumed by vegetation and evaporation, a portion of the precipitation falling in these mountainous areas runs down the mountain slopes into the Valley as surface water in streams, and flows out into the central portion of the Antelope Valley. Another portion of the precipitation that falls on the mountain slopes flows as surface water into existing ponds, lakes, and reservoirs; examples of these include Lake Hughes, Munz Lakes, and Lake Elizabeth, both of which are in the Leona Valley, Little Rock Reservoir, which is located along Little Rock Creek, and Lake Palmdale, which is just south of the City of Palmdale.

Part of the precipitation infiltrates directly into the fractured[9] bedrock along the fronts of these two mountain ranges, and becomes groundwater available for development by water wells[10] drilled into the bedrock. Another part infiltrates directly into the porous unconsolidated alluvium[11] in the valleys along the mountain fronts, such as the alluvium in Leona Valley, and becomes groundwater available for wells completed in the alluvial deposits.

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Lake Hughes, Munz Lakes, and Lake Elizabeth, and incorporates all of Leona Valley, Pine Canyon, and the drainage area of Amargosa Creek.

[9] **Fracture.** A crack, joint, fault, or other break in rocks (Bates, 1984).

[10] **Water Well.** A hydraulic structure, which when properly designed and constructed permits the economic withdrawal of water from a water-bearing formation (Driscoll, 1986).

[11] **Alluvium.** A general term for detrital deposits made by streams on river beds, flood plains, and alluvial fans (Bates, 1984). As used herein, the term refers to all of the unconsolidated deposits in the Antelope Valley including the alluvium, stream channel deposits, fan deposits, basin deposits, lake deposits, dune sands, and undifferentiated nonmarine deposits, all of which are of Quaternary age.

## 4.0 GEOLOGY

The largest portion of the Antelope Valley is underlain by unconsolidated deposits including alluvial deposits, stream channel deposits, fan deposits, basin deposits, lake deposits, dune sand deposits, and undifferentiated nonmarine deposits, all of which are of Quaternary age. By far, the most abundant of these unconsolidated deposits are the alluvial deposits. For purposes of this report, the term "alluvium" is used herein to represent all of these unconsolidated deposits of Quaternary age.

Figure 2 shows the areal extent of the alluvium in the Antelope Valley, referred to herein as the Antelope Valley Alluvium, along with the areal extent of alluvium in the two adjacent valleys, Fremont Valley to the north and El Mirage Valley to the east (DWR, 2003).[12] The surface geology outside of the areas covered by alluvium consists primarily of bedrock.

Consolidated bedrock makes up the Tehachapi Mountains and the San Gabriel Mountains along the northwestern and southwestern boundaries, respectively, of the Antelope Valley. The bedrock is principally composed of granitic rocks, but includes meta-sediments such as limestone and dolomite with occasional intrusive volcanic rocks. Within the central portion of the Antelope Valley, there are occasional occurrences of the bedrock protruding through the alluvium (see Figure 2).

Faults[13] are structural elements that affect the geology and hydrogeology of an area. The principal structural elements of the geology associated with the Antelope Valley are the two major fault zones[14] along the boundaries of the Valley. Figure 3 shows the faults and fault zones in the vicinity of the Antelope Valley. The Garlock Fault Zone parallels the northwestern boundary of the Valley and the San Andreas Fault Zone parallels the southwestern boundary. The San Andreas Fault Zone has produced the rift valley that makes up the Leona Valley and Pine Canyon along the southwestern boundary of the Antelope Valley. Bedrock within and along these fault zones has been heavily fractured, broken, and brecciated.

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[12] California Department of Water Resources (DWR) Bulletin 118, Update 2003, designates the El Mirage Valley as No. 6-43, the Antelope Valley as No. 6-44, and the Fremont Valley as No. 6-46. Some versions of the Antelope Valley alluvium boundary, No. 6-44, have included the Acton Valley alluvium as part of the Antelope Valley alluvium, however, the Acton Valley is a separate unit designated by DWR as No. 4-5, and is not included in the Antelope Valley Alluvium as referenced in this report.

[13] **Fault.** A fracture or fracture zone in rock along which there has been displacement of the rock on the sides of the fracture relative to one another and parallel to the fracture (Bates, 1984).

[14] **Fault Zone.** A fault that is expressed as a zone of numerous rock fractures (Bates, 1984).

The Antelope Valley has been formed by a general down-dropping of the bedrock block that makes up the generally triangular-shaped area of the valley. This down-dropping created a structural basin which has been subsequently filled with alluvial deposits eroded from the Tehachapi and San Gabriel Mountains along the northwestern and southwestern boundaries, respectively, of the structural basin.

Due to differential down-dropping of portions of the structural basin, the depths to bedrock in various portions of the basin vary considerably. Differences in bedrock elevations can result in differences in groundwater level elevations. The differences in water table[15] elevations are occasionally used by geologists to infer the presence of subsurface faults.

In addition to the San Andreas and Garlock Fault Zones, other faults have been mapped or inferred within the Antelope Valley, as shown on Figure 3. Where faults are clearly defined in outcrops at ground surface, the faults have been located and mapped. In other areas, where faults show no direct surface expression, faults have been postulated or inferred based on indirect evidence such as differences in groundwater levels or topographic lineaments. The inferred faults may or may not actually exist; if they do exist they may represent only differences in the bedrock at depth, below the alluvium, and may not be faults that extend upward from the bedrock through the alluvium.

## 5.0 HYDROGEOLOGY

The alluvium in the Antelope Valley is an unconsolidated accumulation of various sized particles including clay, sand, silt, and gravel. The alluvium has a relatively large porosity,[16] its primary porosity,[17] consisting of the void spaces or openings between the particles that make up the alluvial deposits. In the coarser portions of the alluvium, the pores are generally interconnected, providing a pathway for water to move through the alluvial deposits. The coarser portions of the alluvium exhibit a relatively high hydraulic conductivity[18] associated with the high primary porosity. The hydraulic conductivity resulting from the primary porosity can be considered the primary hydraulic conductivity of the alluvium.

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[15] **Water Table.** The upper surface of the zone of saturation in an unconfined aquifer (DWR, 2003). The surface within an unconfined aquifer or confining bed at which the pore water pressure is atmospheric (Fetter, 1994).

[16] **Porosity.** The ratio of the volume of void spaces in a rock or sediment to the total volume of the rock or sediment (Fetter, 1994).

[17] **Primary Porosity.** The porosity that represents the original pore openings when a rock or sediment is formed (Fetter, 1994).

[18] **Hydraulic Conductivity.** A measure of the capacity for a rock or soil to transmit water (DWR, 2003); the

Because the alluvial deposits are unconsolidated, they do not generally show secondary porosity[19] effects such as fracturing or jointing after the formation was formed. Where these deposits are faulted, there may be some effects along the fault plain within the alluvium, but these effects are sometimes difficult to distinguish. Consequently, faulting of the unconsolidated alluvium generally does not produce a significant increase in the overall average hydraulic conductivity of the formation.

Coarser-grained portions of the alluvium that are saturated with groundwater provide the principal aquifers[20] for development of groundwater by wells in the Antelope Valley. Figure 4 shows the locations of many, but not all, of the wells in the Antelope Valley and vicinity. The multiple aquifers within the saturated alluvium constitute the alluvial aquifer system of the Valley. Alluvial groundwater can migrate vertically downward into fractured bedrock underlying the alluvium or laterally into the fractured bedrock adjacent to the alluvial deposits. This situation occurs to a significant extent in the Leona Valley where the alluvial aquifer overlies the highly-fractured bedrock along the San Andreas Fault Zone.

Bedrock that is not fractured generally has a low primary porosity. These consolidated rocks are dense, crystalline materials and the pores that developed during rock formation are generally small and not strongly interconnected. Consequently, unfractured bedrock generally has a low primary hydraulic conductivity.

On the other hand, fractured bedrock with higher secondary porosity may have a much greater overall or average hydraulic conductivity. Bedrock that has been significantly fractured due to faulting and folding of the earth's crust, similar to the granitic rocks and other rocks present along the boundaries and at depth within the Antelope Valley, may have a high overall or average hydraulic conductivity. The fractures provide an interconnected system of openings within the rock, which is the secondary porosity of the rock. In many instances, the secondary porosity openings or fractures within these rocks may be very large, and the combination of interconnected fractures can produce a significantly high overall or average hydraulic conductivity in the bedrock.

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volume of water under field conditions of density and viscosity that will flow through a unit area of aquifer per unit time under a unit hydraulic gradient.

[19] **Secondary Porosity.** The porosity that has been formed by fractures or weathering in a rock or sediment after it has been formed (Fetter, 1994).

[20] **Aquifer.** A body of rock or sediment that is sufficiently porous and permeable to store, transmit, and yield significant or economic quantities of groundwater to wells and springs (DWR, 2003).

In the Antelope Valley, the two major fault zones, the Garlock Fault Zone and the San Andreas Fault Zone, have produced intensive fracturing of the bedrock along and in the vicinity of these fault zones. The Leona Valley is an area that exhibits intensively-fractured bedrock due to the San Andreas Fault Zone that runs through this valley. To a lesser extent other faulting in the Antelope Valley has caused bedrock to be fractured in other areas of the Valley, including bedrock beneath the alluvium. The saturated fractured bedrock zones in these areas constitute the fractured bedrock aquifer system in the Antelope Valley.

