Boundary Considerations

Antelope Valley Groundwater Adjudication

Joseph C. Scalmanini

Luhdorff & Scalmanini,
Consulting Engineers

Groundwater Basin Analyses
California Client Base

Fundamental Premises

- Antelope Valley Adjudication is an adjudication of rights to groundwater
- Antelope Valley Adjudication is not an adjudication of rights to all waters that originate in, or otherwise enter, the Antelope Valley
- Focus of adjudication is thus on most of the Antelope Valley Groundwater Basin where, for practical purposes, all the significant and substantial groundwater pumping can occur

Groundwater Basin

- "a hydrologic unit containing one large aquifer or several connected and interconnected aquifers" (Todd, 1980)
- "an area underlain by one or more permeable formations capable of furnishing a substantial water supply" (Richter, 1974, in Schneider, 1977)
- "an alluvial aquifer or a stacked series of alluvial aquifers with reasonably well-defined boundaries in a lateral direction and a definable bottom" (DWR, 2003)

Lateral Groundwater Basin Boundary Criteria
(after Richter)

Physical	Hydraulic	Political
bedrock contact [n] zone of low permeability [n] fault [n, r] syncline rim [n] buried bedrock ridge [r] constriction in permeable materials [r] deep underflow constrictions [r] aquifer contacts [r] crest of anticline [r] alluvial embayment [f] topographic ridge or divide [f]	groundwater divide [f] limit of pressure area [f] shoreline of ocean or lake [f] center of river or stream [f] unlined canal or reservoir [f]	state [f] county [f] city [f] irrigation district [f] federal installation [f] park district [f]

n – no appreciable movement of groundwater
r – restricted movement of groundwater
f – free, unimpeded movement of groundwater

after Richter, 1974, cited in Schneider, **Groundwater Rights in California, Background and Issues**, 1977

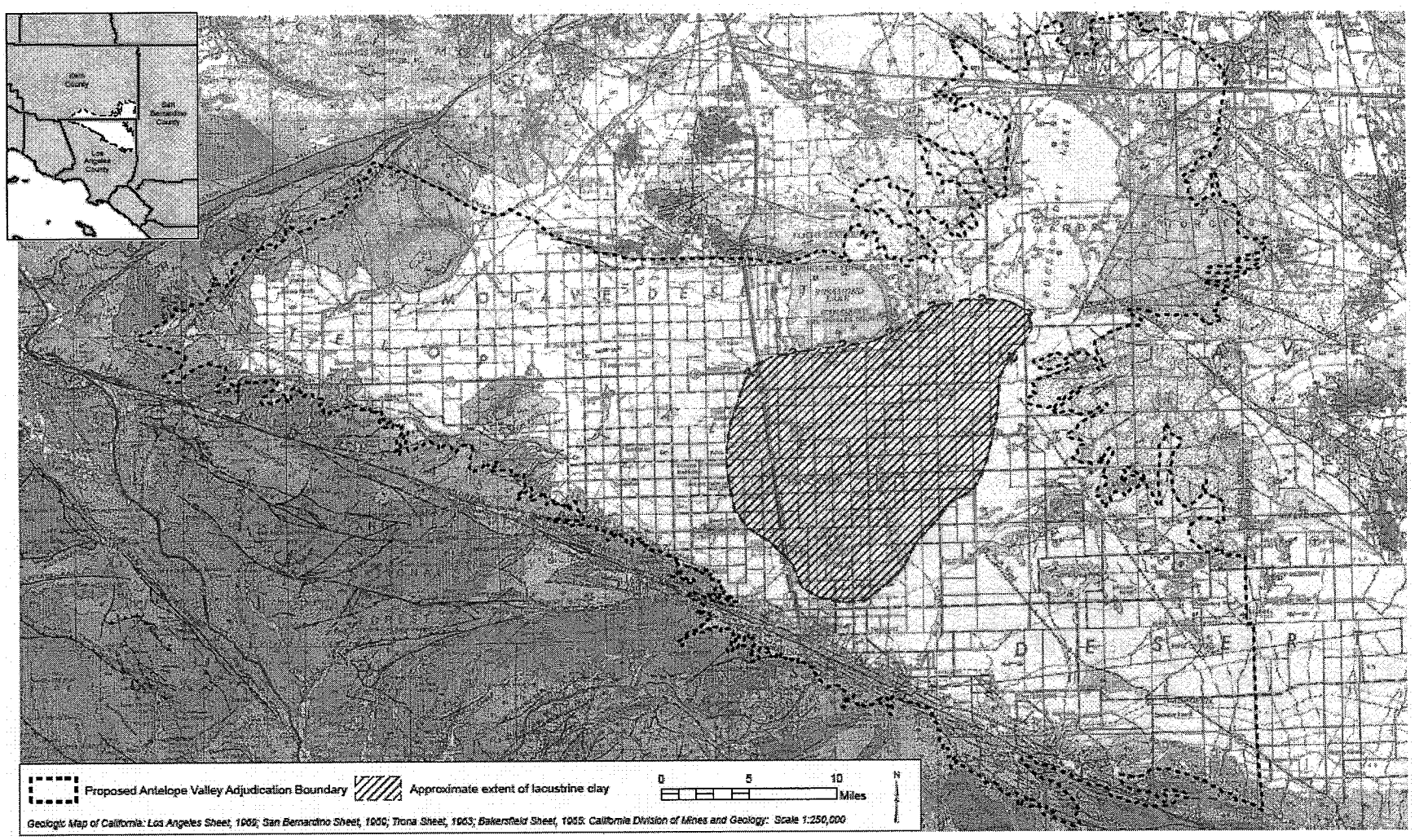
Lateral Groundwater Basin Boundary Criteria (DWR)

"Lateral boundaries are features that significantly impede groundwater flow, such as rock or sediments with very low permeability or a geologic structure such as a fault" (DWR, 2003)

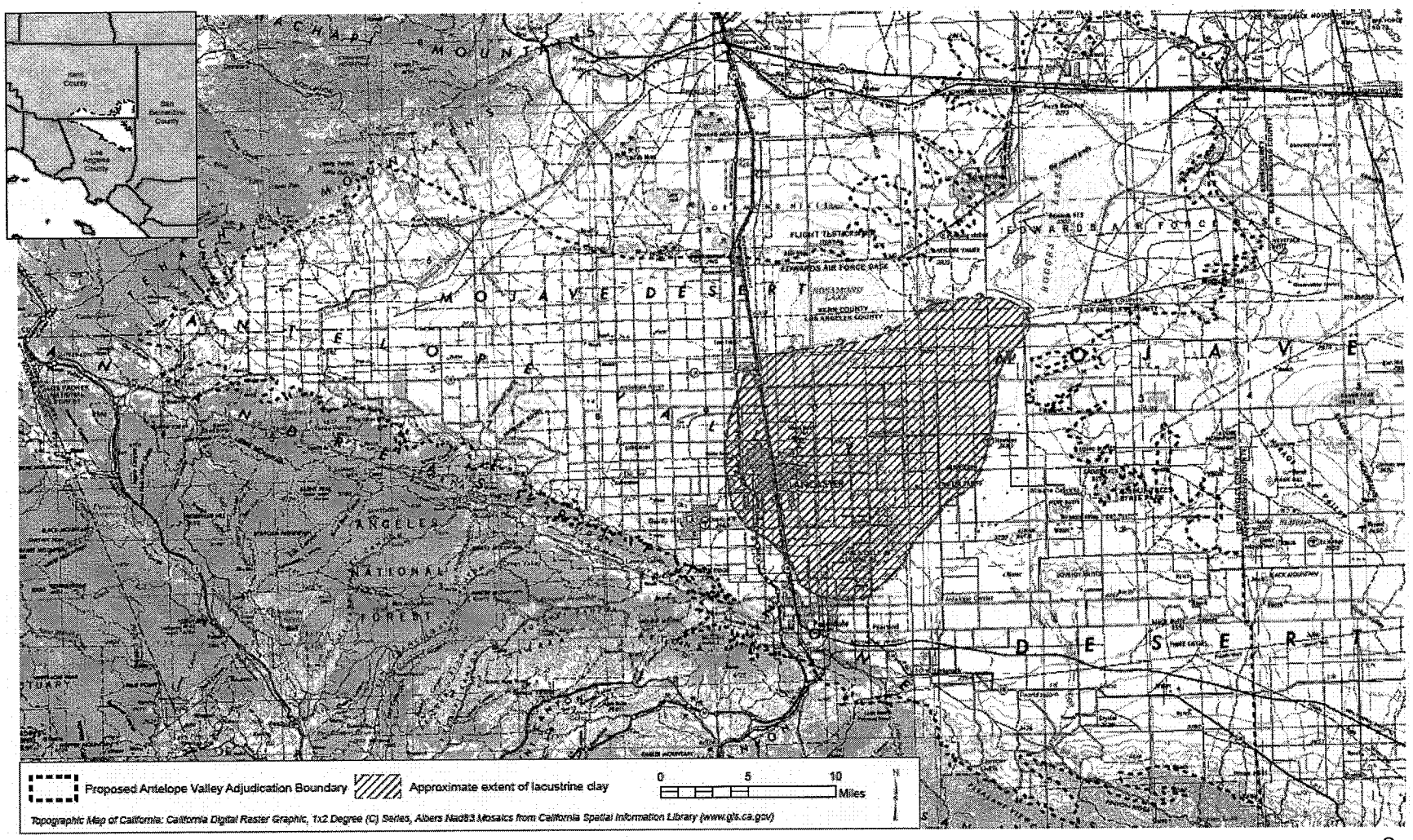
- impermeable bedrock
- constrictions in permeable materials
- faults (noted to not necessarily act as groundwater flow barriers)
- low permeability zones (noted to not form basin boundaries)
- groundwater divides (noted to be movable and thus less useful as boundaries)

from DWR, **California's Groundwater**, Bulletin 118-Update 2003

Proposed Adjudication Area with Geologic Features
Antelope Valley Groundwater Adjudication



