

**Geotechnical/Hydrologic Evaluation of Three Proposed Groundwater Wells
in the Coastal Sub-Basin (Storage Unit 3) of the Montecito Groundwater
Basin**

Santa Barbara County, California

By

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Exhibit 6

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1. List of acronyms

AFY: acre feet per year (1 acre foot = 43,560 cubic feet = 325,851 gallons)

CDWR: California Department of Water Resources

CGWB: Carpinteria Groundwater Basin

CVWD: Carpinteria Valley Water District

ETGM: Environmental Thresholds and Guidelines Manual

gpm: gallons per minute

mg/L: milligrams per liter

MGWB: Montecito Groundwater

MWD: Montecito Water District

RCF: Rincon Creek Fault

R: Groundwater threshold of significance

SBGWB: Santa Barbara Groundwater Basin

SRGWB: Idealized standard reference groundwater basin

SYUGWB: Santa Ynez Uplands Groundwater Basin

TDS: Total dissolved solids

USGS: United States Geological Survey

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Figure 16. Copy of Slade's 1987 Figure 1 showing the MGWB and its storage units. Slade (1987) assessed potential seawater intrusion into storage unit 3 and recommended criteria to prevent it. The range of discharge recommended by Muir (1968) was 100 to 300 acre feet / year. Red features were added by this Contractor. [page 67]

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3. Executive Summary.

This summary presents the key findings derived from the analysis of (i) the applications to install three new wells in storage unit 3 (the coastal sub-basin) of the Montecito Groundwater Basin, (ii) data concerning groundwater extraction and the conditions of the Montecito Groundwater basin, and (iii) several previous reports written about the hydrogeologic characteristics of the Montecito Groundwater basin. The key findings of this report are as follows:

(i). The proposed three new wells (the Schlesinger, Makarechian, and Hair wells) are very likely to cause significant adverse impacts on the groundwater resources of the Montecito Groundwater Basin's coastal sub-basin if constructed and operated.

(ii). The Makarechian and Hair wells would be installed in an intensely groundwater-mined portion of storage unit 3 comprised between Fernald Point to the east, highway 101 to the north, the Pacific Ocean to the south, and the Santa Barbara Cemetery to the west. The Makarechian and Hair wells would have significant adverse impacts on the groundwater resources of storage unit 3 concerning (a) well interference, (b) loss of well yield, and (c) seawater intrusion.

(iii). The Schlesinger well would have significant adverse impacts on the groundwater resources of storage unit 3 concerning (a) seawater intrusion, and (b) stream-aquifer interactions (that is, reduction of stream flow in San Ysidro Creek by groundwater extraction).

(iv). The safe yields of the Montecito Groundwater Basin and its storage units (storage units 1, 2, 3, and the Toro Canyon storage unit) stipulated in the Montecito Water District's 1998 Groundwater Management Plan overestimate the actual safe yields of the four storage units and the basin-wide safe yield. It was herein determined that the safe yields of storage units 1, 2, 3, the Toro Canyon storage basin, and the entire Montecito Groundwater basin equal 545, 38, 409, 130, and 1,122 acre feet per year, respectively. For comparison, the Montecito Water District's 1998 Groundwater Management Plan adopted a basin-wide safe yield equal to 1,650 acre feet per year.

(v). The Montecito Groundwater Basin is in a state of overdraft, which means that groundwater extraction has exceeded natural recharge for several consecutive years, groundwater levels are at historic low, and there are significant adverse impacts on its groundwater resources. The 2014 County of Santa Barbara's Groundwater Basins Status Report stated the following concerning long-term measured groundwater levels in the MGWB: "The hydrograph from the Montecito Basin shows a consistent decline over the period of record (since the early 1960s) and, with the exception of a couple of data points which may not reflect accurate measurements, shows a historic low water elevation". This condition of long-term declining ground water level (with adverse impacts, as shown by this Contractor in this report) is called groundwater overdraft. The County of Santa Barbara's Environmental Thresholds and Guidelines Manual, revised in July 2015, classified the Montecito Groundwater Basin in state of overdraft. This report demonstrates that the extent of overdraft in the Montecito Groundwater Basin is more severe than that stated by the County of Santa Barbara in 2015. The current net overdraft in storage unit 3 (the coastal sub-basin), for example, equals 591 acre feet per year.

(vi). There is ample evidence from high chloride concentrations measured in water from wells within the Montecito Groundwater Basin that seawater intrusion has occurred and is occurring in the Montecito Groundwater Basin.