Many of the fractured bedrock areas in the Antelope Valley are saturated with groundwater and are capable of supplying economic quantities of groundwater to wells drilled into the fractured bedrock. Figure 4 shows many wells within the Antelope Valley watershed that are not constructed in the alluvial aquifer system, but instead are located outside of the mapped Antelope Valley Alluvium. These wells have been constructed in the fractured bedrock and produce water from the fractured bedrock aquifer system.

In addition, groundwater within the fractured bedrock is hydraulically connected to the alluvium, and can transmit water from the mountain fronts through the fractured bedrock into the alluvial aquifer system. Groundwater flows into the alluvium from fractured bedrock that is laterally adjacent to the alluvium and from fractured bedrock that is situated beneath the alluvium.

Together, the alluvial aquifer system and the fractured bedrock aquifer system comprise the Valley aquifer system. Because of this, the lateral and vertical extent of the fractured bedrock aquifer system must be included within the to-be-determined Antelope Valley Groundwater Basin, and therefore, the area encompassing both aquifer systems must be included in the Antelope Valley Area of Adjudication.

## 6.0 GROUNDWATER OCCURRENCE

Groundwater in the Antelope Valley occurs within three principal zones of the subsurface materials:

- saturated, unconsolidated, alluvial deposits below the water table, which comprises the alluvial aquifer system;
- saturated, fractured, consolidated bedrock beneath and adjacent to the unconsolidated alluvial deposits, which comprises the fractured bedrock aquifer system ; and

- unsaturated alluvium and fractured bedrock above the water table, which comprises the vadose zone.[21]

Groundwater fills the pore spaces, or porosity, within the saturated, unconsolidated, alluvial deposits below the water table in the Antelope Valley. These deposits underlie most of the Antelope Valley area and occur in the stream channels leading into the central part of the Valley. Groundwater in the saturated alluvial deposits is generally extracted by use of water wells, but occasionally can discharge to the surface as springs or as exfiltration to streams, ponds, or lakes occupying the valleys.

The groundwater that flows in the saturated alluvial deposits of a stream channel is sometimes referred to as a "subterranean stream." Subterranean streams flowing through known and definite channels -- the groundwater filling and flowing through the pore space of the alluvial deposits within defined beds and banks of stream channels -- may be classified as "surface water" in relation to applications to the California State Water Resources Control Board for appropriating water or in relation to permits or licenses issued pursuant to such applications under California Water Code § 1200.[22] The alluvial aquifer in the Leona Valley is an example of an alluvial aquifer that might fit this description. Groundwater in the alluvial aquifer is recharged by surface precipitation along the mountain front that drains into the lakes in this valley, infiltrates into the alluvial and fractured bedrock aquifer systems, and flows through these aquifer systems into the main Antelope Valley. Although the groundwater in the alluvial aquifers within stream channels might be considered surface water under California Water Code § 1200, for purposes of water-rights adjudication in this matter, all subterranean water is considered groundwater, including water in the saturated alluvium within known and definite channels.

Groundwater also fills the pore space of saturated, fractured bedrock that occurs adjacent to and underlying the alluvial deposits. The fractured bedrock exhibits a significant secondary porosity and secondary hydraulic conductivity. Groundwater that fills the fractures below the water table flows through the fractured bedrock to wells or to other parts of the Valley aquifer system.

[21] **Vadose Zone.** The zone between the land surface and the water table (Fetter, 1994). The zone below the land surface in which pore space contains both water and air (DWR, 2003).
[22] California Water Code § 1200 states: Whenever the terms stream, lake or other body of water, or water occurs in relation to applications to appropriate water or permits or licenses issued pursuant to such applications, such term refers only to surface water, and to subterranean streams flowing through known and definite channels.

Bedrock is commonly found to be highly fractured and highly permeable[23] along major fault zones such as the San Andreas Fault Zone that runs from southeast to northwest along the southern portion of the Antelope Valley (see Figure 4). Groundwater in the saturated portions of the fractured bedrock is generally extracted by use of water wells, but can occasionally discharge as springs or infiltrate directly into surface water streams. There are numerous springs along the mountain fronts of the San Gabriel Tehachapi Mountains within the Antelope Valley watershed boundary. Groundwater in the fractured bedrock can also migrate laterally into the adjacent alluvial deposits or vertically upward into the alluvium from beneath those deposits. For example, the groundwater in the fractured bedrock aquifer system along the Leona Valley flows generally southeastward toward the confluence of that valley with the main Antelope Valley and migrates into the alluvial aquifer system in the main Valley just south of Palmdale.

Groundwater also occurs within the pore space of the vadose zone, the unsaturated subsurface materials above the water table. Although the entire available porosity of the vadose zone is not filled with water, groundwater occupies a portion of the pore space in the vadose zone. Much of the water that enters the vadose zone migrates vertically downward through the vadose zone to the saturated zone[24] below the water table where it eventually combines with the groundwater in the saturated zone. Although groundwater is not commonly extracted from the vadose zone, where perched groundwater[25] occurs within the vadose zone groundwater can occasionally be extracted from the saturated deposits within the perched zones before that vadose-zone groundwater reaches the water table.

## 7.0 SOURCES OF GROUNDWATER RECHARGE

Groundwater recharge[26] occurs from several types of sources. When precipitation falls directly on the surface of the Antelope Valley, a portion of the precipitation evaporates directly into the atmosphere and another portion is consumed by vegetation. The remainder of the precipitation, if any, infiltrates into the vadose zone through which it generally migrates to the water table, recharging the groundwater in the alluvial and fractured bedrock aquifer systems. Precipitation

[23] **Permeable.** Having pores or openings that permit liquids or gases to pass through (Webster, 1976).
[24] **Saturated Zone.** The zone in which the voids in the rock or soil are filled with groundwater at a pressure greater than atmospheric (Fetter, 1994).
[25] **Perched Groundwater.** Groundwater supported by a zone of material of low permeability located above an underlying main body of groundwater (DWR, 2003).
[26] **Groundwater Recharge.** The natural or intentional infiltration of surface water into the zone of saturation (DWR, 2003).

along the mountain fronts adjacent to the Antelope Valley may infiltrate directly into the fractured bedrock or into the unconsolidated alluvial deposits in those areas.

Precipitation along the mountain fronts may also run off as surface water through streams leading into the main portion of the Antelope Valley. Some surface water may be captured for local consumptive uses before it has a chance to recharge the Valley aquifer systems. Surface water that is not consumed by direct evaporation or vegetative consumption, and is not captured in ponds, lakes, or reservoirs for local consumptive uses, infiltrates into the vadose zone, or directly into the saturated zone where the water table is shallow. This water is a significant source of recharge to the Antelope Valley aquifer system.

Surface water storage facilities, including natural or man-made lakes and ponds such as Lake Hughes, Munz Lakes, and Lake Elizabeth, in Leona Valley, Little Rock Reservoir, located along Little Rock Creek, and Lake Palmdale, are also important sources of recharge to the Valley aquifer system. Some of the water contained in the lakes and ponds is consumed by vegetation and direct evaporation. A portion may be taken for local consumptive uses. Another portion, however, infiltrates through the sides and bottoms of the lakes or ponds into the aquifer systems below, contributing recharge to the groundwater systems. In the Leona Valley, the lakes recharge both the alluvial and the fractured bedrock aquifer systems, and this groundwater flows down the Leona Valley to the mane Antelope Valley area.

As with direct precipitation, water that is applied to irrigate agricultural crops and landscaping within the Antelope Valley is only partially consumed by evaporation and vegetative consumption. That portion of the applied water that is not otherwise consumed infiltrates into the vadose zone as irrigation return flow, contributing recharge to the groundwater system. Similarly, water that is provided for domestic use is only partially consumed. A significant portion of this water infiltrates back into the vadose zone through individual wastewater systems (e.g., septic tanks and leach fields) and through irrigation return flow from landscape irrigation. Leakage of water along water transmission and distribution pipelines also enters the vadose zone and contributes recharge to the groundwater system.

Imported water, which is water brought into the Antelope Valley from outside of its watershed boundary, can also be a source of recharge to the groundwater system. The Antelope Valley - East Kern Water Agency is the primary supplier of imported water to the Antelope Valley. Figure 5 is a map of the Antelope Valley - East Kern Water Agency boundary and agency facilities in the Antelope Valley. Recharge of imported water can occur by unplanned infiltration of imported water leaking from canals and pipelines carrying the imported water. Imported water can also be recharged in a planned manner at specific recharge facilities, such as percolation ponds or injection wells. Imported water can be a significant source of recharge to a groundwater system. Where imported water is supplied directly to agricultural or domestic users, the unconsumed portion of the imported water contributes recharge to the groundwater system through irrigation return flow and infiltration from individual wastewater systems.

Reclaimed water can be another important source of groundwater recharge. Leakage of wastewater from sewer lines and other wastewater or reclaimed water systems contributes water directly to the vadose zone. A portion of the effluent from wastewater treatment plants that is discharged directly to surface ponds contributes recharge to the groundwater system by infiltration directly into the vadose zone. Reclaimed water is also provided to some Antelope Valley agricultural users for crop irrigation, and that portion of the reclaimed water that is not consumed, the irrigation return flow, contributes recharge to the groundwater system.

