# ANTELOPE VALLEY SPREADING GROUNDS STUDY

## Phase 1 - Preliminary Report

ENGINEERING GEOLOGY & SOILS OFFICE


LOS ANGELES COUNTY
DEPARTMENT OF PUBLIC WORKS
LAND DEVELOPMENT DIVISION

# ANTELOPE VALLEY
# SPREADING GROUNDS STUDY

## Phase 1 - Preliminary Report

February 22, 1989

TO: Iraj Nasseri
Planning Section
Hydraulics and Water Conservation Division

FROM: M. Johnson
Geology and Soils Section
Land Development Division

In response to your request, we have conducted a research investigation for potential spreading grounds sites in the Antelope Valley. The attached report includes the findings of our study.

LL:sh
JOT:AVM

ANTELOPE VALLEY SPREADING GROUNDS STUDY

PHASE 1 - PRELIMINARY REPORT

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## I - PURPOSE AND SCOPE

This report has been prepared in response to a request from the Hydraulics and Water Conservation Division to evaluate the general hydrogeology and groundwater recharge potential of portions of the Antelope Valley for future spreading grounds locations.

The scope of the report is limited to a review of available published and unpublished geologic and hydrogeologic literature and to the result of a field reconnaissance.

As previously agreed to, the study is to be divided into a preliminary, very generalized phase, and a future, more detailed site specific phase. This report presents the results of the preliminary phase. The second phase of the study will consist of detailed investigations of the selected areas.

At your request, two criteria were included for prospective site selection: a) water discharge (surface runoff), and b) active groundwater production. No particular maximum amount of discharge or production has been specified. In addition, the sites must be located in areas of suitable hydrogeologic conditions.

## II - CONCLUSIONS AND RECOMMENDATIONS

### Conclusions

a) Preliminary literature review indicates that recharge of the Antelope Valley groundwater basin using spreading grounds appears feasible. Potential spreading areas occur along most of the southwestern edge of the Antelope Valley, in a two to five mile-wide band of coarse alluvial materials adjacent to the foothills of the San Gabriel Mountains. This band is bordered by and parallels the active San Andreas Fault.

b) Within the aforementioned band, three prospective spreading areas have been selected which conform to your Division's general criteria of proximity to both groundwater production and significant runoff. The areas are the alluvial fan deposits of Little Rock, Big Rock and Amargosa Creeks (Figure 1).

   Surface discharge of Big Rock and Little Rock Creeks averages 13,200 and 14,800 acre-feet per year, respectively. Runoff for Amargosa Creek is not gaged; rough estimates range from 800 to 9,000 acre-feet per year, with a measured capital storm discharge of 23,000 cubic feet per second.

   Based on preliminary water well extraction information supplied by the Planning Section of the Hydraulics and Water Conservation Division, the Big Rock Creek site lies within two miles of an area of domestic groundwater production. Extraction wells exist in the Little Rock Creek area and are used for irrigation, domestic and industrial supply. A zone of the scattered irrigation wells exists one mile north of the foothills in the

Amargosa Creek area and extends northward for a minimum of six miles (Plates Ia and Ib).

It should be noted that the Little Rock and Big Rock Creek areas are near the California Aqueduct, where additional Metropolitan Water District (MWD) water may be available for spreading.

c) Available on-site geologic and hydrologic information is limited for the three prospective areas. Subsurface investigation and hydrologic studies are warranted, subject to specific recharge and spreading area(s) and site(s) selected.

d) Conflicting data exists as to the nature and location of some of the subunit boundary faults of the Antelope Valley groundwater basin. Additional information will be needed to evaluate their significance relative to recharge.

e) Surface water is of good quality and is suitable for consumptive use. Knowledge of groundwater quality in the prospective recharge areas of Little Rock and Big Rock Creek sites is limited. Apparently, quality is acceptable, except near the community of Littlerock, where nitrates and total dissolved solids concentrations reportedly exceed the Federal Minimum Contaminant Levels (MCL) for public water supply.

Recommendations

a) After one or more of the three areas are chosen, the second phase of the study can be initiated. This phase should include: further, more detailed research of available data; analysis of well logs; consultant's soils and geology reports; information from gravel pit quarry operations; etc. The Information should be used to select specific site(s) for detailed studies.

b) Potential need for subsurface geologic exploration should be determined during the second phase for the specific sites chosen. Subsurface exploration will probably be necessary and recommended, and will include borings for stratigraphic correlation, geophysical logging of wells, aquifer tests, percolation tests, etc.

c) The potential presence of alluvium subject to hydrocompaction (collapsing soils) should be evaluated during site specific studies.

## III - PREVIOUS INVESTIGATIONS

Table 1 is a summary of available studies performed in the Antelope Valley that are applicable to the evaluation of potential spreading and recharge areas. The extent of coverage, and location of potential sites as recommended in each study, are included in the table. Plates IIa and IIb show the locations of the recommended or prospective recharge or spreading areas for each of these studies. The reviewed literature can be grouped into two categories based on the extent of the investigations as follows:

a) Regional - These studies recommend recharge locations based upon geologic considerations, analysis of well logs, and literature review; they are of general and review nature and lack new or specific on-site subsurface hydrogeologic data. Although some conflicting conclusions have been reported by these studies for the same areas (e.g., References 5 and 7, Table 1), the data presented can be used as a baseline for future detailed investigations.

b) Site specific - Some detailed studies have been performed, for the most part by Los Angeles County. They were done primarily for prospective spreading grounds or to evaluate proposed retention basins. These studies provide the most detailed and site specific information available (Table 1, Nos. 9, 10, 11, and 12) and include lithologic logs, depth to water, geophysical data, and infiltration rates.