(vii). The groundwater threshold of significance in storage unit 3 of the Montecito Groundwater Basin equals 0.71 acre feet per year when calculated with the County of Santa Barbara's Environmental Thresholds and Guidelines Manual procedure; yet, it equals zero when site-specific impacts are considered. The three appealed wells (Schlesinger, Makarechian, Hair) are very near the coastline and most likely will worsen seawater intrusion in storage unit 3 of the Montecito Groundwater Basin.

(viii). The Environmental Thresholds and Guidelines Manual's method to calculate groundwater thresholds of significance in alluvial basins of Santa Barbara County does not adequately consider site-specific impacts to groundwater resources in the storage units of the Montecito Groundwater Basin. The Environmental Thresholds and Guidelines Manual's method relies on an idealized reference groundwater basin with characteristics similar to those of the Santa Ynez Uplands Groundwater Basin that does not account for site-specific threats to groundwater resources posed

by well interference, loss of well yield, seawater intrusion, and depletion of stream flow.

(ix). This report's findings concur with the California Coastal Commission's reason to appeal the local permits issued to install the Schlesinger, Makarechian, and Hair wells in that the local permits are inconsistent with the County of Santa Barbara's local coastal program.

(x). There are perplexing gaps of knowledge and lack of transparency about the Montecito Groundwater Basin. Neither the Montecito Water District nor the County of Santa Barbara knows with certainty how much groundwater is extracted from the Montecito Groundwater Basin, nor the number of active wells, their locations, and groundwater extraction rates. It is impossible to protect the groundwater resources of the Montecito Groundwater Basin without such knowledge. There is also at present inadequate monitoring of the Montecito Groundwater Basin, both in terms of the frequency and the spatial coverage of measurements of its groundwater levels and groundwater quality.

The remainder of this report provides an analysis of the reasons leading to findings (i) through (x). This report's Writer concluded –based on the reviewed data- that applications for new wells in the Montecito Groundwater Basin must demonstrate that proposed extraction of additional groundwater would not adversely impact the groundwater resources of this overdrafted basin.

Drought recurrence is a characteristic of the climate of Santa Barbara County. Droughts will recur in the future, perhaps with increasing severity, as they have recurred in the past. Stresses on the Montecito Groundwater Basin will be aggravated if well permitting continues unabated. Seawater intrusion is an irreversible process that cannot be mitigated by rainfall during wet years during which groundwater recharge adds to storage to the coastal sub-basin of the Montecito Groundwater Basin. Depletion of stream flow and loss of well yield by aquifer dewatering are likely to be accentuated in the Montecito Groundwater Basin by the proliferation of new wells.

Other factors pose additional threats to the Montecito Groundwater Basin. The National Research Council (2012), for example, predicted sea-level rise by year 2100 for the coasts of California, Oregon, and Washington to range between 1.3

and 5.6 feet relative to the 2000 mean sea level. Such degree of sea-level rise would exacerbate seawater intrusion in the intensely groundwater-mined storage unit 3 of the Montecito Groundwater Basin.

4. Background and Scope.

Dr. Hugo A. Loáiciga (henceforth “Contractor”) was retained in August 2015 by the California Coastal Commission (henceforth “Commission”) to conduct a geotechnical/hydrologic evaluation of the possible hydrologic impacts of installing and operating three irrigation wells to be drilled and operated in the coastal sub-basin (storage unit 3) of the Montecito Groundwater Basin (MGWB, henceforth).

The County of Santa Barbara’s approvals will be considered by the Commission pursuant to Appeal No. A-4-STB-14-0060 (Schlesinger, 1685 Fernald Point Lane, Montecito); Appeal No. 14CDH-00000-00016 (Makarechian, 1150 Channel Drive); and Appeal A-4-STB-14-0062 (Hair, 1169 Hill Road).

The California Department of Water Resources’ (CDWR) Bulletin 118 (California’s Groundwater, 2003) provides a succinct description of the Montecito Groundwater Basin (MGWB), which underlies the unincorporated town of Montecito and the Toro Canyon watershed. Precipitation ranges from 17 to 21 inches per year. The MGWB’s surface area equals 6,270 acres (9.8 square miles). It is divided into four sub-basins or storage units 1, 2, 3, and the Toro Canyon unit. Storage units 1, 2, and 3 are the northern, central, and southern (coastal) sub-basins, respectively. The Toro Canyon unit lies on the eastern portion of the MGWB. The acreages of storage units 1, 2, 3 and the Toro Canyon unit equal 2,784, 608, 1,674, and 1,204, respectively. Figure 1 depicts the MGWB and its storage units. The MGWB is bounded on the north by the Santa Ynez Mountains and the Arroyo Parida fault, on the east by consolidated rocks, on the southeast by the Fernald fault, and on the northeast by a surface drainage divide that separates the Montecito and Carpinteria Groundwater Basins. The offshore Rincon Creek fault and the Pacific Ocean bound the basin on the south. An administrative boundary on the west separates the MGWB from the Santa Barbara Groundwater Basin (SBGWB), although there is no physical separation between the two basins. The area overlying the basin is drained by several small creeks (Buena Vista, Montecito, Oak, Romero, San Ysidro, Toro Canyon) that flow from the Santa