The alluvial and fractured bedrock aquifer systems beneath the Antelope Valley can also be recharged through subsurface inflow of groundwater from adjacent groundwater areas into the Antelope Valley groundwater system. Groundwater inflow can be from adjacent saturated alluvial deposits, such as from the Fremont Valley Alluvium to the north, the El Mirage Valley Alluvium to the east, and the Leona Valley alluvium to the south. Groundwater inflow can also come from fractured bedrock adjacent to and underlying the unconsolidated alluvial deposits, such as fractured bedrock within the San Gabriel and Tehachapi Mountains and fractured bedrock beneath the alluvial aquifer system. The Leona Valley is a significant source of groundwater flowing from the fractured bedrock along the San Andreas Fault Zone into the main Antelope Valley.

Groundwater outflow can also occur from the Antelope Valley aquifer systems, such as from the Antelope Valley Alluvium into the El Mirage alluvium in the southeastern corner of the Antelope Valley (see Figure 2). The difference between the subsurface inflow of groundwater and the subsurface outflow from the groundwater system is the net groundwater recharge from subsurface inflow of groundwater.

In-lieu recharge is a type of groundwater recharge that results from reduction in or avoidance of groundwater extraction. For example, if an agricultural user takes imported water for irrigation instead of pumping groundwater from wells, the amount of water that would be otherwise pumped and consumed is considered in-lieu recharge of the groundwater system.

## 8.0 AREAS OF GROUNDWATER PRODUCTION AND SURFACE WATER CAPTURE

There are two types of groundwater production areas that are of importance to this matter:

- areas where groundwater is currently being extracted; and
- areas where conditions are favorable for groundwater to be extracted in the future.

Each of these two types of groundwater production areas are discussed, separately, below. Another type of water production that is important to this matter is the capture of surface water. The following paragraphs also discuss the areas where surface water within the Antelope Valley is currently being captured or could be captured in the future for consumptive use, thereby preventing this water from recharging the Valley aquifer system.

Because groundwater is commonly extracted by use of water wells, a convenient means for identifying areas of current groundwater extraction is to look at locations of wells in the Antelope Valley. Figure 4 shows a map of the Antelope Valley with plotted locations of many, but not all, of the wells throughout the Valley. In selecting the Area of Adjudication, it is important to include, as a minimum, all of the areas within the Antelope Valley where groundwater is currently being extracted. Thus, the Area of Adjudication must include, at least, all of the areas in the Valley where wells are currently located, as shown on Figure 4, unless the wells are outside the watershed boundary or within a previously-adjudicated area such as the Mojave Basin Area.

In addition to the areas where groundwater is currently being extracted, there are areas where groundwater is not currently being extracted but where the land is underlain by unconsolidated alluvial deposits or fractured bedrock deposits that are currently saturated, or may become saturated in the future due to groundwater recharge (see Figure 4). These areas of potential groundwater extraction must also be included within the Area of Adjudication because future wells could be installed in these alluvial areas and used in the future to extract groundwater from the Antelope Valley.

Similarly, those areas where groundwater is not currently being extracted but where the land is underlain by permeable, fractured bedrock that is currently saturated, or may become saturated in the future due to groundwater recharge (see Figure 4), must also be included within the Area of Adjudication because wells could be used in the future to extract groundwater in these fractured bedrock areas, also.

Surface water along the mountain fronts is the primary source of natural recharge to the Antelope Valley. If the surface water is captured or diverted for consumptive use before it has an opportunity to contribute recharge to the groundwater aquifers, there could be a significant reduction in the amount of natural recharge available to the Valley. The areas within the watershed boundary along the mountain fronts (see Figure 3) must also be included within the Area of Adjudication to allow the adjudication to properly address these sources of water that could become groundwater recharge.

## 9.0 RECOMMENDED AREA OF ADJUDICATION

The California Department of Water Resources (DWR) has defined the lateral extent of the alluvium within the Antelope Valley, as shown on Figures 2, 3, and 4. Although not all of the alluvium is currently saturated with groundwater, there is the possibility that greater portions of the alluvium will become saturated in the future through recharge of imported water and natural recharge from precipitation and inflow of surface water streams from the mountain fronts. Because of this, it is possible that groundwater development may occur in any area that is currently underlain by alluvial deposits. Consequently, all of the alluvial deposits need to be included within the Area of Adjudication.

In addition to the alluvial deposits, there are considerable areas were fractured bedrock occurs, and portions of the fractured bedrock are saturated and act as sources of groundwater for development by wells (see Figure 3). For example, there are wells in Leona Valley located outside of the alluvial deposits that currently produce groundwater directly from the fractured bedrock. Wells drilled through the alluvium and into the fractured bedrock aquifer system, below, can produce a considerable amount of groundwater directly from the fractured bedrock aquifer system. Because the fractured bedrock occurs most prominently near the fault zones along the northwestern and southwestern boundaries of the Antelope Valley, the Area of Adjudication must be sufficiently broad to incorporate the fractured bedrock aquifer system in these areas.

The mountain fronts along the San Gabriel Mountains and the Tehachapi Mountains, which form the southwestern and northwestern boundaries of the Antelope Valley, respectively, are the areas where the greatest amount of inflow of water into the Antelope Valley watershed area occurs. Precipitation in the mountain ranges provides the greatest source of water for groundwater recharge. Some of this water is in the form of surface water, in streams, ponds, lakes, and reservoirs. All of the surface water and groundwater in these areas must be properly accounted for in resolving the Antelope Valley water-rights matters. Therefore, The Area of Adjudication must be sufficiently broad to include all of the surface water and groundwater resources along the mountain fronts that are within the watershed boundary.

Leona Valley and Little Rock Creek Valley, located along the southwestern boundary of the Antelope Valley, warrant special consideration. Each of these valleys is discussed separately in the following paragraphs.

Leona Valley follows the alignment of the San Andreas Fault Zone, along Amargosa Creek. Leona Valley is filled with alluvium (see Figure 4) and is underlain by intensively-fractured bedrock. Amargosa Creek is a surface water stream that flows from Leona Valley into the Antelope Valley and contributes surface water to the main portion of the Valley. The alluvium in Leona Valley is contiguous with and hydraulically connected to the alluvium in the main portion of the Antelope Valley. Similarly, the fractured bedrock aquifer system in the Leona Valley is hydraulically connected to the alluvium in the main Antelope Valley. Therefore, groundwater in Leona Valley can flow into the main alluvial aquifer system in the main portion of the Antelope Valley. Leona Valley is situated along the foothills of the San Gabriel Mountains, and collects much of the precipitation that occurs along this stretch of the mountain front. This precipitation contributes to the stream flows in this area, contributes water to the ponds and lakes, and is the source of the groundwater stored in the alluvial aquifer system and the fractured bedrock aquifer system in the Leona Valley.

There are three main lakes in Leona Valley: Lake Hughes, Munz Lakes, and Lake Elizabeth. These three lakes are situated within the alluvial deposits in Leona Valley and represent "windows" through the alluvium in which one can see the water table, the lake, in that alluvial aquifer. In other words, these lakes are surface depressions within the alluvium that go deep enough to intersect the groundwater table in the Leona Valley alluvial aquifer. In addition to these lakes, there are several ponds in Leona Valley which also generally represent windows into the water table. Wells in Leona Valley produce water from both the alluvial aquifer system and the fractured bedrock system in this area. If the waters of Leona Valley were not accounted for in the Area of Adjudication and were to be diverted for local consumptive use without restriction, there would be a significant reduction in the amount of water available for the remainder of the water users in the Antelope Valley. Consequently, Leona Valley must be included within the Area of Adjudication.

Little Rock Creek Valley is in the foothills of the San Gabriel Mountains south of the San Andreas Fault Zone, and is traversed by Little Rock Creek. This Creek collects precipitation falling in the San Gabriel Mountains and carries it principally as stream flow in a generally north-northwest direction into the Antelope Valley. A major surface water reservoir, Little Rock Reservoir, has been constructed within this Valley, and there are several other smaller pond structures which capture surface water flowing down Little Rock Creek. Surface water from this creek contributes recharge to the alluvial aquifer system of the Antelope Valley and also contributes recharge to the fractured bedrock aquifer system where Little Rock Creek crosses the San Andreas Fault Zone. If the water in Little Rock Creek Valley were not accounted for in the Area of Adjudication and were to be diverted for local consumptive use without restriction, there would be a significant reduction in the amount of water available for the remainder of the water users in the Antelope Valley. Consequently, Little Rock Creek Valley must be included within the Area of Adjudication.

Figure 6 shows a map with the boundary of the recommended (proposed) Antelope Valley Area of Adjudication. Each segment of the recommended boundary is discussed separately in the paragraphs below.

Based on the above discussion, the appropriate boundary for the Area of Adjudication along the southwestern side of the Antelope Valley is the watershed boundary. The watershed boundary includes the areas of Leona Valley and Little Rock Creek Valley (see Figure 6). In addition, the watershed boundary includes all of the areas where capture of surface water occurs along the foothills of the San Gabriel Mountains, water that normally flows into the Antelope Valley or contributes to the alluvial and fractured bedrock aquifer systems in that Valley.