## IV - GEOLOGIC SETTING

General: The geology and hydrology of the Antelope Valley groundwater basin have been described in numerous reports. Generalized mapping of the geology has been done by various governmental agencies (References 18, 19, 31, 32, 34, 36, 38, 39). The geologic base map used for this report (Plates IIa and IIb) has been modified from the United States Geological Survey (Reference 36).

As described in the preceding investigations, the Antelope Valley is a fault controlled, wedge-shaped basin located in the extreme southwestern part of the Mojave Desert, bounded on the northwest and southwest by the Tehachapi and San Gabriel Mountains, respectively. The valley itself is an alluviated desert of low relief with dry lakes or playas in its lowest areas. Hills and buttes occur isolated within the alluviated plains. Figure 1 shows the regional location and boundaries of the Antelope Valley and shows major physiographic and geographic features within the area.

Structure and Subbasins: Structurally, the subject Antelope Valley is a downdropped tectonic, wedge-shaped block formed by the active San Andreas and Garlock faults on the southwest and northwest, respectively. The eastern boundary is a series of granitic hills and buttes near the San Bernardino County line. These faults and bedrock outcrops define the Antelope Valley groundwater basin.

Other secondary northwest and northeast trending faults occur within the basin and define subbasins (References 34, 35). The faults have been identified on the basis of geophysical surveys, surface expression, stratigraphic correlations or the presence of groundwater barriers. The location of some of these faults and their effectiveness as groundwater barriers have not been thoroughly investigated. As shown in Plate III, several groundwater subunits have been defined in the Antelope Valley and are based principally on the presence of these secondary fault-controlled subbasins. Of these groundwater subunits only the Lancaster, Pearland, Buttes and the Foothill Area are applicable to this study.

Bedrock (Precambrian and Tertiary): The bedrock underlying the basin and comprising the mountains and isolated hills of Antelope Valley consists of a variety of metamorphic, igneous and sedimentary rocks of ages ranging from Precambrian to Tertiary. These bedrock formations are consolidated and are considered non-water bearing for the purpose of this study.

Unconsolidated Quaternary Sediments: The Antelope Valley basin contains younger Quaternary alluvial sediments which consist of hundreds of feet of unconsolidated or uncemented sediments. These basin-fill deposits are a major source of domestic water for the local desert communities and for agriculture. The stratigraphy of the basin has not been studied in detail and is not well defined. Lateral correlation of units is difficult because of the lateral discontinuity of the deposits.

The sediments of the Antelope Valley basin are primarily alluvial or lacustrine types of sedimentary deposits. They are often interbedded and are described as follows:

a) **Alluvial Deposits.** Alluvial deposits form north sloping, foothill alluvial fans along the periphery of the basin. The younger alluvium, zero to 100 feet thick, is found at the surface and is characterized by uncemented or unconsolidated coarse- to medium-grained sand, and often gravelly, deposits. It is undissected and ranges from coarse-grained at the foot of mountains and hills, grading into finer-grained downslope where it merges into valley sediments (Reference 34). The underlying older alluvium (up to several hundred feet thick) is finer-grained, less permeable, and more indurated than the younger alluvium. The older alluvium also occurs as uplifted and dissected fan remnants above the valley floor, and has been incised by the recent drainages. Clay and silt layers are commonly interbedded within both the younger and older alluvium.

b) **Lacustrine Deposits.** Fine-grained sediments were deposited in an ancestral lake that occupied the central portions of the basin. These layers are buried from a few feet to 400 feet below the surface and consist of clays and silts up to 400 feet thick, interbedded with coarse materials up to 20 feet thick (Reference 40). The areal extent and subsurface expression of these sediments is shown in Plates Ia and Ib and Figures 2 and 3.

The distribution of coarse alluvial material is shown on Plates Ia and Ib (References 38 and 39). Geologic mapping was based on the distribution of surficial deposits and, therefore, does not necessarily represent similar grain sizes at depth. As shown on the plates, coarse surficial materials are distributed in a 2 to 5 mile wide band along most of the southwestern edge of the Antelope Valley. This band delimits areas that could have high infiltration rates and consequently are candidate areas for spreading grounds.

## V - HYDROGEOLOGIC SETTING OF THE STUDY AREA

Antelope Valley Ground Water Basin Subunits: Bloyd (Reference 35) subdivided the Antelope Valley groundwater basin into subunits based on the aforementioned structurally defined subbasins. The basis for his subdivisions included groundwater barriers, groundwater divides, presence of bedrock and, in some cases, convenient and arbitrary boundaries. (The subunits are shown in Plates IIa, IIb and III). However, a different interpretation of the location and orientation of some of the faults (e.g., Thayer, Reference 18, Plates Ia,Ib, IIa and IIb) would result in different groundwater subunit boundaries.

Notwithstanding, Bloyd's mapping has been used as a basic reference for subsequent studies (References 6, 7, 8, 9, 37, and 40). Bloyd's boundaries may have to be adjusted, subject to additional geologic and hydrogeologic data. In the interim, and for the purpose of this study, the prevailing nomenclature and delineation of the groundwater "subunits" of Bloyd will be used. The Foothill Area is redesignated for this study as the "Foothill Area Subunit." This groundwater subunit is the alluviated portion of the area south of the Lancaster and Pearland Subunits, as shown on the attached plates.