Proposed Adjudication Area with Topographic Features
Antelope Valley Groundwater Adjudication



Notes on Boundary Selection

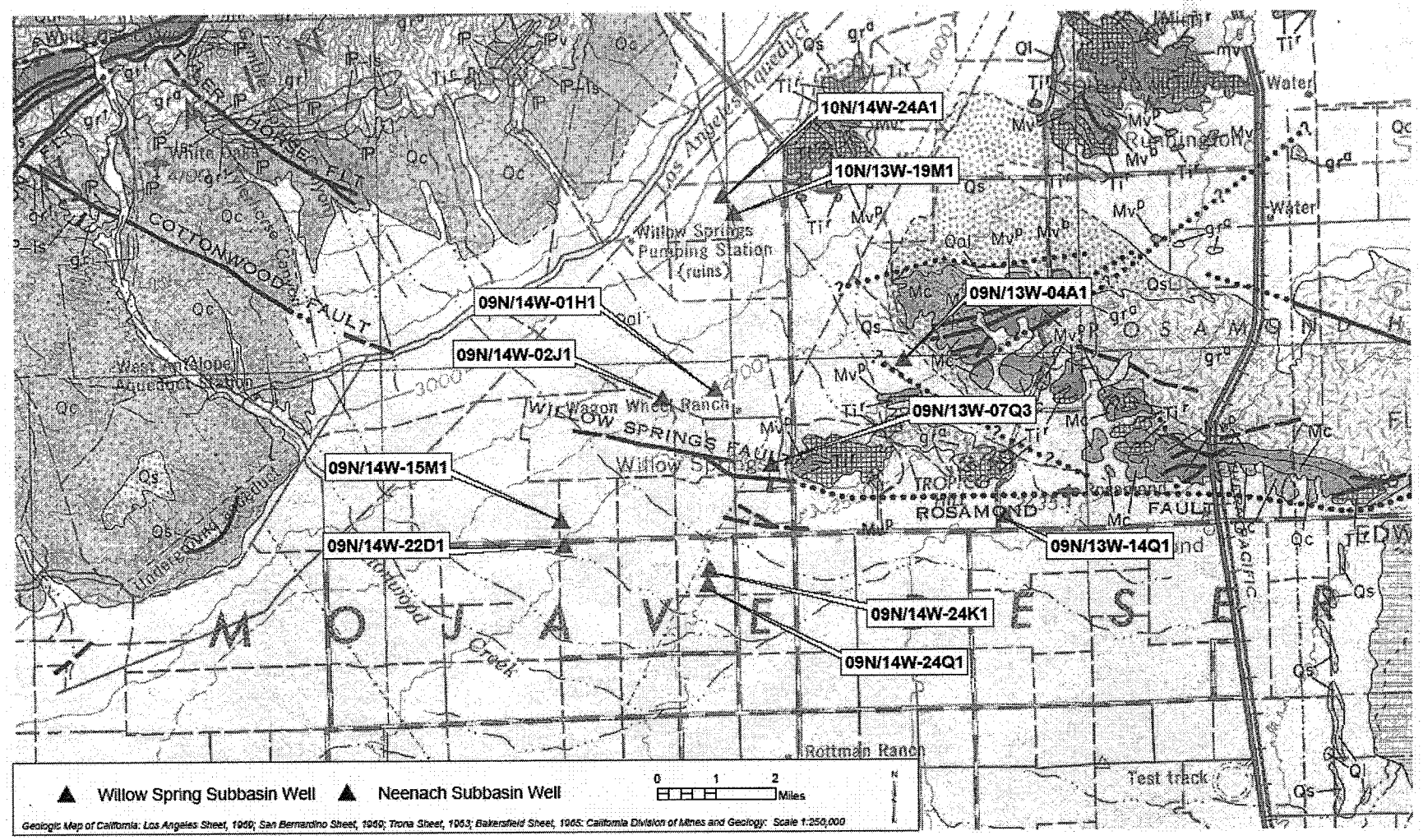
- **Predominantly bedrock contacts, with local exceptions**
  - narrow alluviated gaps between bedrock contacts
  - fault with substantial flow impedance
  - County line (nearly no-flow line)

Exceptions recognize that preferable boundaries, e.g. bedrock contacts, are not present throughout entire aquifer system (typical of all systems)

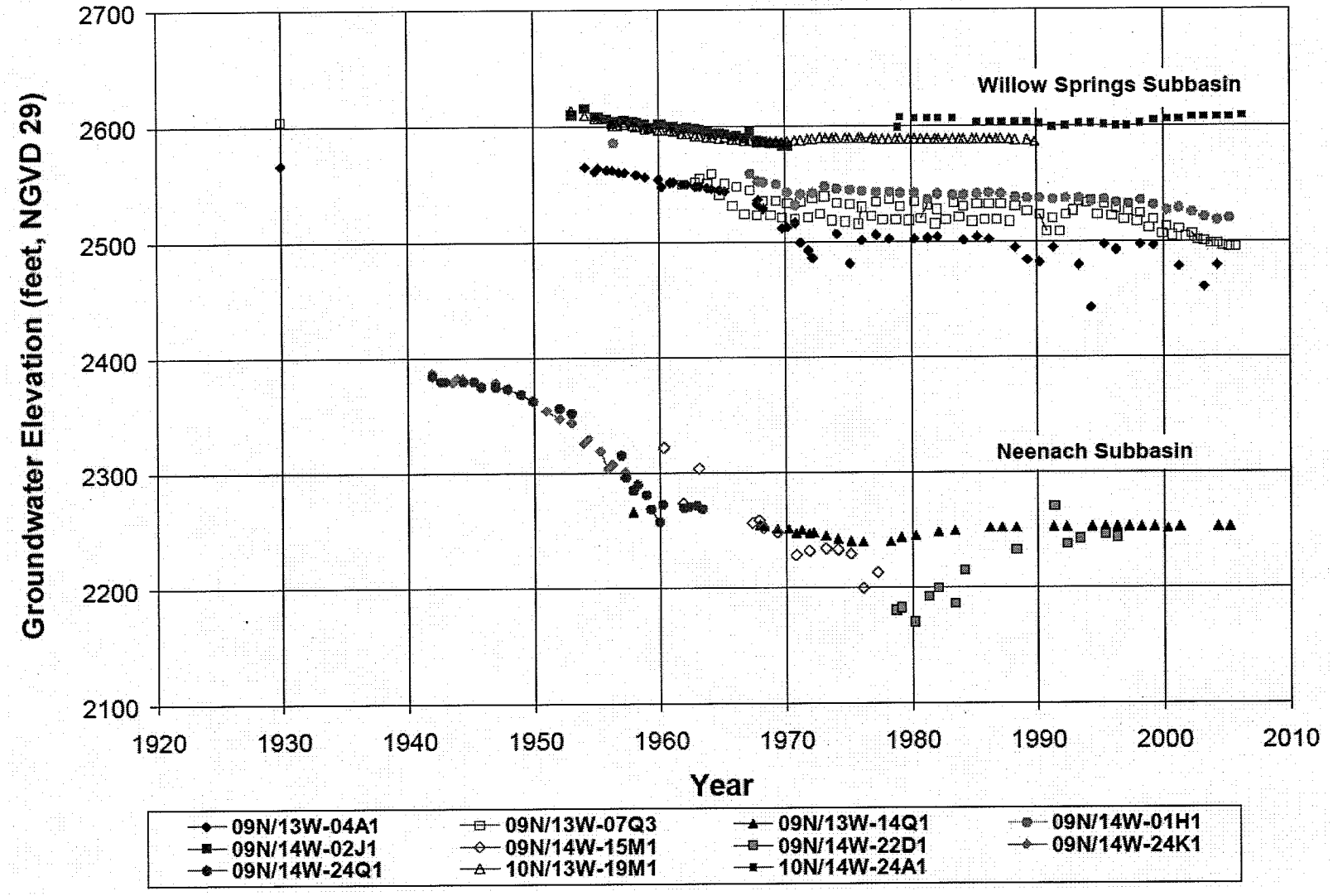
Cottonwood Fault/Willow Springs-Rosamond Fault Boundary

- **Mapped geologic feature**
- **Substantial impedance to groundwater flow**
  - several hundred feet of head (water level) difference
  - consistent head difference over time
  - predominant groundwater flow parallel to fault (not across fault)