The area within (north and northeast of) the watershed boundary line along this southwestern boundary of the Valley also effectively includes all of the alluvial aquifers that are contiguous with and hydraulically connected to the main Antelope Valley alluvial aquifer system, and includes all of the fractured bedrock areas that are likely to be developed as sources of groundwater along the San Andreas Fault Zone. Consequently, it is recommended that the watershed boundary or crest line of the San Gabriel Mountains along the southwestern boundary of the Antelope Valley be selected as the boundary of the Area of Adjudication in this vicinity (see Figure 6).

As discussed above, the foothills along the Tehachapi Mountains, which form the northwestern boundary of the Antelope Valley, experience significant precipitation and runoff of surface water that contributes to the groundwater resources of the Antelope Valley. There are numerous streams that flow generally southeastward down the mountain slope into the Antelope Valley. All of these mountain streams carry the precipitation from the Tehachapi Mountains down to the alluvial deposits in the lower portion of the Antelope Valley.

Of particular importance is Oak Creek Valley, which is located just south of the Tehachapi Pass. The main highway from the Antelope Valley to Bakersfield runs through Tehachapi Pass (see Figure 6). Oak Creek Valley parallels the alignment of the northeast-southwest-trending foothills of the Tehachapi Mountains and the Garlock Fault Zone. Oak Creek, which is located in this valley, captures a significant amount of surface runoff from the mountain front and carries this water in a northeasterly direction into the main Antelope Valley watershed. The creek then turns and continues flowing in a southerly direction towards the community of Willow Springs, and discharges its water onto the ground recharging the alluvial aquifer system in the Willow Springs vicinity.

If the water captured within the foothills along the Tehachapi Mountains, and particularly the water captured by Oak Creek, were not accounted for in the Area of Adjudication and were to be diverted for local or other consumptive use without restriction, there would be a significant reduction in the amount of water available for the remainder of the water users in the Antelope Valley. Consequently, the drainages along the foothills of the Tehachapi Mountains, and in particular the drainage area of Oak Creek, must be included within the Area of Adjudication.

Based on the above, the appropriate boundary for the Area of Adjudication along the northwestern side of the Antelope Valley is the watershed boundary (see Figure 6). The watershed boundary includes the areas of the streams in the foothills of the Tehachapi Mountains, and in particular includes the drainage area for Oak Creek. The watershed boundary includes all of the areas of surface water capture along the foothills of the Tehachapi Mountains, water that normally flows into the Antelope Valley or contributes recharge to the alluvial aquifer system and the fractured bedrock aquifer system in that Valley. The area within (east and southeast of) the watershed boundary also effectively includes all of the alluvial aquifer system in this portion of the main Antelope Valley and all of the fractured bedrock areas that may be developed in the future as sources of groundwater along the foothills. Consequently, it is recommended that the watershed boundary in the Tehachapi Mountains along the northwestern boundary of the Antelope Valley be selected as the boundary of the Area of Adjudication in this vicinity (see Figure 6).

The Willow Springs area of the Antelope Valley warrants special consideration in this matter (see Figure 6). In defining the aerial extent of the Antelope Valley Alluvium in the Willow Springs area, DWR has drawn a somewhat-arbitrary, straight-line, northwest-southeast-trending boundary line separating the Willow Springs area to the south from the Fremont Valley Alluvium to the north (hereinafter referred to as the "DWR Willow Springs boundary"). Saturated alluvial deposits extend from the Willow Springs area northward across this line into the Fremont Valley, and under certain circumstances groundwater may flow northward out of the Willow Springs area into the Fremont Valley aquifer systems.

There is a considerable amount of groundwater development in the Willow Springs area, primarily for agricultural use. The water table in this area is considerably higher in elevation than the water table farther south in the Antelope Valley. This produces a strong hydraulic gradient[27] in the southerly direction from the Willow Springs area into the main portion of the Antelope Valley.

Surface water drainage from the face of the Tehachapi Mountains – surface water captured by Oak Creek -- flows southerly across the DWR Willow Springs boundary, the northern boundary of the Willow Springs area, and recharges the groundwater in the Willow Springs area. If the water that is captured by Oak Creek within the foothills along the Tehachapi Mountains, water which flows through the area just north of the DWR Willow Springs boundary, were not accounted for in the Area of Adjudication and were to be diverted for local or other consumptive use without restriction before entering the Willow Springs area, there would be a significant reduction in the amount of water available for the remainder of the water users in the Willow Springs area and in the Antelope Valley. Consequently, the drainage of Oak Creek, north of the Willow Springs area, must be included within the Area of Adjudication (see Figure 6).

To meet the objective of including the drainage from Oak Creek within the Area of Adjudication, a reasonable, appropriate, and convenient boundary line segment has been selected to incorporate this drainage area into the Area of Adjudication (see Figure 6). The boundary line segment best suited for this purpose is a north-south line, beginning at the southeastern end of the DWR Willow Springs boundary line segment along the north side of the Willow Springs area, and extending due north to the point of intersection of that north-south

[27] **Hydraulic Gradient.** The change in total hydraulic head or pressure (i.e., the difference in the water table elevation or the elevation of water in wells) with change in distance, generally measured in the direction that yields the maximum rate of decrease in head (Fetter, 1994).

line with the watershed boundary of the Antelope Valley. This segment of the boundary line for the Area of Adjudication appropriately incorporates the drainage of Oak Creek and the aerial extent of the Antelope Valley Alluvium, but does not include any of the drainage areas that carry surface water to the Fremont Valley to the north. Consequently, it is recommended that the north-south line described above be selected as the boundary of the Area of Adjudication in the Willow Springs area (see Figure 6).

For the most part, the jagged line representing the northern extent of the Antelope Valley Alluvium, extending from the Willow Springs area east to the county line, is based on the contact between the alluvium and bedrock in the hills that protrude above the level of the alluvium in this area. In a few instances, this boundary line represents the watershed boundary of the Antelope Valley, which separates the drainage area of the Antelope Valley from the drainage area of the Fremont Valley (see Figure 2). Unlike the foothill areas of the mountains along the Tehachapi and San Gabriel Mountain ranges, the area along the northern boundary of the Antelope Valley Alluvium receives little precipitation, and provides little recharge to the groundwater system. There is no significant surface water in this area that would warrant extending the Area of Adjudication to any significant distance beyond the line representing the boundary of the Antelope Valley Alluvium in this area. Consequently, it is recommended that the northern boundary line of the Antelope Valley of Alluvium, as delineated by DWR, be selected as the boundary of the Area of Adjudication along this northern portion of the Antelope Valley (see Figure 6).

The Mojave Basin Area is a large portion of land in San Bernardino County, east of the Antelope Valley, where water rights have been previously adjudicated. The boundary of the Mojave Basin Area, has been specifically defined in the Judgment. The western boundary of the Mojave Basin Area is a line that coincides with the county line, in part, the watershed boundary line, in part, and the boundary line of the Mojave Water Agency, in part (see Figure 1). Because water rights in the Mojave Basin Area have been previously adjudicated, it is not appropriate for the Antelope Valley Area of Adjudication to cross this boundary and overlap the Mojave Basin Area.

Portions of the Antelope Valley Alluvium boundary, as delineated by DWR, extend eastward into the adjudicated Mojave Basin Area. Because the water rights associated with lands enclosed within these extensions of the Antelope Valley Alluvium are already adjudicated, it is appropriate to truncate these extensions at the Mojave Basin Area boundary line (see Figure 6).

In other areas along the eastern side of the Antelope Valley, the boundary of the Antelope Valley Alluvium does not extend as far east as the Mojave Basin Area boundary line. These areas are underlain by bedrock at the surface, not alluvium, but it is possible that groundwater could be developed from fractured bedrock wells in these areas in the future, For this reason, it is appropriate to include these areas in the Area of Adjudication. Consequently, it is recommended that the eastern boundary of the Antelope Valley Area of Adjudication be selected as the western boundary of the Mojave Basin Area adjudication (see Figure 6).

Combining the segments of the Antelope Valley Area of Adjudication, as described above, the complete boundary line of the recommended and proposed Antelope Valley Area of Adjudication has been delineated, as shown on Figure 6. This selected area meets the stated objective for the Antelope Valley Area of Adjudication: an area that includes all of the parcels of land that currently use the water resources of the Antelope Valley or could utilize those water resources in the future, and is sufficiently large to include the full surface expression or area of the Antelope Valley Groundwater Basin that is to be defined later, but which does not overlap areas where water rights have been previously adjudicated.

## 10.0 DEFINITION OF JURISDICTIONAL BOUNDARY

To define the Jurisdictional Boundary of the Antelope Valley Area of Adjudication, it is important to use commonly-applied land-surveying techniques. For this purpose, we have superimposed the Township-Range-Section (TRS) survey information over the Antelope Valley Area of Adjudication. Because the section lines do not exactly follow the boundary of the Area of Adjudication, we have selected the Jurisdictional Boundary as a sequence of straight lines following the TRS section lines immediately outside of the Area of Adjudication boundary as a convenient and precise means for defining the Jurisdictional Boundary. Figure 7 shows the Area of Adjudication, the TRS system, and the proposed Jurisdictional Boundary line based on the TRS system that encloses the Area of Adjudication with a specifically-defined line that can be surveyed using commonly-applied land-surveying techniques. We recommend that this line be selected as the Jurisdictional Boundary for the Antelope Valley Area of Adjudication.