Subunit Sediment Characteristics:

a) **Lancaster Subunit.** The distribution of the Lancaster Subunit sediments, which consist of lacustrine and alluvial sediments as described above, provide a significant control on the groundwater regime, in addition to the influence of the presence of subunit faults. In the Lancaster Subunit, coarse alluvial sediments form two main aquifers. Essentially, there is an upper, unconfined principal aquifer and a lower, confined aquifer, separated by an aquitard layer of lacustrine clays and silts (see Figures 2 and 3).

   The upper unconfined aquifer is the main production zone of the valley with a thickness from 450 to 600 feet (Reference 40). Mostly composed of unconsolidated sand and gravel, it commonly has layers and lenses of silt and clay which produce local semi-perched conditions. The lower confined aquifer underlies the unconfined aquifer and is limited to the areal extent of the lacustrine deposits. Because of the age and depth of burial, the lower aquifer is more consolidated than the principal aquifer. The western-most boundary and subsurface extent of the aquitard (lacustrine deposits) is shown in Plate Ia and Figures 2 and 3, respectively. Presumably, the two main aquifers merge to the west, in areas peripheral and outside the limits of the lacustrine deposits (Figure 2). It is also possible that the two aquifers also merge to the south (Figure 3).

b) **Pearland, Buttes and Foothill Area Subunits.** The lacustrine deposits of the Lancaster Subunit are not present in the Pearland, Buttes or Foothill Area Subunits (see Figures 2 and 3). Limited information presently exists on the hydrologic and sedimentary characteristics of the Quaternary alluvium in these subunits.

   Site specific studies (References 21, 23, 24, and 25) indicate that the unconsolidated permeable young alluvium, tens of feet thick, is underlain by a more consolidated and finer-grained older alluvium in the Pearland Subunit. Apparently these conditions exist west of Littlerock where fine-grained materials have been encountered at the bottom of a local quarry pit (verbal communication with the plant superintendant). Young alluvium is underlain by bedrock in the Amargosa Creek area (Foothill Area Subunit, References 14, 15, and 26).

Groundwater Levels and Subsurface Flow: General depths to groundwater in the Lancaster and other subunits are shown in Plate III. Before extensive pumping began in the valley (prior to 1955) artesian conditions were prevalent in the Lancaster Subunit (Reference 30, Plates Ia and Ib). However, groundwater withdrawals have lowered the water table up to several hundred feet, and artesian conditions have ceased to exist. In addition, heavy pumping has resulted in groundwater depressions near Lancaster (see Plate III).

Groundwater flow in the Antelope Valley Basin moves centripetally from the base of the San Gabriel Mountains into the north central part of the Lancaster Subunit (see Plate III).

In the Pearland and Buttes Subunits, water moves northwesterly toward the Lancaster Subunit and recharges the principal aquifer (Plate III). Subsurface flows derived from infiltration along Big and Little Rock Creeks, located in the southeast portion of the Valley, enter into the Pearland Subunit; lesser amounts reach the Buttes Subunit, and some underflow occurs from these basins into the Lancaster Subunit (References 37 and 40, Figures 2 and 3).

Water Quality: The overall groundwater quality of the Antelope Valley is good, and has remained unchanged since development of the valley took place (References 8, 9, 30, 35, and 40). Characteristically, the best quality water is at the south and west sides of the valley near recharge areas and is of a calcium bicarbonate composition. More alkaline (sodium bicarbonate and sodium sulfate) composition is found towards the playa areas.

Groundwater at the Pearland Subunit is generally acceptable for human consumption. However, locally in the vicinity of Littlerock, nitrates and total dissolved solids have been increasing probably as a result of irrigation of fertilized fields (Reference 40). Groundwater in the Buttes Subunit is within Maximum Contaminant Level (MCL) values based on public water supply criteria, except for naturally occurring fluorides. High levels of fluorides also occur in the foothill areas, along the San Andreas Fault.

The upper aquifer of the Lancaster Subunit contains inferior quality water with higher dissolved solids and nitrate concentrations in the area of aforementioned historic high water levels.

The surface water which enters the valley from the San Gabriel Mountains is of good quality and suitable for domestic use. This includes the runoff from Big Rock and Little Rock Creeks.

General Hydrologic Parameters: Little detailed data for evaluating and locating recharge areas is available for the Antelope Valley area. Only a few aquifer tests have been made in the valley and none are known within the study area.

Percolation rates and permeability have been estimated for some of the proposed areas cited in the literature and are shown in Table 1. Bloyd (Reference 35) estimated transmissivity values for the principal aquifer based on average and estimated values of the specific capacity of wells. Based on his calculations of a transmissivity of 65,000 gallons per day per foot (gpd/ft) he concluded that "... the rate of movement of water in the principal aquifer is too slow to provide a means of distribution of imported water" (Bloyd, op. cit.). The mathematical model developed for the valley by the U. S. Geological Survey (Reference 37) estimated values of transmissivity based on Bloyd's work and by calibration of the mathematical model. Based on this study, values of transmissivity for the Pearland Subunit range between 8,000 and 23,000 gpd/ft, for the Butte Subunit around 67,000 gpd/ft, and for the eastern part of the Lancaster Subunit from 67,000 to 105,000 gpd/ft. The major source of uncertainty in their model is the lack of definitive measurements of the model parameters (transmissivity, storativity and hydraulic conductivity).