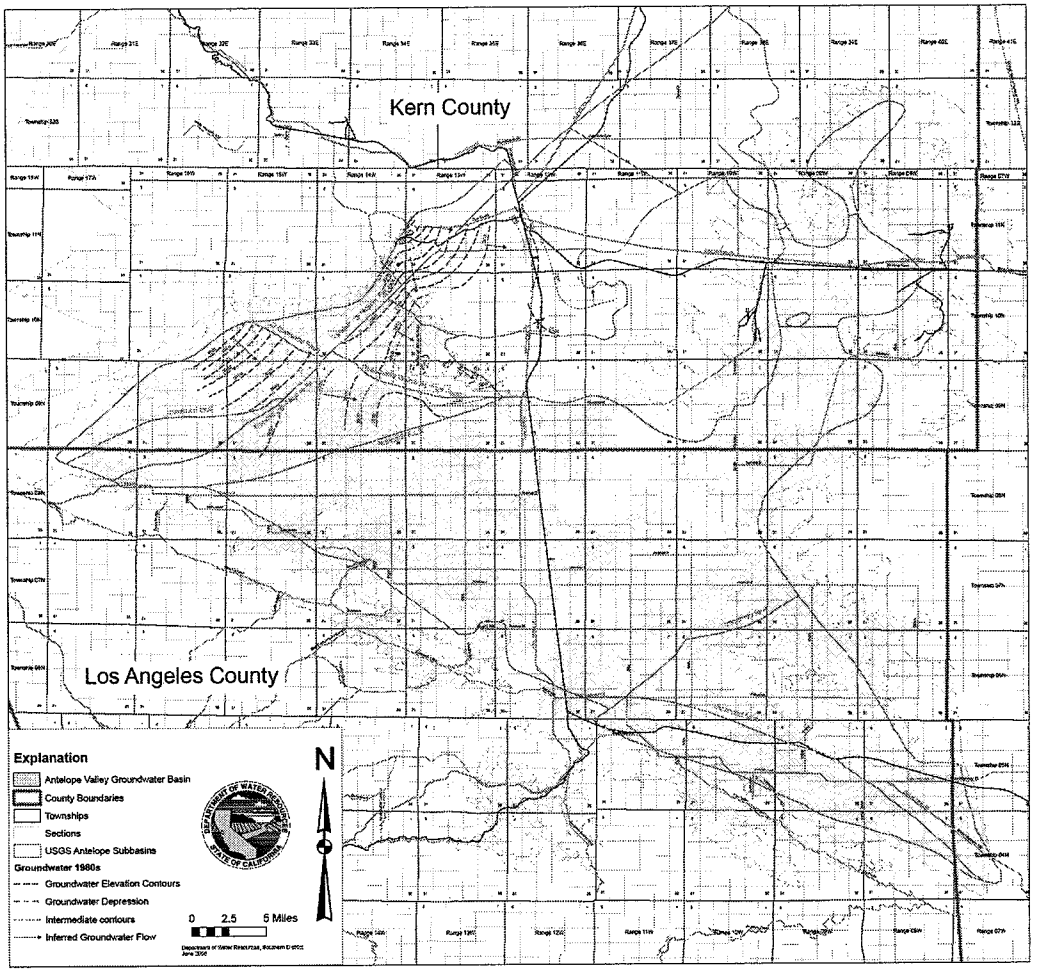
Cottonwood Fault/Willow Springs-Well Location Map



Historical Groundwater Levels
Willow Springs-Rosamond Fault Area



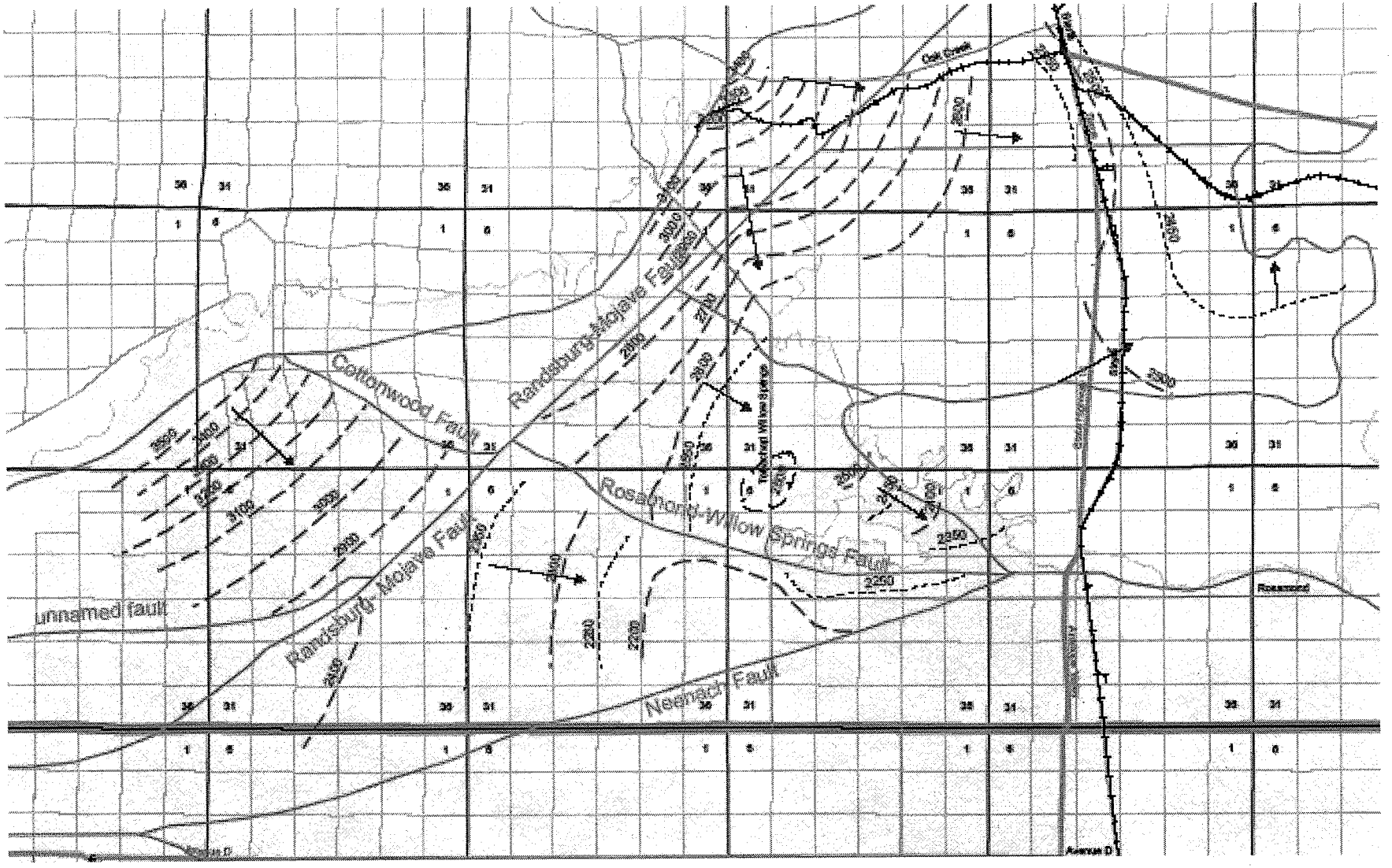
Groundwater Elevation Contours, Willow Springs Area (from R. Pierotti, DWR, Expert Declaration, June 29, 2006)



This map was created generally using GIS shape files available through the State of California. Transportation layers were obtained from [www.gis.ca.gov/data.epl]. These source files are typically in Teale Albers projection. The original DWR Groundwater Basin file was obtained at [www.groundwater.water.ca.gov/bulletin118/basin_maps/index.cfm] in UTM 10, NAD27 projection. This shape file has been reprojected to UTM 11 NAD83. The USGS Antelope Valley Groundwater basin subunits shape file was provided by Dr. Peter Martin of the U.S. Geological Survey. Groundwater elevation contours are interpreted from water levels reported in the 1960s. This map is subject to change given the availability of additional information. California Department of Water Resources, Southern District, June 2006.

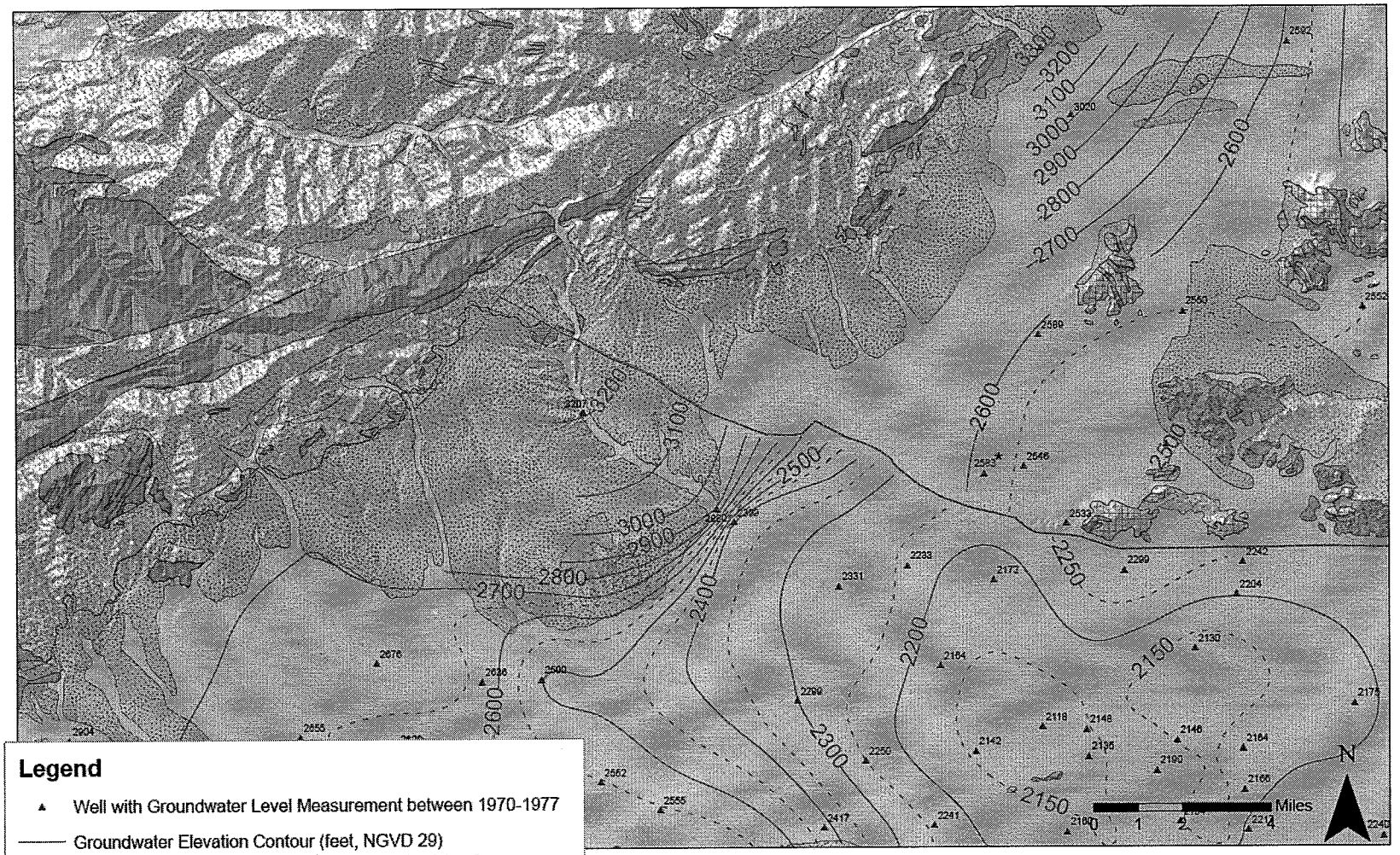
Exhibit 2:
Groundwater Elevation Contours
in Northwestern Antelope Valley

