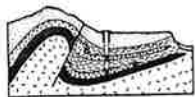


HYDROGEOLOGIC SUMMARY
of the
CARPINTERIA, MONTECITO, AND SANTA BARBARA
WATER DISTRICT SERVICE AREAS
for
SANTA BARBARA REGIONAL WATER RECLAMATION STUDY
(Appendix D--CH2M HILL Project Report)

Prepared By
Michael F. Hoover, Consulting Geologist
March 1980



MICHAEL F. HOOVER Consulting Geologist

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March 19, 1980

CH₂M Hill
P.O. Box 2088
Redding, California 96001

Attention: Mr. Donald R. Fox

Subject: Santa Barbara Waste Water Reuse Study
Geohydrologic Study

Gentlemen:

INTRODUCTION

Transmitted herewith is our geohydrologic investigation of the Carpinteria, Montecito, and Santa Barbara Water District Service areas. Our report summarizes the hydrologic and geologic characteristics of the groundwater basins within the Santa Barbara, Montecito, and Carpinteria Water District Service Areas. This report consists of a geohydrologic narrative describing the areal extent and significant physical characteristics of the major aquifers, including water levels, water quality, a discussion of the safe (perennial) yield of the basins, and a discussion of the potential for salt water intrusion.

On the basis of the above information, we have made recommendations concerning the use of wastewater in areas that have poor quality groundwater and areas that are presently overpumped and/or susceptible to salt water intrusion.

MICHAEL F. HOOVER
Consulting Geologist



CH₂M HILL
March 19, 1980
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If you have any questions concerning this report, please
contact me.

Sincerely,

A handwritten signature in dark ink, appearing to read "Michael F. Hoover". The signature is fluid and cursive, with a long horizontal stroke at the end.

Michael F. Hoover

MFH:rb

HYDROGEOLOGIC SUMMARY
OF THE
CARPINTERIA, MONTECITO, AND SANTA BARBARA WATER DISTRICT SERVICE AREAS
MARCH 1980

INTRODUCTION

Study Area

The area considered by this report includes the service areas of the Carpinteria County Water District, Montecito Water District, and the City of Santa Barbara service areas (Plate 1). These service areas comprise an east-west trending strip along the south coast of Santa Barbara County. The service area boundaries extend from the ocean to the foothills of the Santa Ynez mountains. Rainfall ranges from less than 16 inches per year along the coast to over 24 inches per year in the foothills.

Sources of Supply

The Districts' water supplies are from two sources: ground water (from wells) and surface water imported from Lake Cachuma, a Bureau of Reclamation project located along the Santa Ynez River north of the Service areas. Approximately 15% to 20% of the water districts' supplies come from water wells. The remainder is from the Lake Cachuma supply including a minor amount from tunnels in the Santa Ynez mountains, which transmit the water from Lake Cachuma to the south coast.

HYDROGEOLOGY

Generalized Geologic History

Geologically, the south coast of Santa Barbara County is an east-west trending south dipping homocline which is interrupted

by numerous folds and faults. A generalized geologic map of the area is shown on Plate¹. Crustal movements beginning during late Pliocene time created basins in which unconsolidated sands, clays and gravels were deposited. The general boundaries of the groundwater basins were established by these movements and are shown on Plate¹.

Most of the local basins are characterized by a southward thickening sedimentary wedges that are open to the ocean. The Santa Barbara Basin is open to the ocean on the southeast. The Montecito Basin is open to the ocean to the south. The Carpinteria Basin is open to the ocean to the west.

Water-bearing Rocks

Water bearing rocks are divided into two groups: the consolidated rocks of Tertiary age and the unconsolidated deposits of Tertiary and Quaternary age.

The consolidated rocks are composed primarily of shale and siltstone with lesser amounts of sandstones. These rocks form the backbone of the Santa Ynez Mountains and the more prominent foothill areas within the study area. The consolidated rocks are not generally considered a good source of ground water because of relatively low well yields (0 to 100 gallons per minute) and low storage volume of the aquifer.