## VI - NEED, REQUIREMENTS, AND CRITERIA FOR POTENTIAL RECHARGE AND SPREADING AREAS

General Need: The existing and the projected development rate in the Antelope Valley area will continue to increase the demand on producing aquifers. Recharge is a logical solution to alleviate the present overdraft condition of the Antelope Valley groundwater basin.

In addition to the spreading of local runoff waters, excess State Water Project (SWP) water, imported to the valley through the California Aqueduct, could also be stored in the groundwater basins for use at a later date. The Department of Water Resources is presently evaluating management alternatives for conservation facilities for their SWP water, including the recharge of Antelope Valley basins through spreading grounds (see also Reference 9).

Basic Conditions and Data Required for Spreading and Recharge Areas: Important hydrologic parameters to be considered for the evaluation of spreading grounds include rates of percolation, runoff coefficient, permeability, transmissivity, storativity, storage capacity, specific capacity, etc. Bloyd (Reference 35) stresses the importance of adequate storage capacity above the existing water table, permeable aquifer materials and surface conditions suitable for infiltration of surface waters. In addition to these basic considerations, the Hydraulics and Water Conservation Division includes the criteria that the recharge area must be in an area of high discharge and near areas of groundwater production. However, the specific discharge and production minimums still have to be established.

Prospective Recharge and Spreading Areas: The required criteria for relatively high runoff or stream discharge for recharge by spreading might be met in three areas in the Antelope Valley. These prospective areas can be broadly defined as the surficial coarse alluvial deposits and fans of Big Rock, Little Rock and Amargosa Creeks as mapped in Plates Ia and Ib. Selection of a site specific spreading ground location will require further investigation.

Hydraulic and Water Conservation Division's additional criteria that the prospective site(s) be in an area of groundwater extraction has been acknowledged and considered. Based on present reconnaissance type information, the same three areas appear to meet this requirement.

Other potential spreading areas may exist in Los Angeles County to the northwest and southeast along the mapped band of coarse-grained alluvial materials at the edge of the valley (Plates Ia and Ib) and where significant runoff or well production occurs. However, existing available data is significantly lacking and it is understood that these areas are of lesser priority.

As a result of the aforementioned criteria of runoff, well production, and priorities, our geologic research has been focused on the Big Rock, Little Rock and Amargosa Creek areas. These are areas where the Geology and Soils Section has done relatively recent site specific geologic studies or reviews for other Department of Public Works' projects (References 14, 15, 21, 22, 23, 24, 25, and 26).

Findings on each of the prospective areas are outlined below regarding available data on runoff, local hydrogeology, and preliminary information on groundwater production provided by the Hydraulic and Water Conservation Division.

## VII - PROSPECTIVE SPREADING AREAS ALONG BIG ROCK, LITTLE ROCK AND AMARGOSA CREEKS

General Discharge (Runoff) Characteristics: The subject three major streams provide over 75% of the runoff that enters Antelope Valley from the San Gabriel Mountains. Their hydrologic characteristics, based on existing literature, are as follows:

a) Big Rock Creek. The Big Rock Creek drainage area in the San Gabriel Mountains is 23 square miles (Bloyd, Reference 35) and provides about 33% of the runoff into Antelope Valley. The stream flow has been gaged near the apex of the fan and in Valyermo Basin since the 1890's and commonly ranges between 11,500 to 15,000 acre-feet/year; a maximum discharge of 64,830 acre-feet/year was measured in 1978-79.

   Spreading grounds now exist both in the Valyermo Basin (part of the Big Rock Creek drainage area) and at the apex of the Big Rock alluvial fan. Inflow is measured periodically by the Hydraulic and Water Conservation Division at Valyermo Basin.

b) Little Rock Creek. Little Rock Creek has a drainage area of 49 square miles (Bloyd, Reference 35). After the stream enters Antelope Valley it continues as a channel for a distance of seven miles before it merges with the valley floor.

   Stream gages located upstream of the Little Rock Creek Reservoir and Dam have measured discharges since 1954, with an average annual discharge of 14,870 acre-feet (Reference 10). This quantity represents approximately 40% of the runoff into the Antelope Valley from the San Gabriel Mountains.

The Little Rock Creek Reservoir is located upstream from the fan apex and is used to store runoff for agricultural and domestic use. Water is diverted to Palmdale Lake to the west. Another diversion ditch extends from near the head of the wash eastward to the town of Littlerock. Engineering studies of the dam have determined that there are stability and safety problems with its design. Remedial options include either repairing or breaching the dam. The Department of Water Resources (DWR, Reference 10) has studied different water conservation alternatives for the latter choice. Some of the alternatives include the construction of spreading grounds along the Little Rock Creek. The option(s) chosen will affect available runoff for spreading on the subject prospective site.

c) Amargosa Creek. The drainage area of Amargosa Creek is approximately 20 square miles. Stream flow is not gaged; estimates based on point discharges roughly add from 500 to 800 acre-feet/year (Reference 37), other estimates (Reference 18) add to an annual runoff of 9,000 acre-feet/year. Discharge into Antelope Valley from this creek is low because its drainage area does not extend to the snow line in the San Gabriel Mountains. Capital storm discharge for this creek has been estimated at 23,000 cubic feet per second.

Reconnaissance Information on Groundwater Production: Reconnaissance type information provided by the Hydraulic and Water Conservation Division is summarized below.