Groundwater Elevation Contours (1980's)
Willow Springs-Rosamond Fault Area (DWR)



from R. Pierotti, DWR, Expert Declaration, June 29, 2006

Contours of Equal Groundwater Elevation (1970s)
Willow Springs-Rosamond Fault Area (LSCE)



Legend

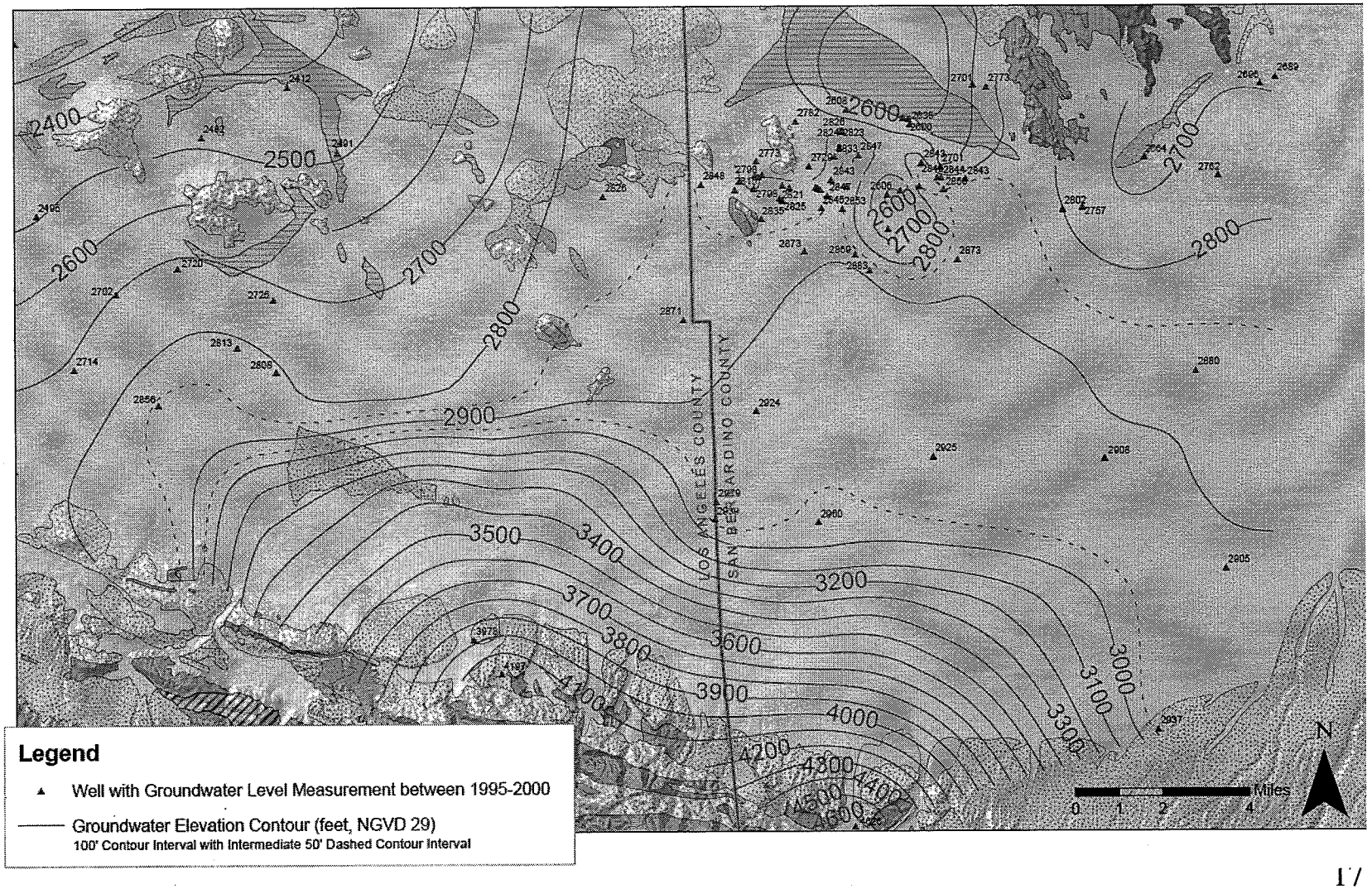
▲ Well with Groundwater Level Measurement between 1970-1977

—— Groundwater Elevation Contour (feet, NGVD 29)
100' Contour Interval with Intermediate 50' Dashed Contour Interval
* Groundwater Level measurement from 1970

Southeast Antelope Valley Boundary
(Los Angeles/San Bernardino County Line)

- **Political boundary (free flow) with no technical or physical significance**
  - unconsolidated aquifer materials are fully connected
- **Western boundary of adjudicated Mojave Water Agency area**
- **Coincident with local groundwater gradient that supports essentially no flow across boundary**

Contours of Equal Groundwater Elevation (1990s)
Los Angeles/San Bernardino County Line (LSCE)



Legend

- ▲ Well with Groundwater Level Measurement between 1995-2000
- —— Groundwater Elevation Contour (feet, NGVD 29)
  100' Contour Interval with Intermediate 50' Dashed Contour Interval

Groundwater Recharge as a Boundary Consideration

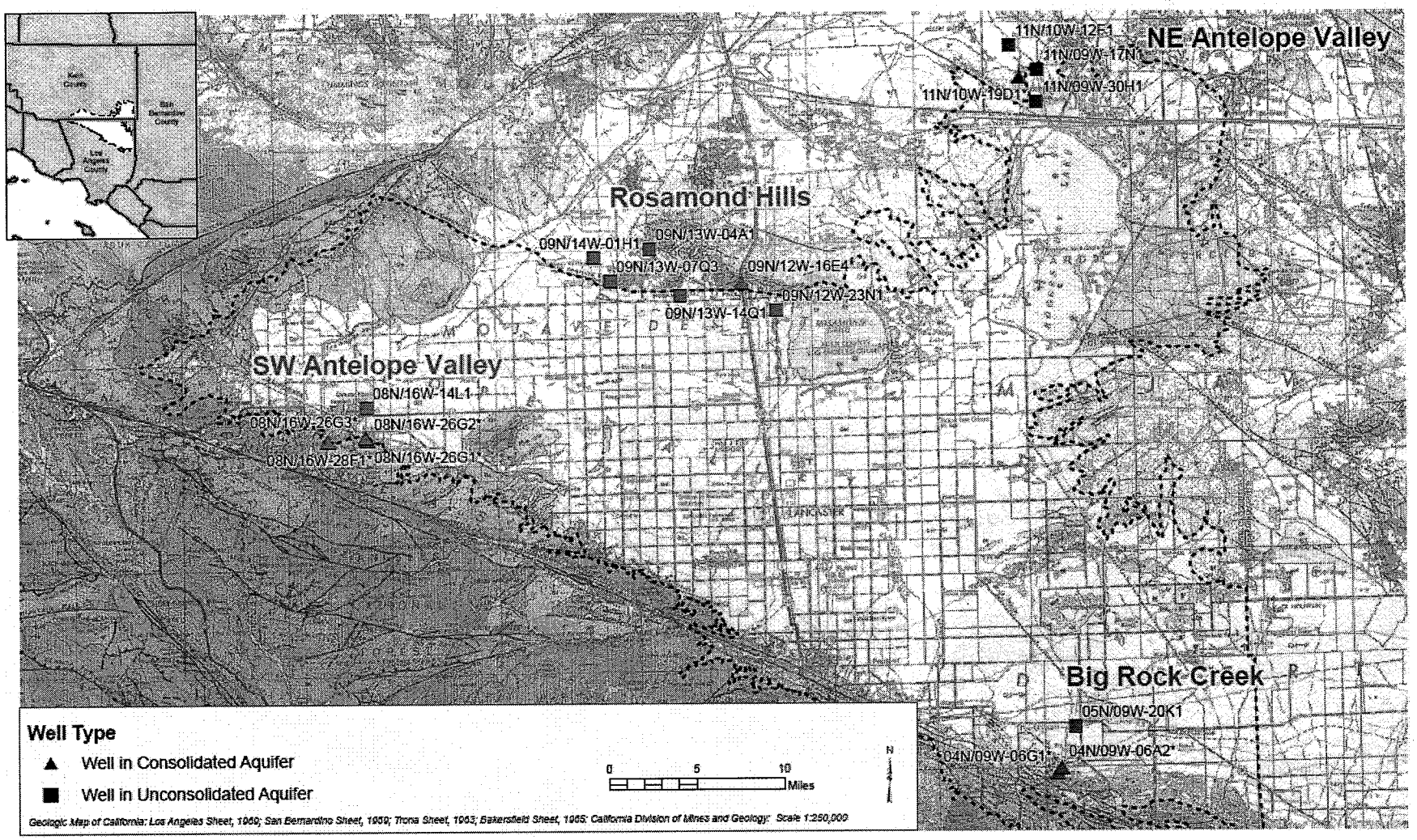
- **Precipitation on Valley Floor**
  - minimal
  - included within groundwater basin boundaries
- **Mountain Runoff**
  - most significant source of "native" water that contributes to groundwater recharge
  - partially diverted for water supply
  - historically estimated in 40,000 – 70,000 afy range
  - originates outside groundwater basin boundaries
- **Clay Dewatering**
  - slow drainage from thick clays in Edwards AFB-Lancaster area
  - results from historical mining of groundwater above/below clays
  - one-time (slow), non-renewable source of "recharge"
  - included within groundwater basin boundaries
- **Supplemental Imported Water – State Water Project**
  - increasing component of water supply since 1972
  - Table A Contract Amounts = 165,000 afy (not all for Antelope Valley)
  - recharge currently in 30,000 to 40,000 afy range
  - originates far from Antelope Valley