## 11.0 CLOSURE

Geomatrix is pleased to have been given the opportunity to prepare this report and to provide our recommendations concerning the Antelope Valley Area of Adjudication and the

Jurisdictional Boundary for the Antelope Valley Groundwater Cases. We trust that the information contained herein is adequate for your use. If there are any questions, or if we can be of additional service, please call.

Respectfully submitted,
**GEOMATRIX CONSULTANTS, INC**.

N. Thomas Sheahan, PG, CEG, CHG, PGP, CPG
Vice President and Principal Hydrogeologist

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## ATTACHMENT A,

## REFERENCES

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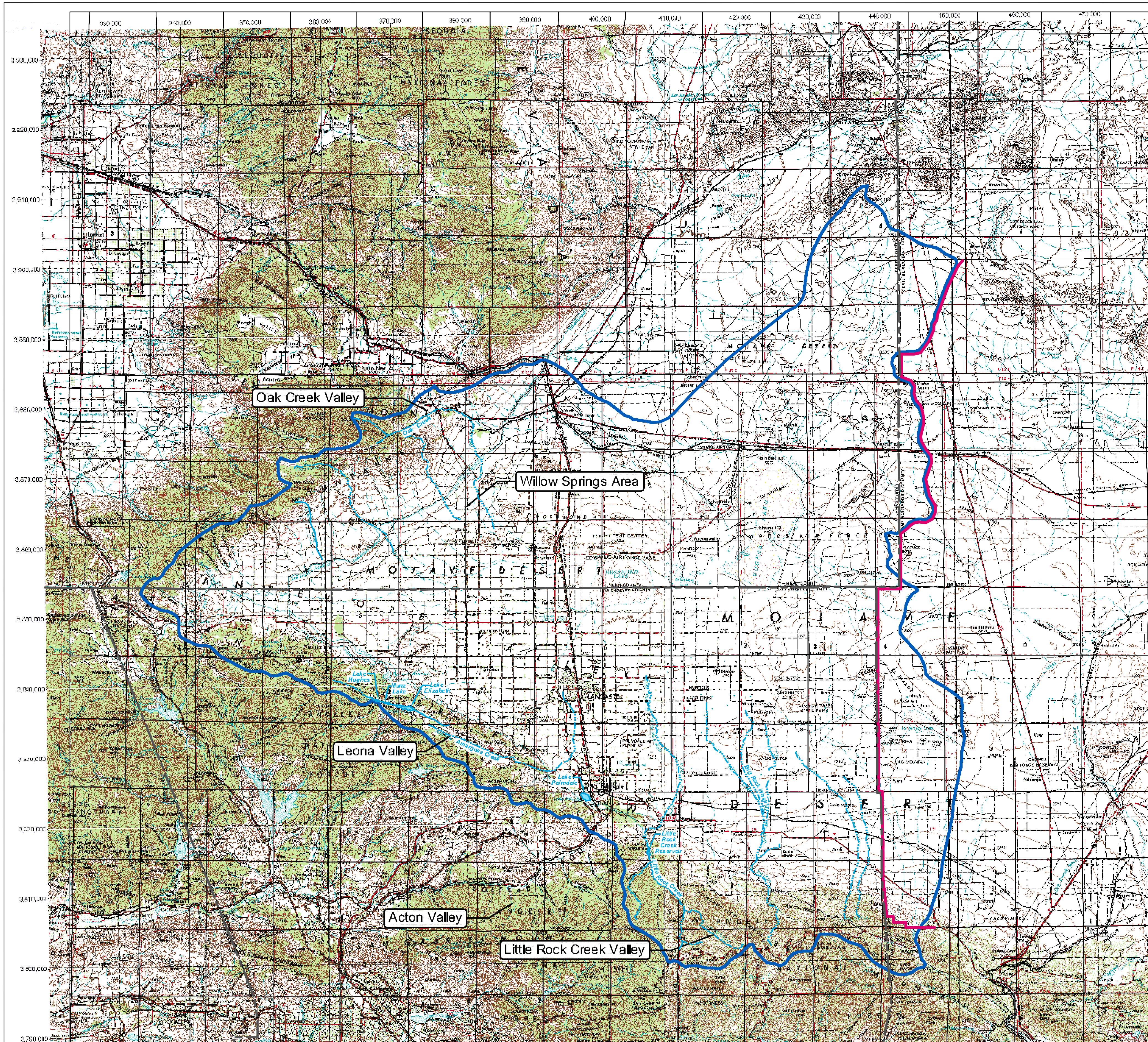
**ATTACHMENT B**

**FIGURES**


| | |
|---|---|
| Figure 1 | Antelope Valley Topography and Watershed Boundary |
| Figure 2 | Areal Extent of Antelope Valley Alluvium, Fremont Valley Alluvium, and El Mirage Valley Alluvium |
| Figure 3 | Antelope Valley Faults and Fault Zones |
| Figure 4 | Wells in Antelope Valley |
| Figure 5 | Antelope Valley – East Kern Water Agency Boundary and Facilities |
| Figure 6 | Antelope Valley Area of Adjudication |
| Figure 7 | Jurisdictional Boundary of Antelope Valley Area of Adjudication |




Explanation

Watershed boundary

Mojave Basin Area boundary

County line

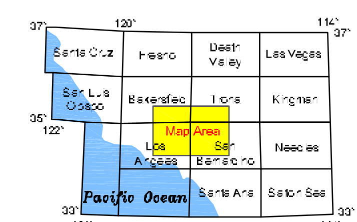
Creek or stream

Lake or reservoir

Township and range

Note:

1. Map coordinates are 10,000-foot California State Plane Coordinate System, Zone 5.




0 3 6

Approximate scale in miles

Basemap modified from U.S.G.S. Western United States 1:250,000 scale Bakersfield, Trona, San Bernardino, and Los Angeles quadrangles (revisions dated 1971, 1969, 1969, and 1975, respectively).

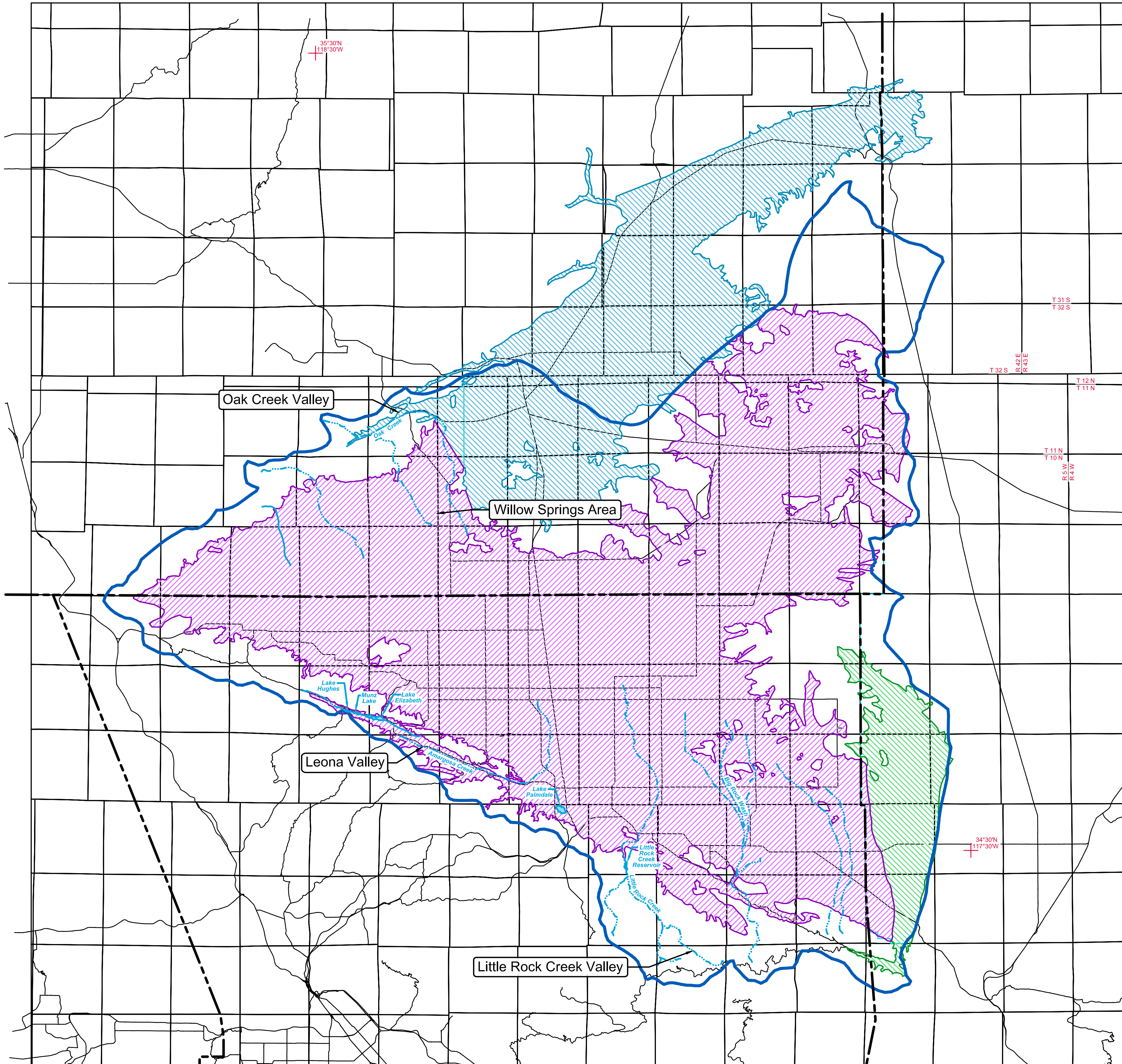
ANTELOPE VALLEY TOPOGRAPHY AND WATERSHED BOUNDARY

Antelope Valley Adjudication
Antelope Valley, California

| By: jrw | Date: 6/22/06 | Project No. 8029.001 |
|---|---|---|

Geomatrix

Figure 1

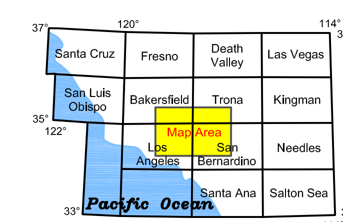



## Explanation

- Watershed boundary
- Antelope Valley Alluvium
- Fremont Valley Alluvium
- El Mirage Valley Alluvium
- County line
- State and U.S. highways
- Creek or stream
- Lake or reservoir
- Township and range