Ynez Mountains towards the Pacific Ocean. The primary groundwater-bearing deposits in the Montecito Groundwater Basin are unconsolidated alluvial deposits, the Casitas and Santa Barbara Formations. Groundwater is generally unconfined within alluvial deposits, where well yields are modest. The upper Casitas Formation is the main groundwater-bearing stratum of the Montecito Groundwater basin. It is partially confined in some parts of storage units 1 and 3. The Santa Barbara Formation occurs only in a restricted area in the southwest portion of the basin and, therefore, is of negligible use as a groundwater source in the MGWB (CDWR's Bulletin 118, 2003; see also, CDWR, 1999).

Figure 2 depicts the approximate locations of the properties where the Schlesinger, Makarechian, and Hair wells would be installed if approved. It is seen in Figure 2 that the Makarechian and Hair wells would be located less than 300 feet away from each other and less than 300 feet from two other existing wells (Haber, Hair). Figure 2 shows that the Schlesinger well would be located less than 200 feet from the nearest point along the course of San Ysidro Creek. The County-approved Schlesinger, Makarechian, and Hair wells would lie within 400 feet from the high-tide line.

Wells A and B, shown in Figure 2, are owned by the Biltmore Hotel and are about 500 feet east of the Makarechian and Hair wells. The Biltmore wells have a combined permitted groundwater extraction equal to 32 acre feet / year (AFY) according to the CCC. There are several other active wells near the Schlesinger, Makarechian, and Hair wells. Wells labeled C and D, for example, are private wells owned by the Montecito Sea Meadows Mutual Water Company and the Ivydene Mutual Water Company, respectively. Senior Environmental Health Specialist Norman Fujimoto (Public Health Department, County of Santa Barbara) reported in a site inspection dated January 22, 2014, that the two wells functioning at the Montecito Sea Meadows Mutual Water Company were pumping a combined 164 gpm (gallons per minute) in November 2013. If that rate were maintained constantly it would amount to 264 AFY of groundwater extraction. The Montecito Sea Meadows Mutual Water Company reported to the State's Drinking Water Program that it extracted approximately 58 acre feet of groundwater in 2014 with the two wells constructed on site in 1984 as part of the Ocean Meadows Development Plan project. The Ivydene well has a permitted extraction equal to 20 AFY according to the CCC. Other active wells near the appealed wells belong to

the Sykes Mutual Water Company, the Lingate Lane Mutual Water Company, and the Miramar Addition & Improvement Water Company. The latter three water companies have a combined groundwater extraction of approximately 68 AFY (from letter by Mrs. George P. Kerns to the South Central Coast Regional Commission, dated April 21, 1977).

The approximate locations of the Montecito Water District's (MWD, henceforth) four active municipal wells, namely, the Amapola, Ennisbrook 2, Ennisbrook 5, and Paden 2 wells are depicted in Figure 2, also. These wells had a combined groundwater extraction of approximately 495 AFY in water year 2014-2015 (that is from September 1, 2014, through August 31, 2015). The combined extractions of wells A, B, C, D, those belonging to the Sykes, Lingate Lane, and Miramar Addition and Improvement water companies, and those owned by the MWD are estimated by this Contractor to be about 879 AFY. To this amount one must add the extractions of many other wells within the coastal sub-basin (storage unit 3) of the MGWB. Preliminary research by Commission staff suggests that there are at least a dozen wells within a half mile from the Schlesinger, Makarechian, and Hair wells, and at least 250 wells lie within storage unit 3. This Contractor estimates that during current drought conditions the groundwater extraction in the coastal sub-basin of the MGWB may exceed 1,000 AFY. The implications of this level of groundwater extraction for the coastal sub-basin in particular, and the MGWB in general, are elaborated further in section 8 of this report.

Proximity to the coastline, to surface water resources (creeks), and interference between neighboring wells extracting groundwater from the same water-bearing geologic formations are key topics addressed in this report. It can be seen in Figure 2 that there are three streams flowing toward the Pacific Ocean that are comprised between the Makarechian and Hair well's proposed locations and that of the Schlesinger well. Those are Montecito, Oak, and San Ysidro creeks. Figure 3 shows a Google Earth image of the approximate locations of the proposed Makarechian and Hair wells, and the existing Chase, Haber, and private wells A and B. Figure 4 is a Google Earth image of the approximate location of the Schlesinger well. Notice the proximity to the coastline of the appealed groundwater wells.