Other Boundary-Related Considerations

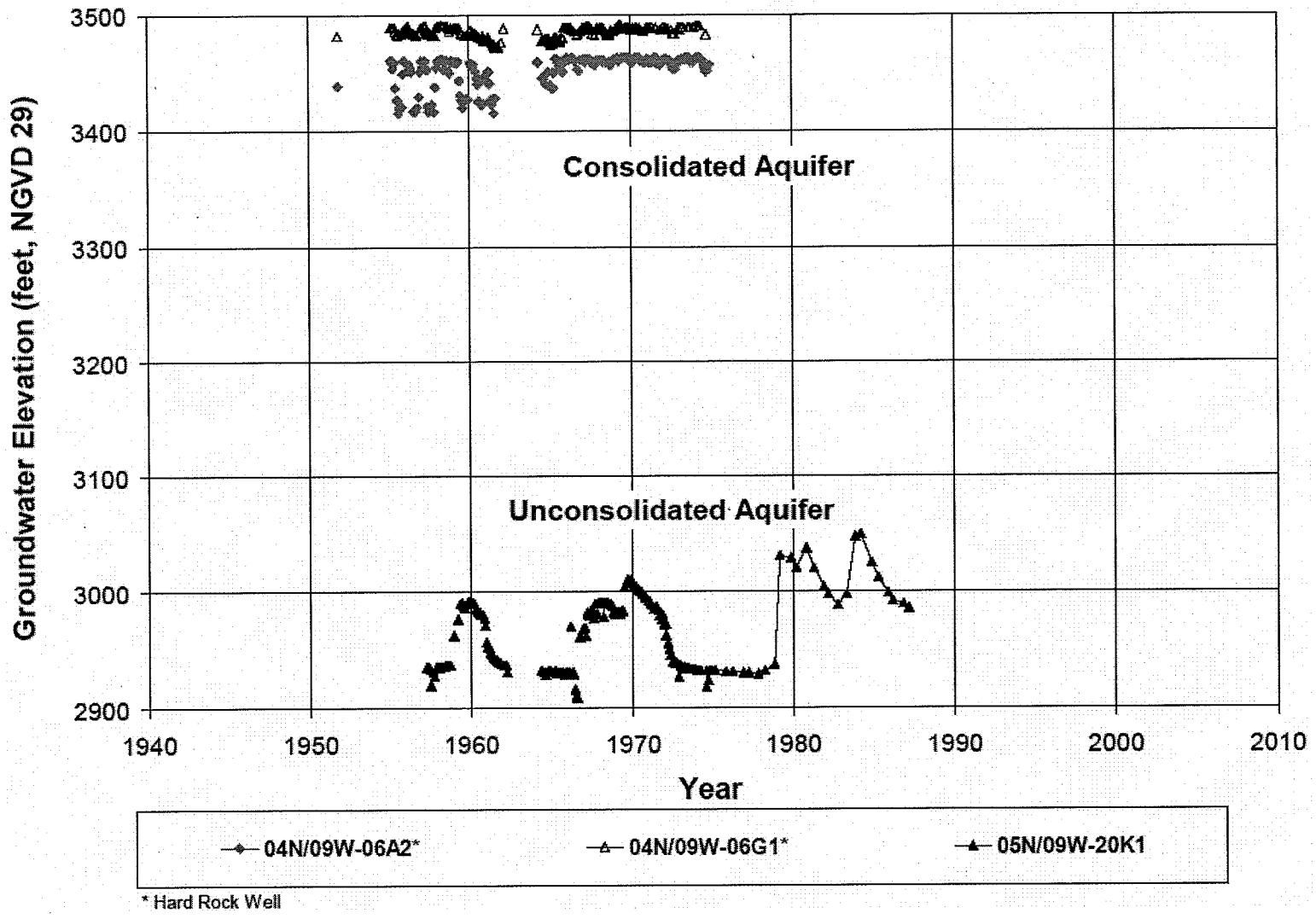
- **Groundwater Impacts Across Basin Boundaries**
  - propagation of impacts/response across boundaries?
  - separate groundwater systems?

- **Groundwater – Surface Water Interaction Across Basin Boundaries**
  - precipitation
    - gage locations, periods of record, amounts
  - runoff (streamflow)
    - gage locations, periods of record
    - gaged runoff
    - ungaged runoff
    - fate of runoff: diversion, recharge, loss

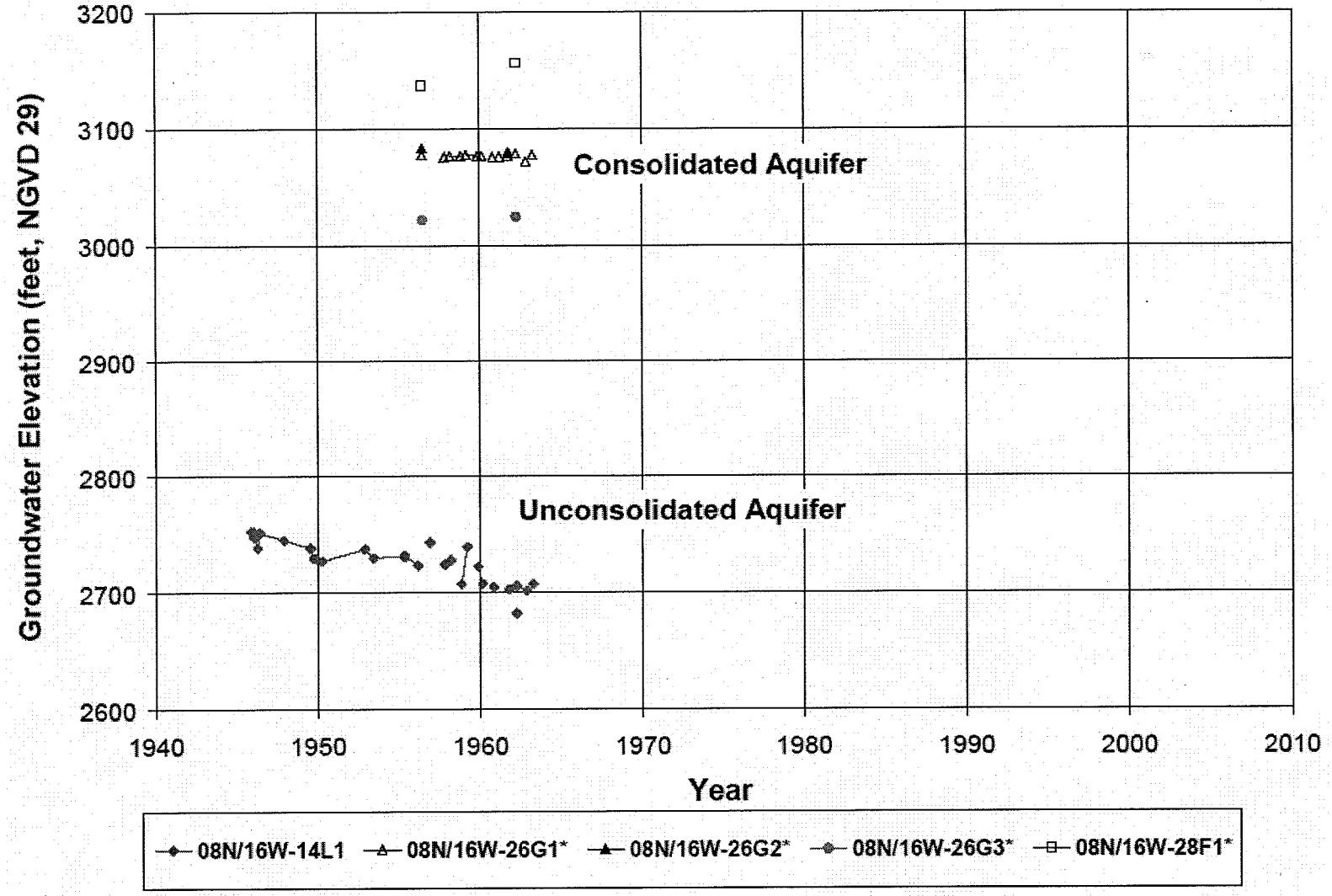
Well Locations – Historical Hydrologic Conditions
Consolidated and Unconsolidated Aquifers



Big Rock Creek Historical Groundwater Levels
Consolidated and Unconsolidated Aquifers