Note:

1. The alluvial valley files were obtained from the Department of Water Resources at [www.groundwater.water.ca.gov/bulletin 118/basin_maps/index.cfm] in a UTM 10, NAD27 projection. The shape files have been reprojected into California State Plane Coordinate System, Zone 5, NAD83 projection. The Antelope Valley Alluvium boundary was isolated into a separate shape file.




0 3 6
Approximate scale in miles

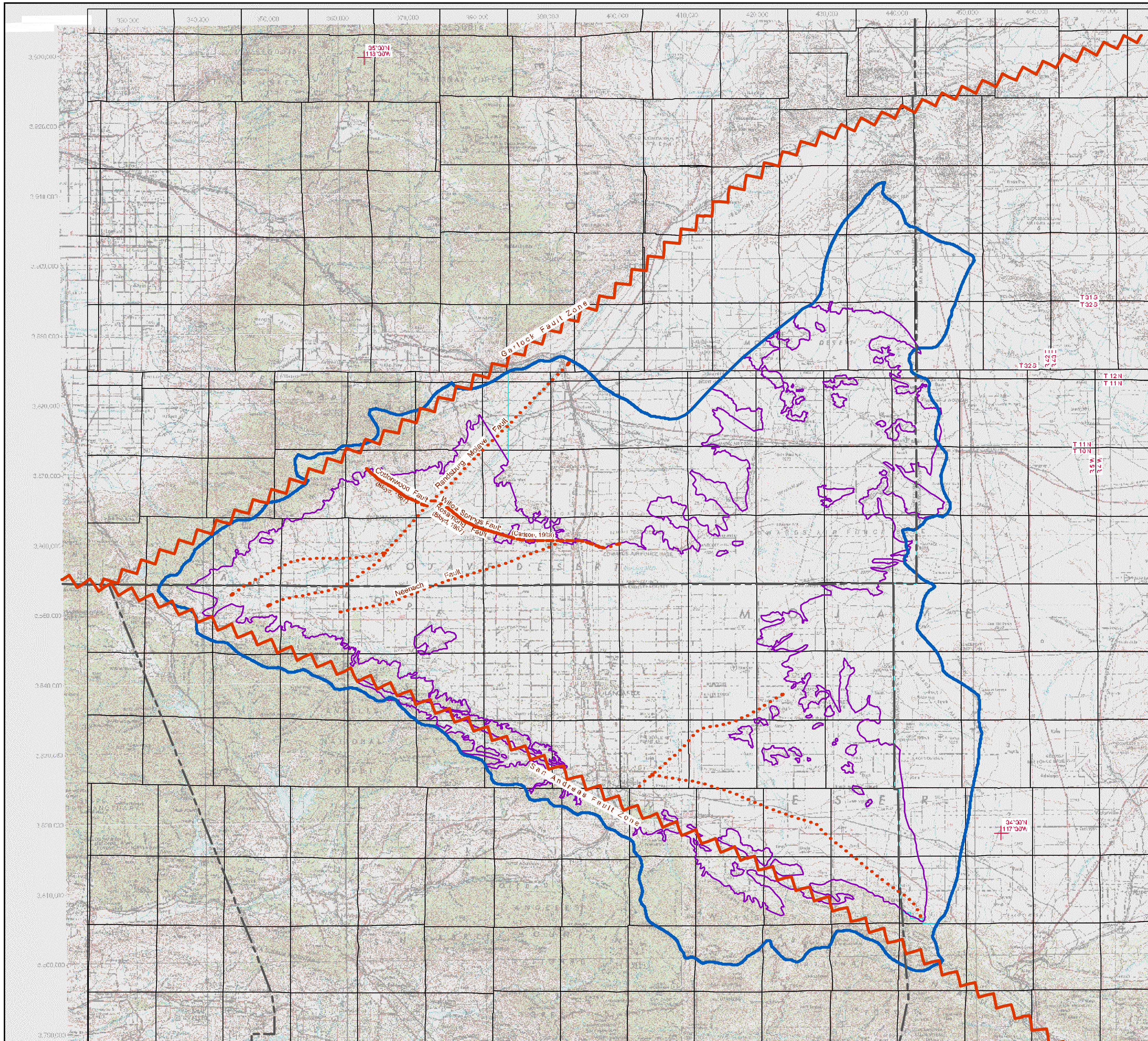
Basemap modified from U.S.G.S. Western United States 1:250,000 scale Bakersfield, Trona, San Bernardino, and Los Angeles quadrangles (revisions dated 1971, 1969, 1969, and 1975, respectively).

# AREAL EXTENTS OF ANTELOPE VALLEY ALLUVIUM, FREMONT VALLEY ALLUVIUM, AND EL MIRAGE VALLEY ALLUVIUM

Antelope Valley Adjudication
Antelope Valley, California

By: jrw | Date: 6/22/06 | Project No. 8029.001

Geomatrix | Figure 2




**Explanation**

Fault, dashed where approximately located, dotted where postulated

Fault zone

Watershed boundary

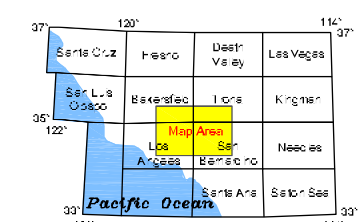
Antelope Valley alluvium boundary

County line

Township and range

Notes:

1. The alluvial valley files were obtained from the Department of Water Resources at [www.groundwater.water.ca.gov/bulletin 118/basin_maps/index.cfm] in a UTM 10, NAD27 projection. The shape files have been reprojected into California State Plane Coordinate System, Zone 5, NAD83 projection. The Antelope Valley Alluvium boundary was isolated into a separate shape file.
2. Map coordinates are 10,000-foot California State Plane Coordinate System, Zone 5.