General distribution of water well production provided are shown in Plates Ia and Ib. The distribution of two different types of wells is indicated as follows: 1) Type 1: irrigation, public supply, industrial or stock wells with 5 horsepower motor or larger, and 2) Type 2: domestic or other wells with motors smaller than 5 horsepower. Type 1 suggests higher production than Type 2; however, the size of the pump may reflect the demand or use requirements rather than the actual aquifer(s) capability.

a) Big Rock Creek Area. A Type 2 area of domestic wells is located about two miles west-northwest of Pearblossom. Type 1 and 2 wells occur scattered in the Valyermo Basin.

b) Little Rock Creek Area. There are Type 1 wells located within one mile northeast of the wash near Littlerock. Additional wells are located north, downstream for a distance of about 6 miles.

c) Amargosa Creek Area. A production zone of Type 1 wells exists in a reach from one to six miles northerly of the proposed Amargosa Retention Basin. A few Type 2 wells are also present in the general area.

Regional Hydrogeologic Conditions of Prospective Spreading Grounds Areas: Preliminary studies of the hydrogeologic conditions have been performed by the Geology and Soils Section (References 21, 23, 24, and 25) and by GeoSoils (References 14 and 15) in the three prospective areas, and are summarized below.

Additional investigation will be necessary for site characterization of the most favorable alluvial deposits within the fan areas of Big Rock, Little Rock and Amargosa Creeks. Additional data and research will be required for an estimate of available storage.

a) Big Rock Creek Area. Two areas of interest occur along the drainage course; one at the Valyermo Basin, and the other on the alluvium north of the apex of the Big Rock Creek fan. Based on the study by the County (Reference 21, Plate IIb), the following is concluded:

   1) Valyermo Basin. The Valyermo Basin is a structural depression within the San Andreas Fault Zone, infilled with Quaternary alluvial deposits. The sediments, about 50 to 100 feet thick, are unconsolidated sands and gravels of high permeability. Groundwater recharge occurs primarily by stream flows of Big Rock Creek. Privately owned and operated spreading grounds already exist in the basin.

      Faults bound this basin to the north and south (see Plate IIb). These faults act as barriers to the flow of groundwater. The fault to the north (Hidden Spring) is greatly responsible for impounding groundwater within the basin, but does not impede subsurface flow northward into the Big Rock Creek fan area. Hydrographs monitored for the past 25 years indicate that water levels within the basin have fluctuated between 10 and 25 feet, with corresponding changes in water level depths.

      Based on historic water levels additional storage available in the basin ranges between 2000 to 3800 acre-feet. The areas for spreading grounds are located at the southerly portion of the basin as shown in Plate IIb.

   2) Big Rock Creek Fan Area. The fan area consists of 80 to 130 feet of younger alluvium consisting of unconsolidated sand and gravel, with minor silt lenses. This unit is underlain to depths of over 300 feet, by a moderately indurated older alluvium composed of silt and coarse sand. Only the younger alluvium is considered an important aquifer.

      The Los Angeles City Department of Airports (Reference 12) has proposed to surface mine 2 parcels for aggregate resources on the Big Rock Creek fan (T5N R9W, Section 19). The depth proposed for these quarries is 50 feet. The geologic data for this project is not yet available for review.

      Two faults have been mapped traversing the alluvial fan of Big Rock Creek. One separating the Foothill Area Subunit from the Pearland Subunit, and the other separating the Pearland from the Buttes Subunit. The study performed in this area (Reference 21) failed to find definitive ground water evidence for the existence of either of these faults, therefore, this suggests that the faults do not act as significant barriers to groundwater flow, and groundwater can percolate from the Pearland into the Buttes Subunit.

The buried siphon of the California aqueduct located near the apex of the Big Rock Creek fan, acts as a partial subsurface dam, and impedes subsurface flow of groundwater. Spreading facilities in the Big Rock fan should be located downstream from the siphon (Reference 21).

b) Little Rock Creek Fan Area. The alluvial fan extends about 5 miles north of the base of the mountains and its thickness ranges from 80 feet at its inception to over 250 feet at its northern end (Reference 2). Apparently, the materials composing the fan consist mostly of coarse sediments, with some interbedded clay layers.

The only available subsurface hydrogeologic studies for the fan area have been performed for the Department's proposed Hunt Canyon Retention Basin (References 23, 24, and 25). The retention basin is located on the south-western portions of the Little Rock Creek alluvial fan (see Plate IIb).

At this location, 50 to 100 feet of permeable sands and gravels (young alluvium) are underlain by a low permeability layer of silty and clayey sands (older alluvium).

Similar conditions apparently exist at the quarry pit northeast of the retention basin site where 50 to 80 feet of suitable aggregate is underlain by clayey materials (verbal communication with the quarry site Superintendant).

The Department's 1986/87 investigation (References 24 and 25) determined that the fault separating the Foothill Area Subunit from the Pearland Subunit does offset the bedrock at depth, but does not constitute a groundwater barrier within the alluvial units.

Groundwater levels one-half mile north of the proposed Hunt Canyon Basin has been measured at 113 to 126 feet below the surface.

c) Amargosa Creek Fan Area. Information on the alluvial fan deposits of the Amargosa Creek area is limited. Subsurface investigation for the proposed Amargosa Retention Basin (Plate IIa) by a consultant (Geosoils, References 14 and 15) indicates that younger alluvium in this area is 50 to 80 feet thick, and consists of unconsolidated coarse and gravelly sand. Permeability of the alluvium at the proposed retention basin was estimated by the consultant in the range of $10^{-1}$ to $10^{-5}$ cm/sec. The young alluvium is underlain by crystalline bedrock. The thickness of the alluvium toward the north where it joins the Lancaster Subunit is unknown at this time.