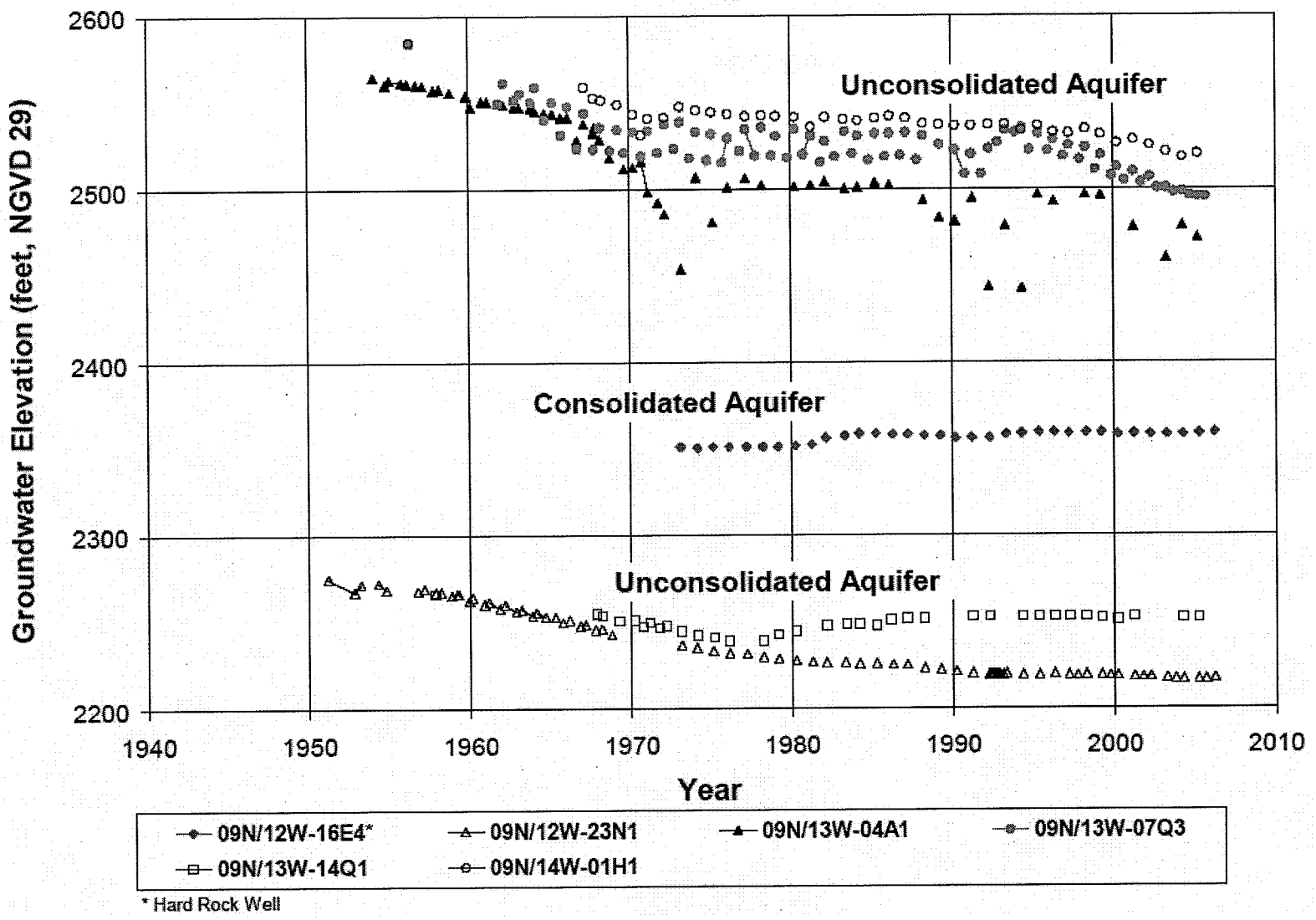


Southwestern Historical Groundwater Levels
Consolidated and Unconsolidated Aquifers



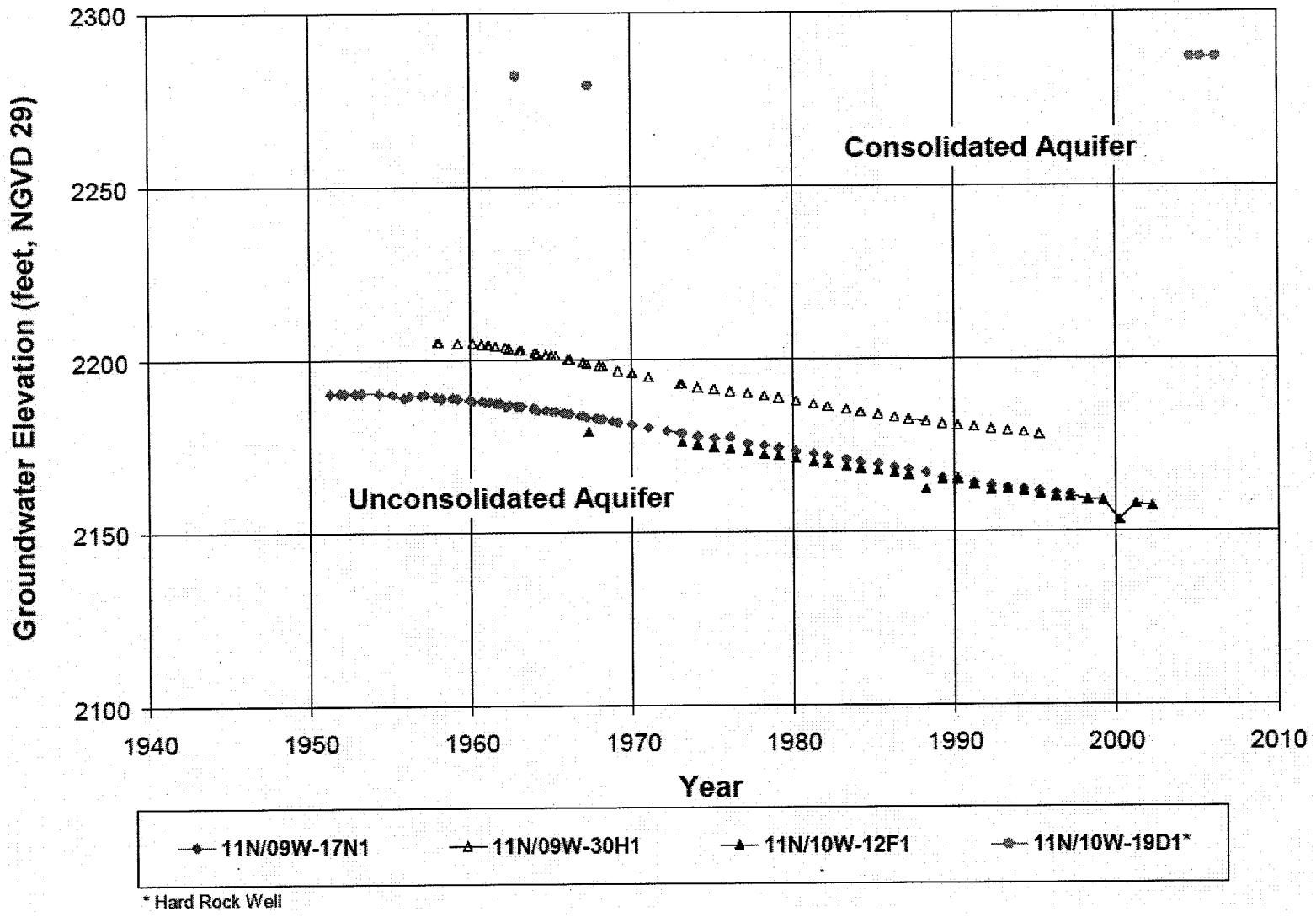
* Hard Rock Well

Rosamond Hills Historical Groundwater Levels Consolidated and Unconsolidated Aquifers