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0 3 6

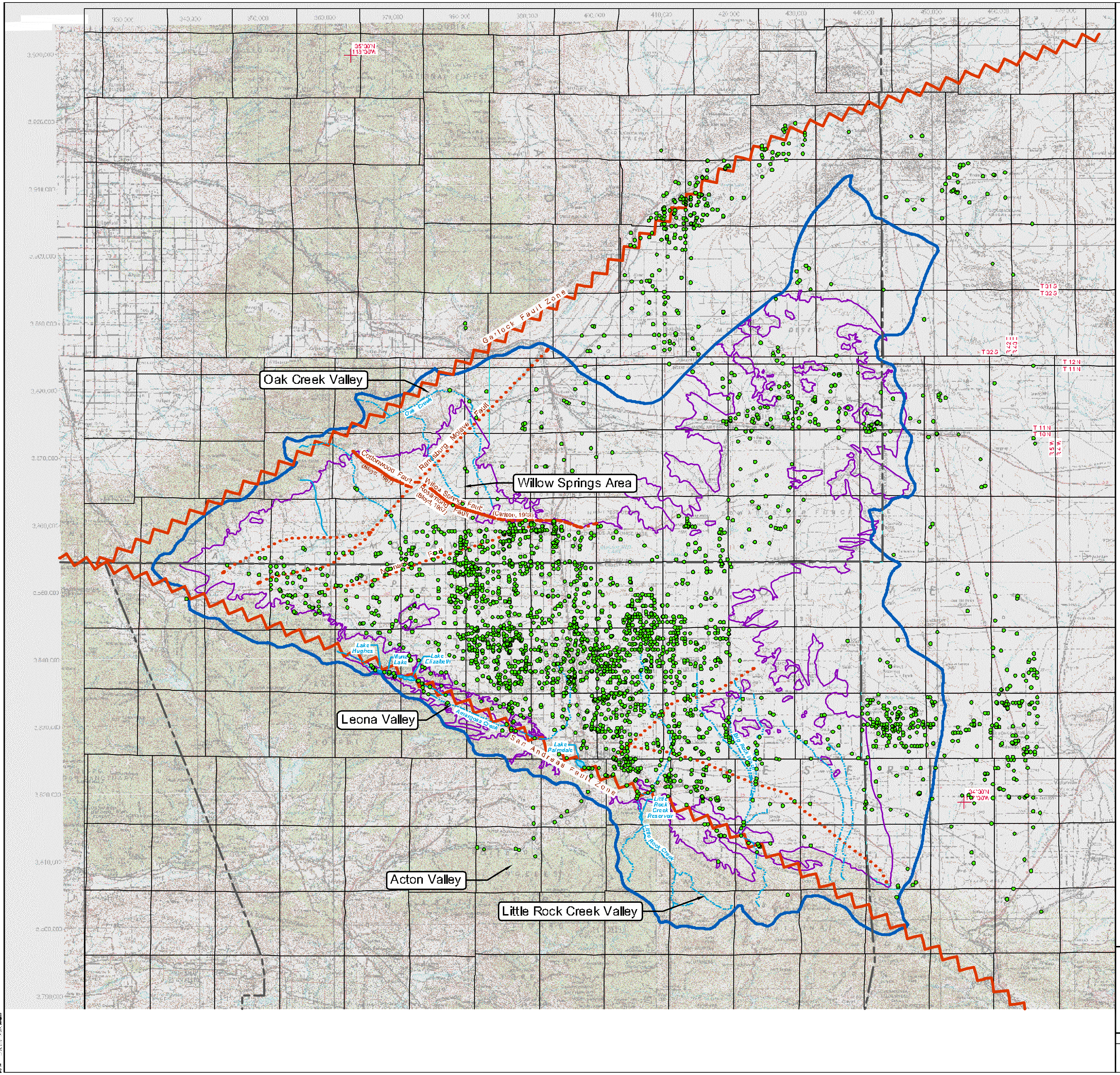
Approximate scale in miles

Basemap modified from U.S.G.S. Western United States 1:250,000 scale Bakersfield, Trona, San Bernardino, and Los Angeles quadrangles (revisions dated 1971, 1969, 1969, and 1975, respectively).

# ANTELOPE VALLEY FAULTS AND FAULT ZONES

Antelope Valley Adjudication
Antelope Valley, California

| By: jrw | Date: 6/22/06 | Project No. 8029.001 |
|---|---|---|
| Geomatrix | | Figure 3 |

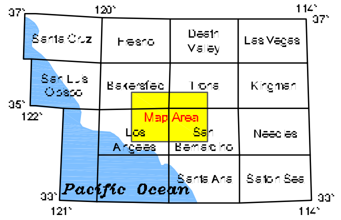



## Explanation

- Water well
- Watershed boundary
- Antelope Valley Alluvium boundary
- Fault, dashed where approximately located, dotted where postulated
- Fault zone
- County line
- Creek or stream
- Lake or reservoir
- Township and range

Notes:

1. The alluvial valley files were obtained from the Department of Water Resources at [www.groundwater.water.ca.gov/bulletin 118/basin_maps/index.cfm] in a UTM 10, NAD27 projection. The shape files have been reprojected into California State Plane Coordinate System, Zone 5, NAD83 projection. The Antelope Valley Alluvium boundary was isolated into a separate shape file.
2. Map coordinates are 10,000-foot California State Plane Coordinate System, Zone 5.



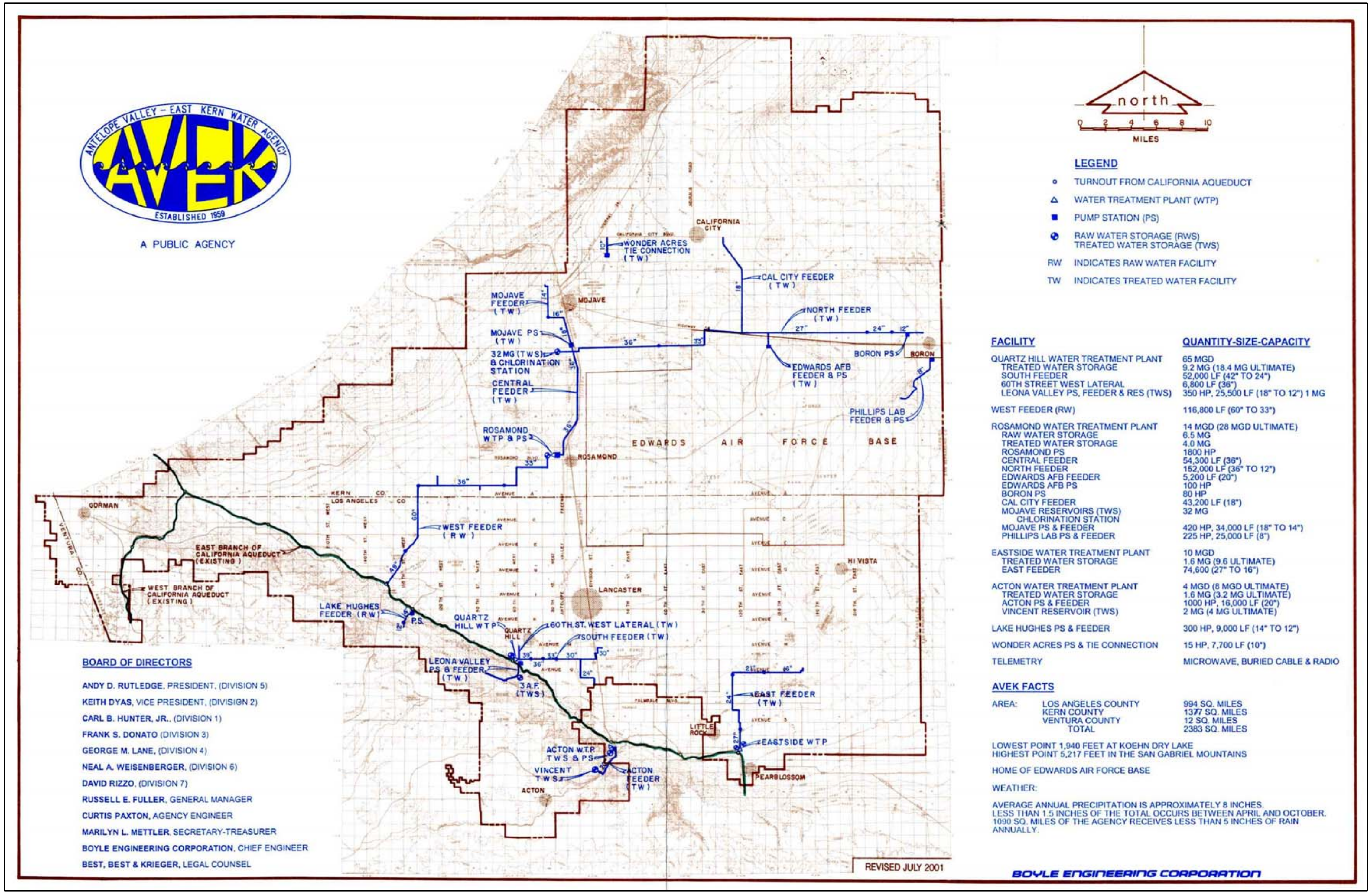

0 3 5
Approximate scale in miles

Basemap modified from U.S.G.S. Western United States 1:250,000 scale Bakersfield, Trona, San Bernardino, and Los Angeles quadrangles (revisions dated 1971, 1969, 1969, and 1975, respectively).

# WELLS IN ANTELOPE VALLEY AND VICINITY

Antelope Valley Adjudication
Antelope Valley, California

| By: jrw | Date: 6/22/06 | Project No. 8029.001 |
|---|---|---|
| Geomatrix | | Figure 4 |