The unconsolidated rocks in the area are represented by the Santa Barbara and Casitas Formations, and Quaternary alluvium. The Santa Barbara Formation underlies Santa Barbara Basin and portions of the Carpinteria and Montecito basins. The Santa Barbara Formation consists of marine sand, silt and clay. The non-marine Casitas Formation gradationally overlies the Santa Barbara

Formation and is composed of moderately to well-sorted gravel to clay size material.

Alluvium, including fanglomerate and older and younger alluvium are present over much of the area. The thickness of this material does not usually exceed 200 feet and is commonly much less.

The aquifers are generally of the artesian type and are generally either confined or semi-confined. Well yields from these formations are highly variable but commonly in the 200-800 gpm range with specific capacities of 2-7 gallons per minute per foot of drawdown. Transmissibility is also variable with values of 2000-20000 gallons per day per foot of aquifer most common.

GROUND-WATER LEVELS

Plate 2. shows water levels within the various basins. Groundwater flow is generally southward, or to areas of heavy pumpage. This latter example is best exemplified in the Santa Barbara Basin where an elongate depression exists in association with recent heavy pumpage from the City of Santa Barbara wells located in the south-central portion of the basin. This closely monitored heavy pumping program is being cooperatively studied by the USGS and the City of Santa Barbara to monitor the effects of possible salt water intrusion during periods of heavy pumpage.

It would appear from an analysis of water level (and chemical) data that the numerous east-west trending faults which cross the area act as semi-permeable barriers to ground water migration, forming semi-separate sub-basins within the major basins. It is our opinion that the deeper aquifers are more readily affected by these

faults. The shallower aquifers (commonly alluvium) do not appear to be offset by the faults, or, if offset, ground water migration is not significantly affected by the faults.

All of the basins show a considerable range in water levels through time. Basin water levels respond to rainfall and pumpage. Long-term well records indicate ground-water levels in the three district areas declined to historic lows during the early 1950's as a result of rapid agricultural and urban expansion in combination with below average rainfall. The oceanward portions of all three basins had water levels significantly below sea level.

With the availability of Lake Cachuma water to the South Coast in 1954, ground water pumpage declined and water levels began to rise. Ground water levels in all the basins are at near historic high levels, with the exception of the southern portion of the Santa Barbara Basin. It should also be noted that the South Coast has experienced 3 consecutive years of above average rainfall.

WATER QUALITY

Water quality data (including total dissolved solids, chlorides, boron, and sodium absorption ratios) is shown on Plate 3.

Ground water quality from wells within the study area is quite variable. The best water quality tends to be in the central portions of the basins. Poor quality water (high TDS and boron) is often related to the proximity of faults. Slightly higher TDS contents are typical for wells in consolidated rock aquifers. High chloride ion contents are common near fault zones and in wells along the coast that either penetrate only the shallow aquifers (> 50 feet deep) and/or have inadequate sanitary seals.

These areas are designated on Plate III.

SAFE YIELD

The safe yield is the amount of water that can be withdrawn from a ground water basin on an annual basis without causing undesirable environmental effects on the basin. The safe yield of the various basins has been evaluated by various investigators. The U.S. Geologic Survey (USGS) first established safe yield values for the South Coast Basins in 1951 (Upson). Most of the safe yield values of the basins within the study area have since been refined by more detailed investigations. The safe yield values listed below represent the most recent, or in our opinion, the most accurate estimates. Also included below is the pumpage in the basin under "average rainfall" conditions. Pumpage figures include both private and municipal pumpage.

TABLE I

Basin	Estimate of Safe Yield (acre-feet/year)	Pumpage (average rainfall)
Santa Barbara (including East sub-basin)	2100-3300 (Todd, 1978)	up to 2800 *
Montecito (including Toro canyon sub-basin)	1650 (Hoover, 1980)	725
Carpinteria	4500 (Geotechnical Consultant, 1976)	4300 to 4500

* Basin testing during 1979 resulted in higher than average pumpage in the Santa Barbara Basin rather than a water shortage.

As shown on Table I, the pumpage is nearly equal to the safe yield in the Carpinteria Basin during years of average rainfall. During years of below average rainfall pumpage will exceed

rainfall; however, detailed analysis (Geotechnical Consultant, 1976) indicates that salt water intrusion will not be a problem during normal 5-year drought cycles.