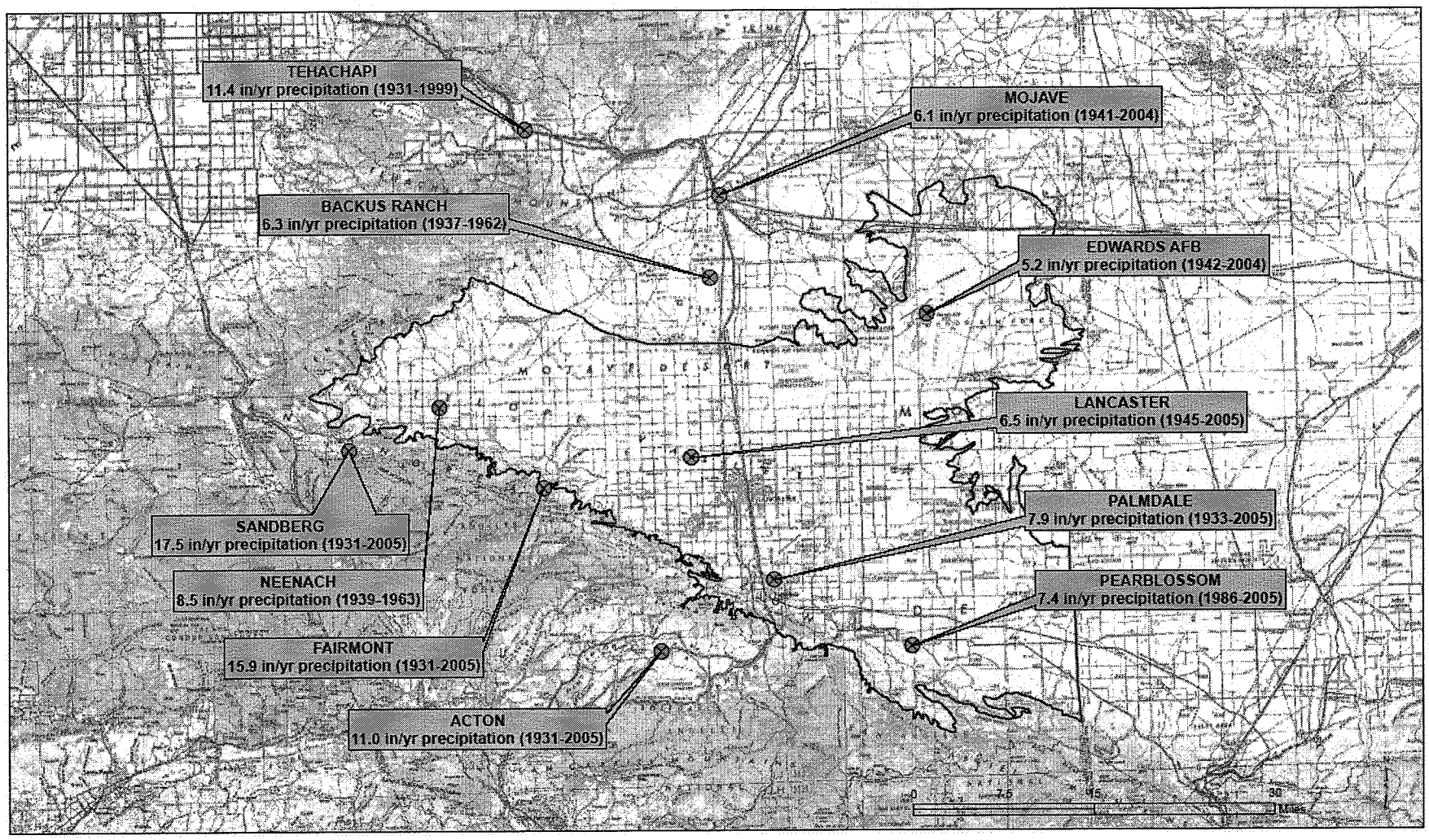
* Hard Rock Well

Northeastern Historical Groundwater Level
Consolidated and Unconsolidated Aquifers

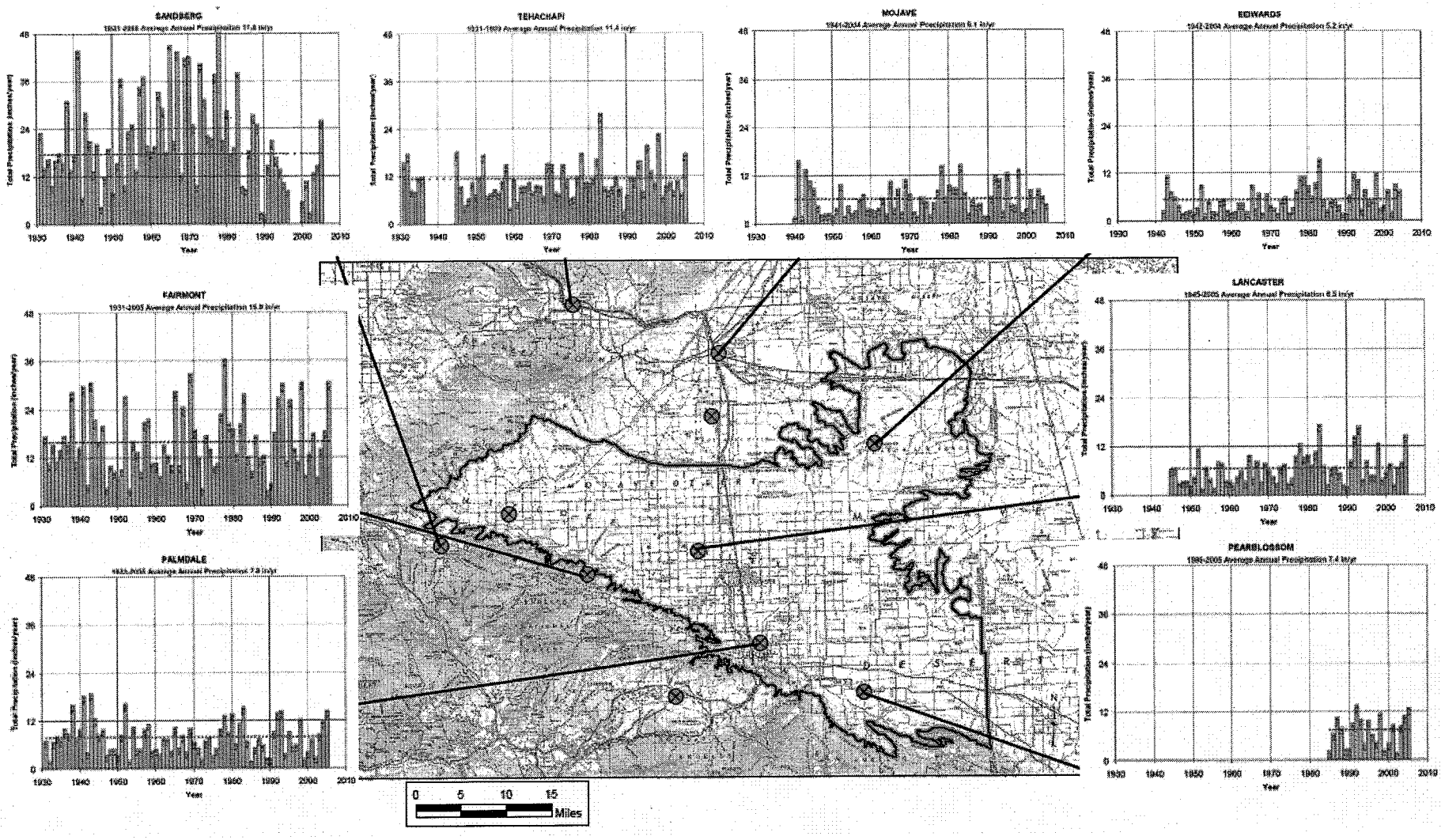


* Hard Rock Well

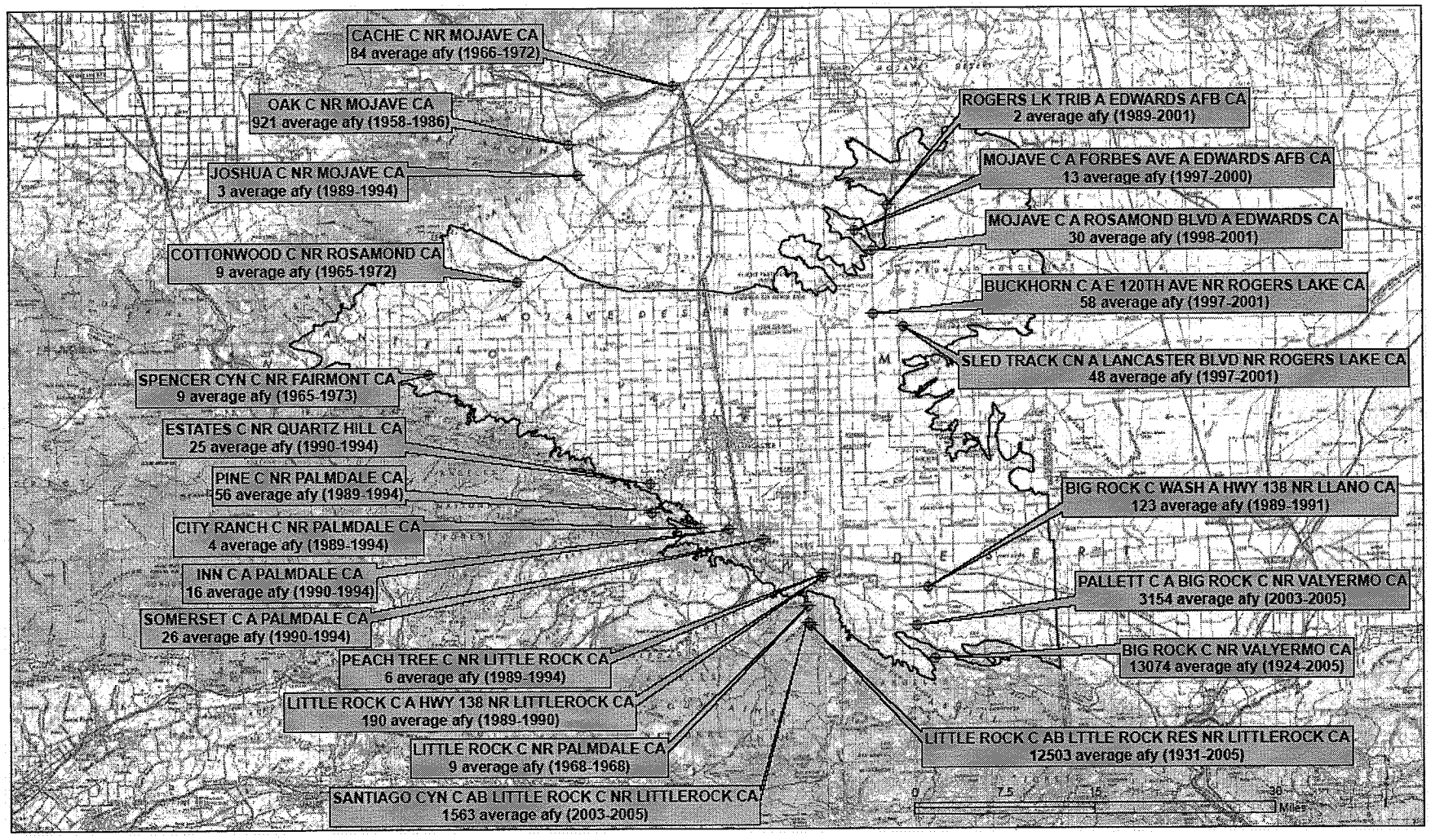
Antelope Valley Precipitation Gage Locations