The location and nature of the mapped fault north of the proposed Amargosa retention basin, representing the boundary between the Foothill Area Subunit and the Lancaster Subunit (Plate Ia), has not been investigated. This fault was mapped based on the water level disparities (Reference 35).

Groundwater in one of the piezometer at the site, installed during the consultant's exploration, was encountered 65 feet below the surface.

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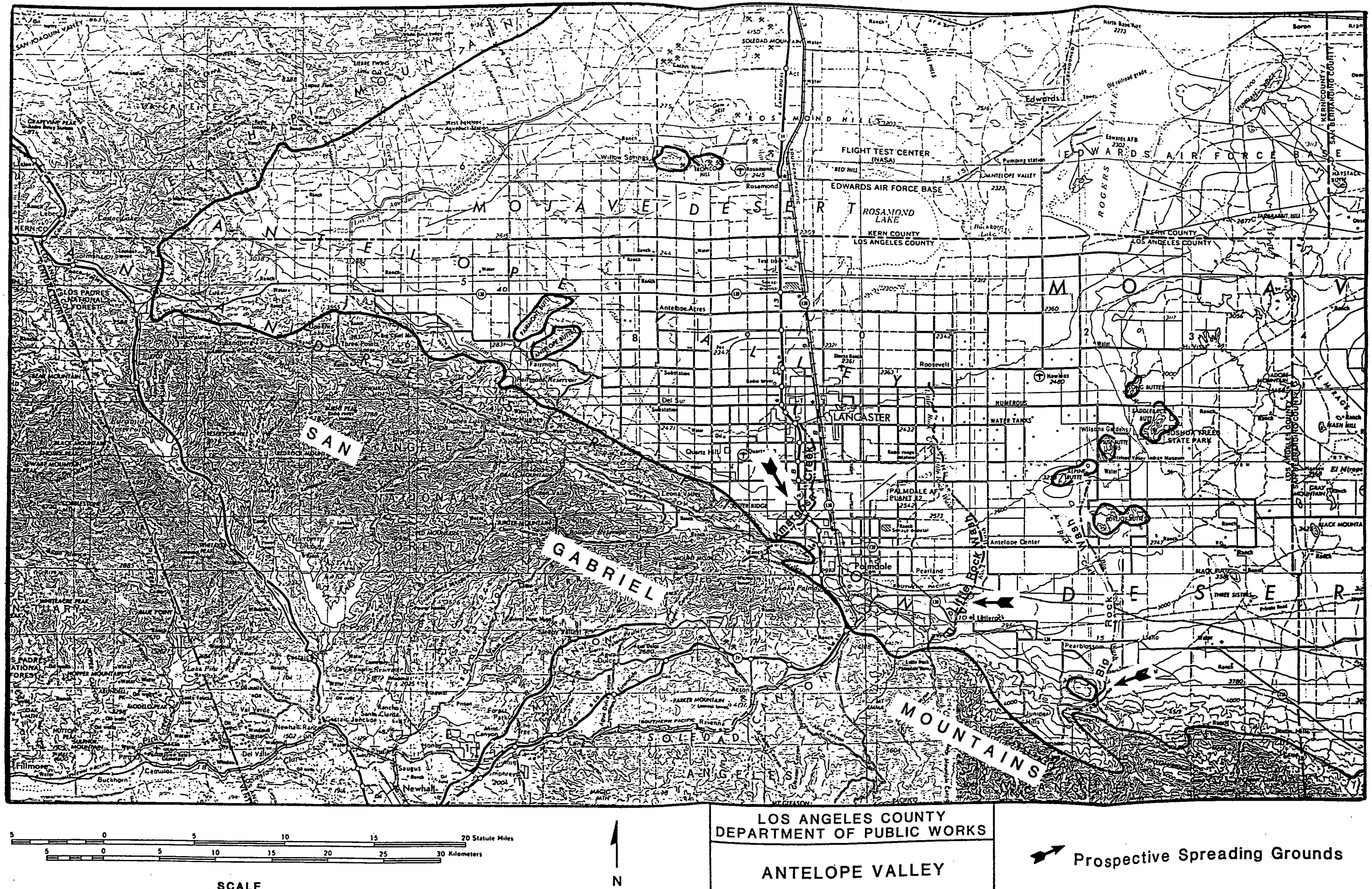


LOS ANGELES COUNTY
DEPARTMENT OF PUBLIC WORKS

ANTELOPE VALLEY

VICINITY MAP

Date: Feb. 1989 | Prepared By: C.N.