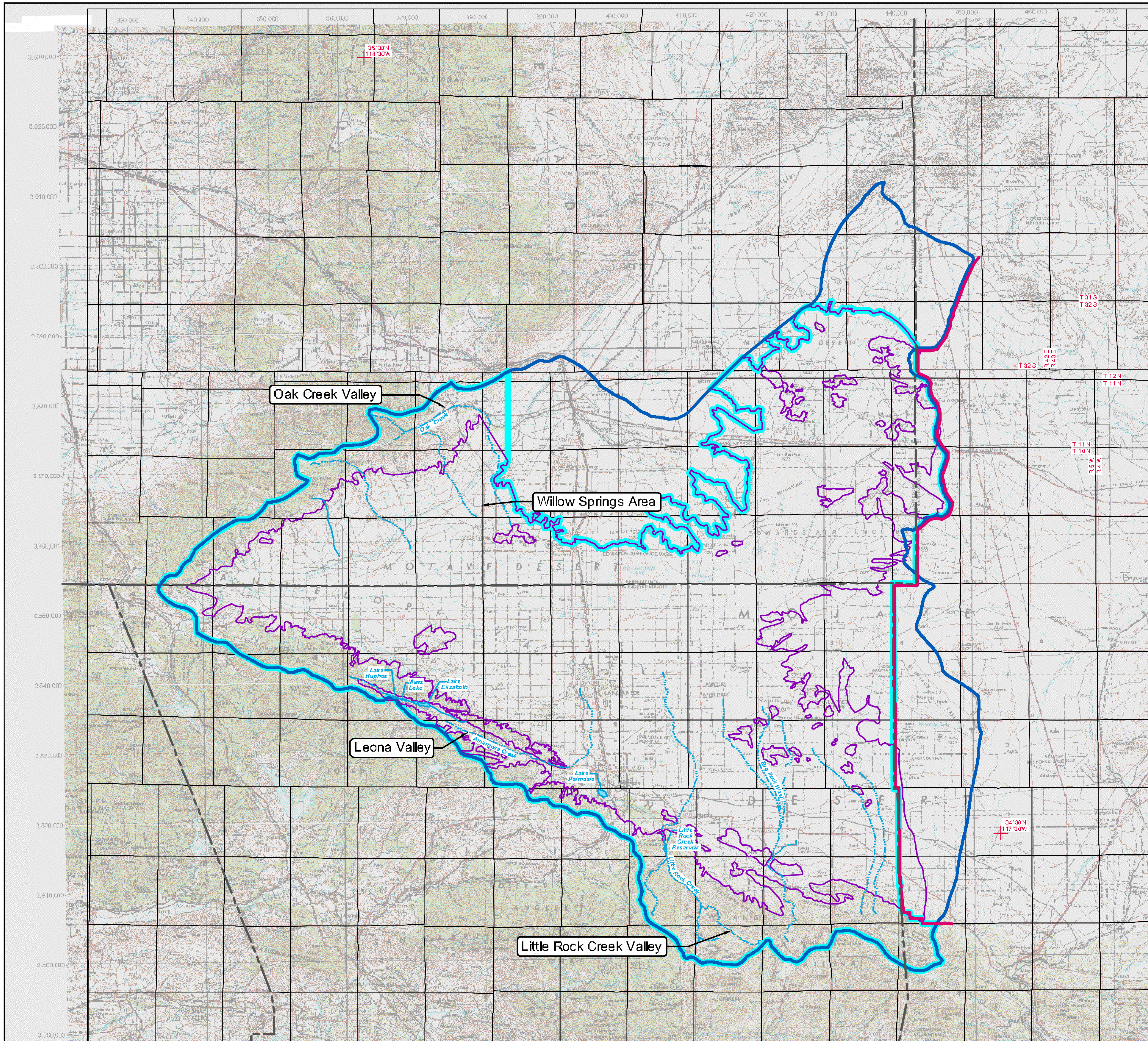

0 3 6
Approximate scale in miles

Basemap modified from a figure by Boyle Engineering Corporation, revised July 2001.

ANTELOPE VALLEY-EAST KERN WATER AGENCY BOUNDARY AND FACILITIES

Antelope Valley Adjudication
Antelope Valley, California

| By: jrw | Date: 6/21/06 | Project No. 8029.001 |
|---|---|---|
| Geomatrix | Figure 5 | |

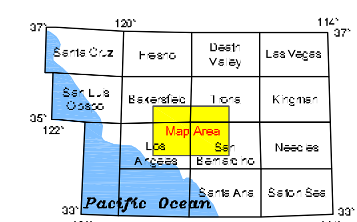



### Explanation

- Area of Adjudication boundary
- Watershed boundary
- Antelope Valley Alluvium boundary
- Mojave Basin Area boundary
- County line
- Creek or stream
- Lake or reservoir
- Township and range

Notes:

1. The alluvial valley files were obtained from the Department of Water Resources at [www.groundwater.water.ca.gov/bulletin 118/basin_maps/index.cfm] in a UTM 10, NAD27 projection. The shape files have been reprojected into California State Plane Coordinate System, Zone 5, NAD83 projection. The Antelope Valley Alluvium boundary was isolated into a separate shape file.
2. Map coordinates are 10,000-foot California State Plane Coordinate System, Zone 5.



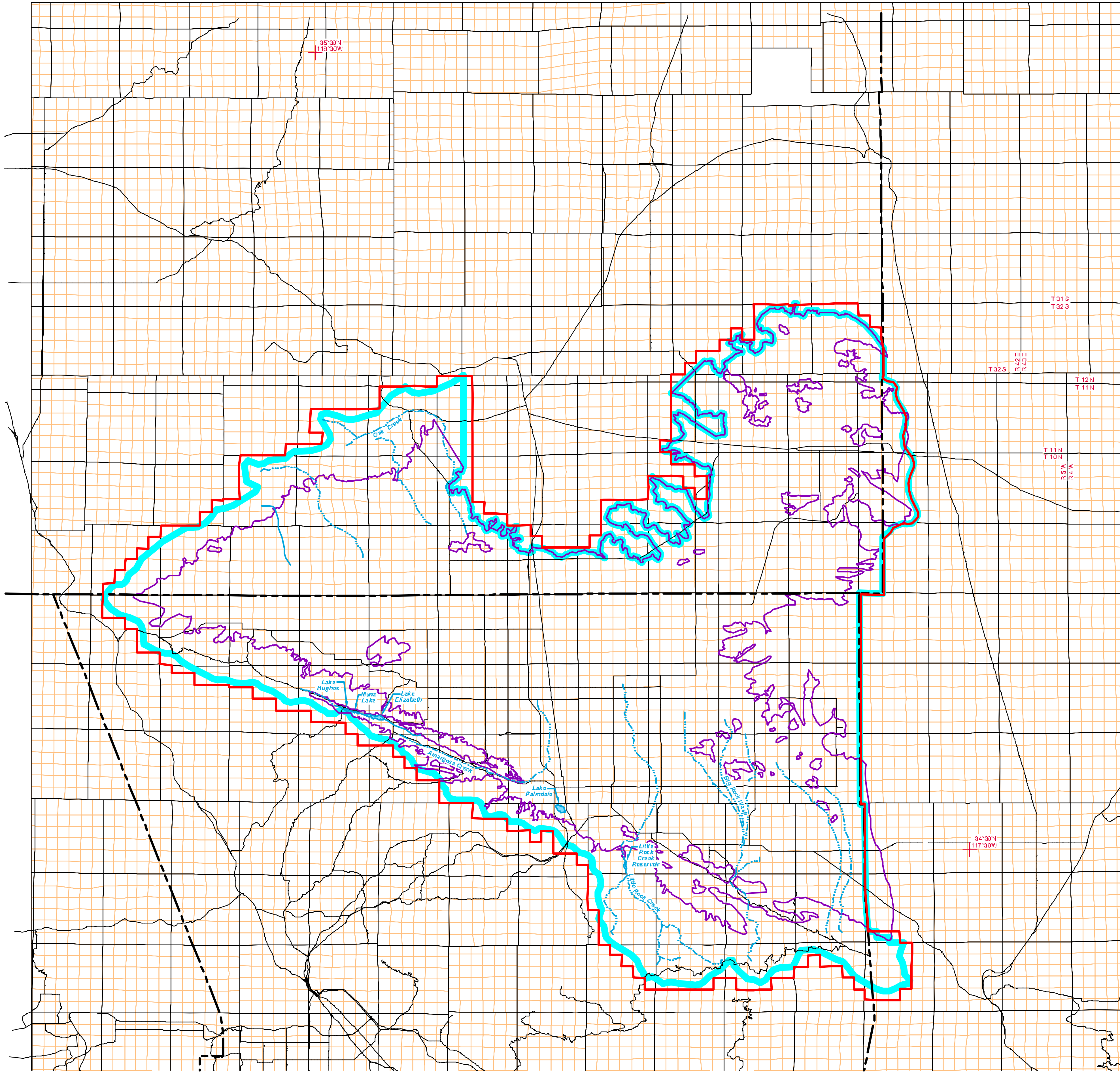

0 3 6
Approximate scale in miles

Basemap modified from U.S.G.S. Western United States 1:250,000 scale Bakersfield, Trona, San Bernardino, and Los Angeles quadrangles (revisions dated 1971, 1969, 1969, and 1975, respectively).

## ANTELOPE VALLEY AREA OF ADJUDICATION

Antelope Valley Adjudication
Antelope Valley, California

| | | |
|---|---|---|
| By: jrw | Date: 6/22/06 | Project No. 8029.001 |
| Geomatrix | | Figure 6 |

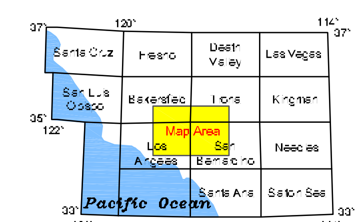



Explanation

- Jurisdictional Boundary of Area of Adjudication boundary
- Area of Adjudication boundary
- Antelope Valley Alluvium boundary
- County line
- State and U.S. highways
- Creek or stream
- Lake or reservoir
- Township and range
- Section

Note:

1. The alluvial valley files were obtained from the Department of Water Resources at [www.groundwater.water.ca.gov/bulletin118/basin_maps/index.cfm] in a UTM 10, NAD27 projection. The shape files have been reprojected into California State Plane Coordinate System, Zone 5, NAD83 projection. The Antelope Valley Alluvium boundary was isolated into a separate shape file.




0 3 6
Approximate scale in miles

Basemap modified from U.S.G.S. Western United States 1:250,000 scale Bakersfield, Trona, San Bernardino, and Los Angeles quadrangles (revisions dated 1971, 1959, 1969, and 1975, respectively).

# JURISDICTIONAL BOUNDARY OF ANTELOPE VALLEY AREA OF ADJUDICATION

Antelope Valley Adjudication
Antelope Valley, California

| By: jrw | Date: 6/22/06 | Project No. 8029.001 |
|---|---|---|
| Geomatrix | | Figure 7 |