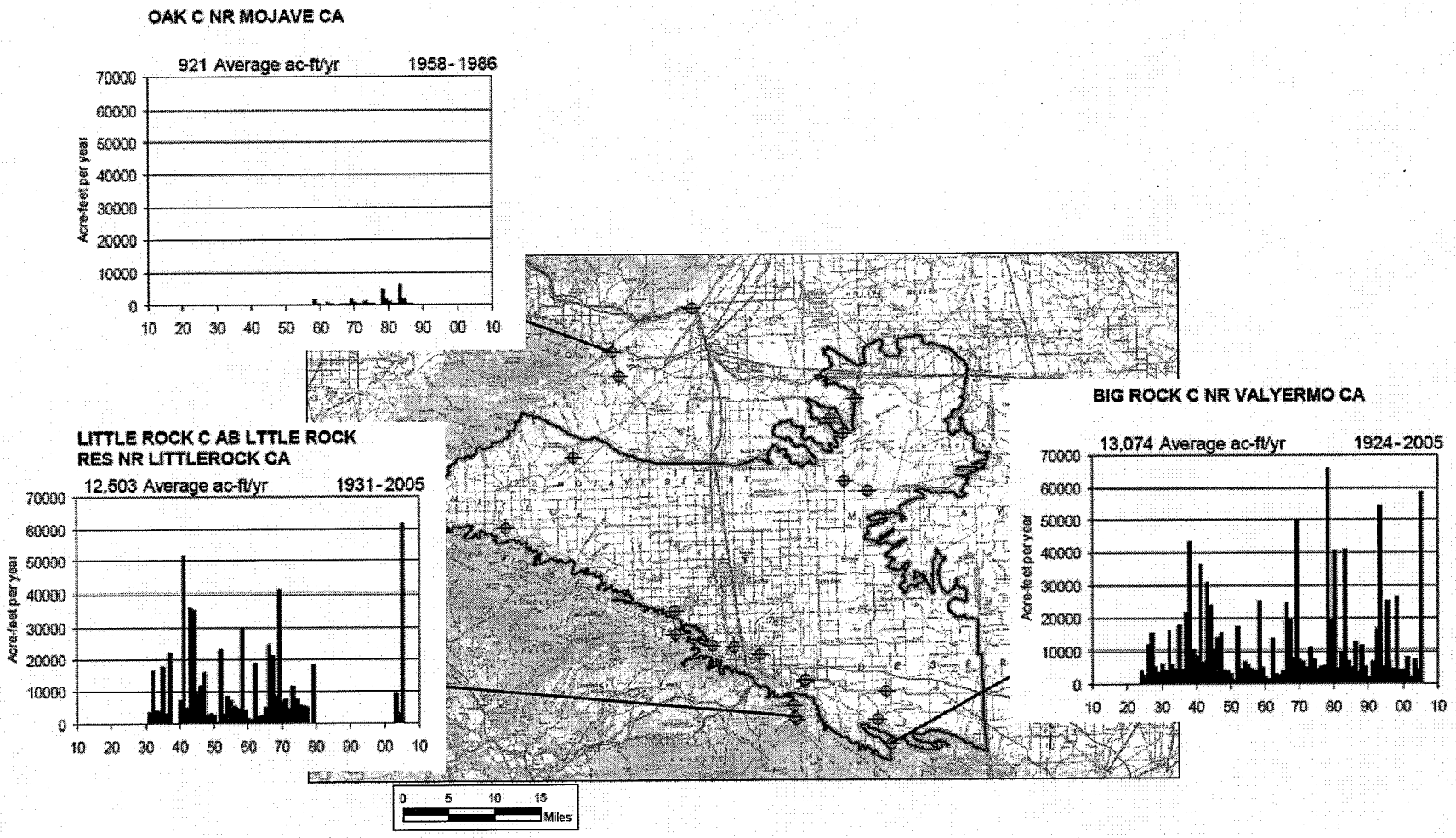
Historical Annual Precipitation



Antelope Valley Surface Water Gage Locations



Historical Annual Surface Water Flow



Historical Estimates of Surface Water Runoff

(all amounts in acre-feet per year)

	Thompson (1929)	Thayer (1946)	Calif. DWR (1947)	Snyder (1955)	Bloyd (1967)	Durbin (1978)
Measured/Estimated						
Big Rock Ck Canyon						
above gauge	—	15,000 mea	11,720 mea	7,940 est?	—	—
below gauge	—	— (d)	3,628 est	2,190 est	—	—
subtotal	14,500 est	15,000 (e)	15,348	10,130	—	11,500 est
Little Rock Ck						
above gauge	—	16,800 mea	12,080 mea	13,470 est?	—	—
below gauge	—	5,500 est	2,816 est	2,710 est	—	—
subtotal	21,000 est	22,300	14,896	16,180	—	12,800 est
Subtotal measured/estimated runoff	35,500	37,300 (e)	30,244	26,310	27,000 est	24,300
Estimated						
B. Rock Ck to L. Rock Ck	—	4,000	1,920	1,260	—	
L. Rock Ck to Amargosa Ck (a)	—	9,000 (f)	5,376	1,920	—	
Portal Ridge	—	—	1,760	510	—	8,700 (j)
Tehachapi Mtn Cks	2,500 (c)	2,500	22,208 (g)	17,100 (h)	1,000 (i)	7,700
Sheep Rock Ck (b)	—	10,000	4,896	4,010	—	—
Subtotal estimated runoff	39,500	37,500	36,160	24,800	—	16,400
Total	**75,000**	**74,800**	**66,404**	**51,110**	—	**40,700**

— not reported

(a) includes Amargosa Ck runoff unless otherwise noted

(b) east of B. Rock Ck and outside of proposed adjudication boundaries

(c) also includes runoff from Tehachapi Mtns outside of proposed adjudication boundaries (e.g., Oak Ck)

(d) runoff from below gauge apparently included in the estimated runoff of 4,000 afy from the area "B. Rock Ck to L. Rock Ck"

(e) apparently does not include runoff from below gauge in Big Rock Ck Canyon

(f) includes Amargosa Ck only; runoff from additional areas not reported

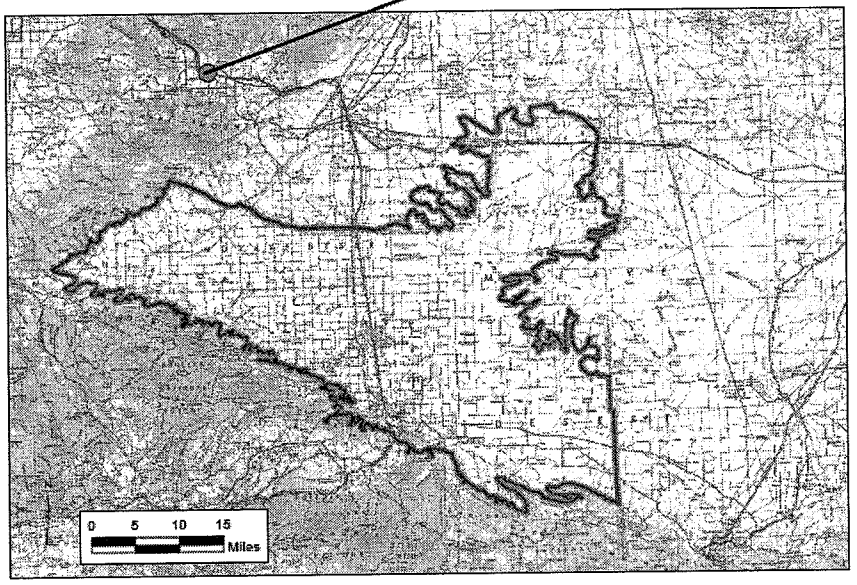
(g) also includes runoff from portions of San Gabriel Mtns, and from Tehachapi Mtns north of proposed adjudication boundaries (4,288 afy)

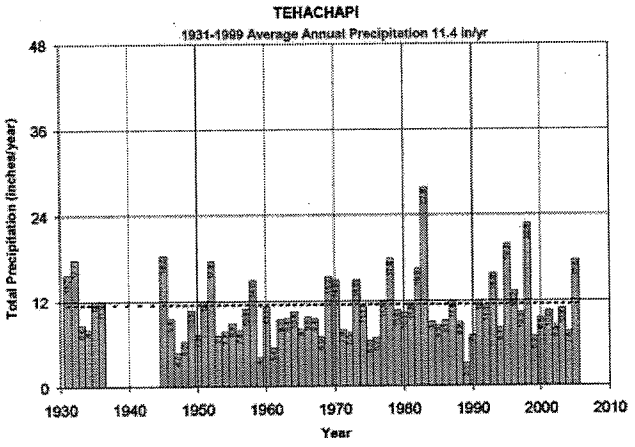
(h) also includes runoff from portions of San Gabriel Mtns

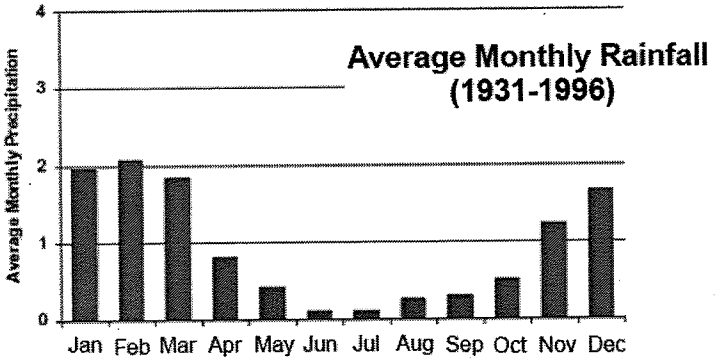
(i) includes Oak Ck only

(j) estimate for San Gabriel Mtns runoff excluding Big and Little Rock Cks

Historical Precipitation, Tehachapi Mountains Fremont/Antelope Valleys Area







Historical Monthly Streamflow, Oak Creek Tehachapi Mountains, Fremont/Antelope Valleys Area