Although water levels in the Montecito Basin were low during the 1950's (Hoover, 1980), water levels are presently very high due to heavy rainfall and increased surface water supplies. The Santa Barbara Ground Water Basin was not heavily pumped from the late 1950's up until 1979, due to increased surface water supplies. However, due to a slowly increasing demand, the City of Santa Barbara expects to increase its well production up to the safe yield by 1984. During 1979, the City wells were pumped to capacity in order to test the response of the basin rather than to satisfy a water shortage.

SALT WATER INTRUSION

Growth on the south coast is presently limited by the availability of water supplies. As pumpage increases in the future in order to satisfy the demand created by new growth, the water basins will come under stress. When a ground water basin is stressed (pumpage exceeds recharge) water levels decline. Declining water levels in a ground water basin open to the ocean could result in salt water intrusion at some time in the future.

Previous studies (Upson, 1951 and Evenson, 1962) which considered over 40 years of water chemistry data, concluded that structural (offshore faults) and stratigraphic features (thick clay deposits) effectively seal deeper aquifers, thereby precluding salt water intrusion. However, recent monitoring programs conducted by the U.S.G.S. in cooperation with the City of Santa Barbara indicate that there has recently been a

measurable deterioration of water quality in the deeper aquifers of the Santa Barbara Basin. Degradation of water quality near the pumping City wells is not expected, nor is long-term ground water quality deterioration expected in view of the ongoing monitoring program.

The potential for deep aquifer intrusion does exist in the Santa Barbara Basin, and **probably in the other basins.** It is our opinion that chemical degradation of the deeper aquifers in all three basins will only occur when water levels are lowered substantially below sea level for significant periods of time (5 years or more).

Ongoing programs at the Orange County Water District indicate that wastewater which has undergone tertiary treatment can be injected into coastal wells, in order to artificially raise water levels above sea level. It is our opinion that such an injection program adjacent to the coastline of all these basins would create an effective hydrologic barrier to salt water intrusion.

Poor quality water within the shallow aquifer which exists in all three basins is a normal occurrence. (Piper and Garrett, 1953 and Pollard, Garrett, and Sinnott, 1959), and is not considered a significant problem.

IDENTIFICATION OF AREAS OF POTENTIAL SALT WATER INTRUSION

It is our conclusion that all three of the basins will in the near future undergo stress from increased pumping. Salt water intrusion into the deeper aquifers may result if water levels are lowered significantly below sea level. As described previously, the southern portions of the Santa Barbara Basin are currently experiencing the preliminary signs of salt water intrusion into the deeper aquifers. The southwest portion of the Montecito Basin

is apparently in hydrologic continuity with the Santa Barbara Basin and has experienced minor intrusion. The Toro Canyon sub-basin probably does not have a salt water intrusion problem at present. The Carpinteria basin is entirely open to the ocean on the west. Thick intervals of semi-impervious clays may be effectively blocking the migration of high salt waters into the primary aquifers. However, the potential for chemical deterioration of the ground water during periods of prolonged drought in combination with heavy pumping is considered possible.

RECOMMENDATIONS FOR AREAS OF WASTEWATER USE

Since significant lowering of ground-water levels below sea level in the Santa Barbara, Montecito and Carpinteria basins could create a potential of salt water intrusion into the deep primary aquifers of these basins, injection of wastewater into specific areas along the coastline is recommended. Injection would create a recharge mound, which would act as an effective barrier to salt water intrusion.

There are other areas which currently utilize quality ground water for agricultural or irrigation purposes. Use of wastewater in these areas for non-domestic purposes is recommended. These areas are shown on Plate 4. Detailed soil studies are recommended since many of these areas may have low permeability soils.

Other potential areas for direct use of wastewater include outlying golf courses and agricultural areas in the foothills. The cost efficiency of distribution to these areas must be considered an important factor in analyzing the feasibility. Soil permeability in these areas are also low and should be considered.

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Plate 1 - Geologic Map - too big to scan

Plate 2 - Groundwater Level Contour Map - too big to scan

Plate 3 - Groundwater Quality Map - too big to scan

Plate 4 - Areas of Recommended Wastewater Use - too big to scan