FIGURE 1

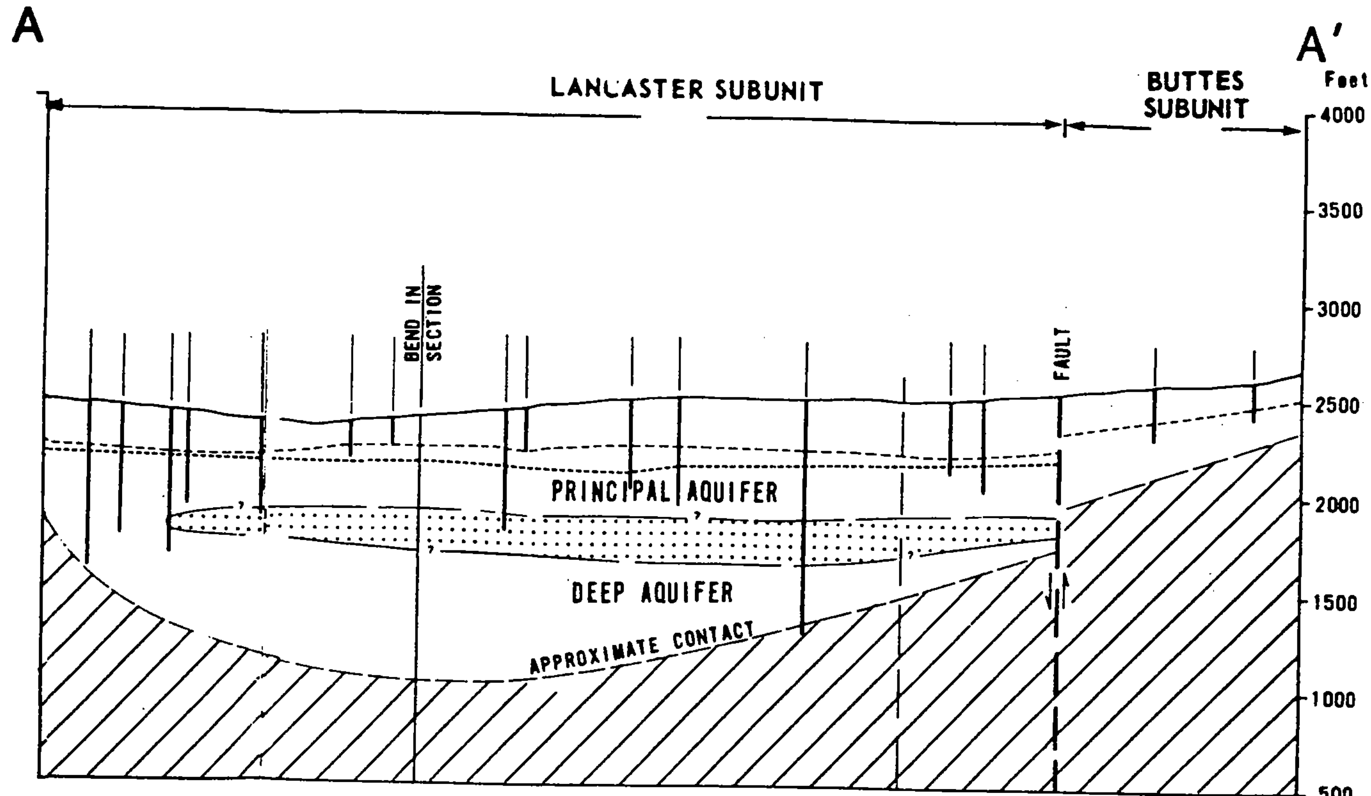


Figure 2 – Generalized geologic cross-section A–A′

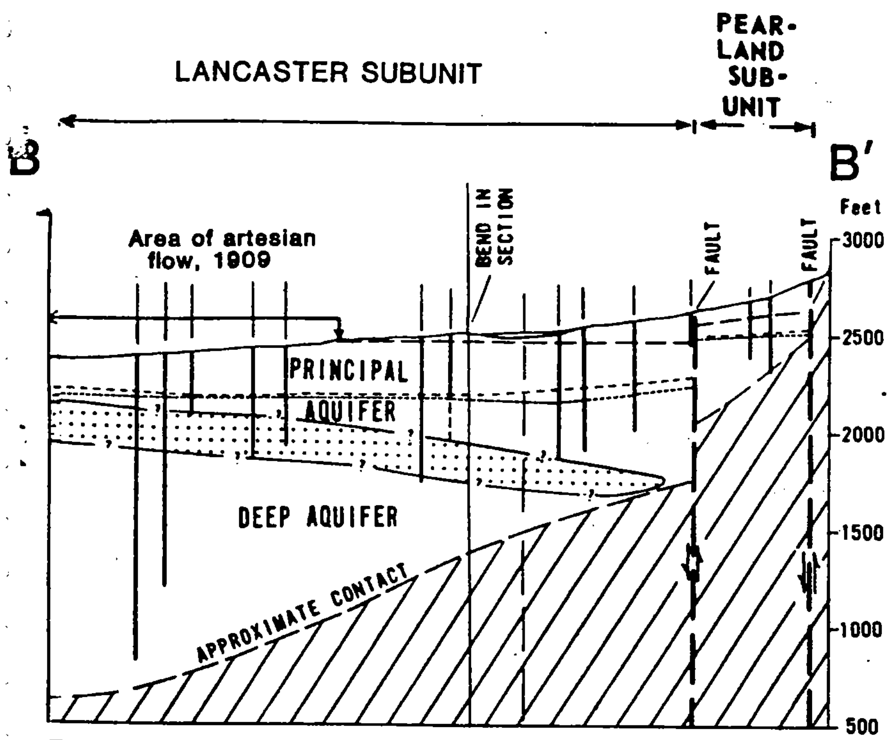


Figure 3 – Generalized geologic cross-section B–B′

**EXPLANATION**

(figures 2 and 3)

UNCONSOLIDATED DEPOSITS

LACUSTRINE DEPOSITS

CONSOLIDATED ROCKS

FAULT—Approximately located; arrows indicate direction of relative vertical movement

WELL--Dashed where perforated

WATER LEVEL, 1909

WATER LEVEL, 1964

WATER LEVEL, 1982

Geology modified from Bloyd (1967) and Durbin (1978)
Lacustrine deposits shown diagrammatically

Location of section lines shown on Plate III

| REFERENCE (+ see text) | AREA COVERED AV:Antelope Valley | PURPOSE (SCOPE) | REVIEW ONLY | SUBSURFACE INVESTIGATION | RUNOFF | PROSPECTIVE SPREADING GROUNDS AREAS: BASIS FOR SITE SELECTION | *HYDROLOGIC PARAMETERS | POTENTIAL SITES | WATER QUALITY INFORMATION | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|
| 1911-USGS Water Supply Paper 278 +1 | AV | Geologic and hydrogeologic study | yes | no | L: 1.33 to 9.4 $ft^3$/sec B: 16,927AF | Surface I between Little Rock Creek and Palmdale Reservoir | I: 20% | Little Rock Creek | yes | Comprehensive study. Shows extent of artesian conditions |
| 1946-LACFCD, Thayer +2 | AV | General geology related to groundwater for water conservation purposes | yes | no | L: 343 AF/$mi^2$ 22,300AF B: 653 AF/$mi^2$ 15,000AF A = 8,000 AF(E) | Not Discussed | Not Discussed | Not discussed | no | Postulates structural groundwater basins based on differing water levels |
| 1967-USGS Water Resources Open File Report +3 | AV | Regional qualitative analysis of groundwater basins for planning purposes | yes | previous (1966)+ | L and B: 27,000AF | Estimated hydrologic parameters, geologic factors, impounding behind fault barriers | Average P: 20% (E) Average T for proposed Sites: 65,000 gpd/ft (E) | West Antelope Basin, and 10 other regional sites | yes | Most referenced study. Comprehensive analysis Postulates and names groundwater subbasins. Estimated T values are too low for efficient groundwater movement |
| 1970-LACFCD +4 | Southeast portion of AV | Water conservation and flood control | yes | no | L: 7,900AF B:15,100AF | Discharge/percolation ratios | I for B: 65%(E) I for L: 50%(E) | Little and Big Rock Creeks | no | General discussion of geology and hydrology |
| 1976-DWR (TIR) +5 | AV | To identify potential spreading grounds | yes | no | No Information | General geologic processes, lithologic well logs and well production | High P estimated from lithologic logs and well production | a) Adjacent to remnant hills b) Adjacent to faults c) Along stream channels | no | Hypothetical study |
| 1978-USGS Water Supply Paper +6 | AV | To contruct a groundwater model of the basin | N/A | no | L: 12,100AF B:12,200AF | Not discussed | T: 8,000 to 100,000 gpd/ft (E) | Not discussed | no | Secondmost quoted study. Based mostly on reference 3 (1967) Describes relationship between aquifers |
| 1979-DWR (TIR) +7 | AV | Reconnaissance study for cost estimate of storing and recapture of California Aqueduct water in AV | yes | no | L: 12,000AF B: 11,500AF | Previous studies, lithologic well logs | I for B: 2-3 ft/day (E) I for L: 3 ft/day (E) I for Kings Cy: 1.5-2 ft/day (M) | None, spreading not feasible in any area | yes | Reconnaissance study, based mostly on conclusions of Ref. 3 (1967). Discusses effectiveness of faults as groundwater barriers |
| 1980-DWR District Report +8 | AV | Formulate and evaluate alternatives for a comprehensive water management plan | yes | no | No Information | Not discussed | Not discussed | Upper reaches of Big Rock and Little Rock Creeks | yes | Evaluation of water management alternatives |
| 1983-LACFCD +9 | Big Rock Creek drainage area | Geohydrology of Big Rock Creek, feasibility study for recharge | no | 5 borings 5 obs. wells Depths to 300' | B: 64,830AF (1977-78) | Subsurface investigation, geologic and hydrologic studies | Runoff coefficient: 0.12 | Near apex of B fan and southeast portion of Valyermo Basin | no | Detailed geologic and hydrologic study. Discusses effectiveness of faults as groundwater barriers |
| 1985/86- LACFCD +10 | Hunt Canyon and vicinity | Geohydrology for proposed detention basin | no | 6 borings 2 obs. wells electric logs Depths to 180' | No Information | Subsurface investigation, geologic and hydrologic studies | I for Qal: 1.5 to 7 ft/day (E) I for Qoa: 0.5 ft/day (E) P: 20% in Qal, less in Qoa (E) | Feasible spreading ground | yes | Proposed basin is feasible as spreading grounds. Discusses effectiveness of faults as groundwater barriers |
| 1986- DPW +11 | Anaverde Retention Basin | Geologic investigation for proposed retension basin | no | 5 borings 2 obs. wells seismic Depths to 60' | No Information | Site selected for Retention Basin only | I: 0.15 to 0.20 ft/day (E) | Not an adequate site for groundwater recharge | no | Bedrock exposed in basin |
| 1987 Geosolis Consultants +12 | Amargosa Retention Basin | Determine geologic conditions | no | 4 borings 1 observation wells to depths of 100 ft seismic refraction | No Information | Site selected mostly for flood control | P: $10^{-1}$ to $10^{-5}$ cm/sec Average $10^{-3}$ cm/sec | Adequate site if excavation of basin is reduced | no | Limited knowledge of basin geology |

* I: Infiltration P: Permeability T: Transmissivity (E): estimated (M): measured B: Big Rock Creek L: Little Rock Creek Qal: Young Alluvium Qoa: Older Alluvium

gpd/ft = gallons per day per foot AF = acre feet per year obs.: observation A = Amargosa

+ USGS Open File Report



TABLE 1