Figure 5 depicts the approximate locations of wells permitted within storage unit 3 and the associated coastal zone (the latter under CCC jurisdiction). It is striking in Figure 5 the agglomeration of wells in the vicinity of the coastline and near creeks, two environments particularly vulnerable to groundwater extraction. It is also remarkable in Figure 5 the clustering of many wells within the coastal zone, a practice conducive to well interference and loss of well yield. This Contractor reviewed County of Santa Barbara records of well permits issued since 1906 till present that revealed about 1,280 such permits. The status of many of these wells remains uncertain or unknown to the local water purveyor (the MWD) and the local well-permitting agency (the County of Santa Barbara). In a letter dated November 21, 2014, from the MWD to the County of Santa Barbara, the former acknowledged that it “had no mechanism for accurately determining the active number of active wells, or the private well water use and demand; nor does it have a viable mechanism for monitoring the extraction of groundwater from the aquifers within its service area”. The same letter reported the failure of “approximately three dozen private wells” within the MWD service area and asked the County of Santa Barbara for a moratorium of well permits within the boundary of the MGWB. The MWD’s Engineering Manager informed its Board of Directors in a May 19, 2015, memorandum that the private extraction of groundwater was believed to range between 700 and 1,000 acre feet / year (AFY) in the MGWB. This Contractor estimates the amount of private extraction from the MGWB exceeds the 700 to 1,000 AFY estimate by the MWD, and may be larger than 1,500 AFY. In fact, it was stated above that this Contractor estimates that the current groundwater extraction in storage unit 3 alone possibly exceeds 1,000 AFY.

The applications to construct the Schlesinger, Makarechian, and Hair wells were submitted during the ongoing severe drought that started in water year 2011-2012 (that is, September 1, 2011 through August 31, 2012). The number of well applications has surged in Montecito and the rest of the State of California during the current drought, concomitant with the reduction of surface-water sources. At the same time, many wells have gone dry as an increasing number of wells extract groundwater from the same groundwater bearing formations, whose natural recharge has been greatly or totally reduced during the current drought. The decline of hydraulic head in coastal groundwater sub-basins caused by intensified

groundwater extraction is the direct cause of seawater intrusion that contaminates otherwise freshwater-water coastal aquifers (Loáiciga, et al. 2012). Baseflow from aquifers to support streamflow in streams is reduced or terminated by falling groundwater levels as the aquifer-stream hydraulic connection is broken (Kram and Loáiciga, 2014). Hydraulic interference among neighboring wells increases the drawdown in the wells, which may lead to reduction of wells' yields and well failure (Loáiciga, 2004) as recently reported by the MWD's letter dated November 21, 2014 to the County of Santa Barbara asking for a moratorium on permitting of new wells in the MGWB.

The May 19, 2015, memorandum from the MWD's Engineering Manager to the Board of Directors presented groundwater-level data for Spring 2015 showing that the four active MWD wells that are sources of potable-water production had the levels listed in Table 1.

Table 1. Groundwater levels in the four MWD municipal wells, Spring 2015. The four featured wells lie within storage unit 3, the coastal sub-basin.

Well name	Groundwater level	Units
Amapola	-20	Feet below mean sea level
Ennisbrook 2	-26	Feet below mean sea level
Ennisbrook 5	-47	Feet below mean sea level
Paden 2	-58	Feet below mean sea level

The implications of the data shown in Table 1 for the purpose of protecting the water quality in storage unit 3 of the MGWB are further elaborated in section 5 (dealing with seawater intrusion in storage unit 3) of this report. The County of Santa Barbara's 2014 Groundwater Basins Status Report states that the groundwater level in the MGWB has been declining since the 1960s and are at historic low (see page 12 of the 2014 report). The water levels listed in Table 1 support that statement.

Figure 6 portrays measured rainfall in Montecito since water year 1925-1926. The last four water years (2011-2012 through 2014-2015) are marked in red in Figure 6. Rainfall during the current drought averaged 9.17 inches per year which is the lowest four-year average since 1925 in Montecito, where average annual rainfall

equals 19.91 inches. Droughts, defined by the Contractor as three or more consecutive years with below (long-term) average annual rainfall (see Loáiciga, 2005), are recurrent phenomena in Santa Barbara County, and in the Montecito area, in particular.

Figure 7 depicts drought recurrence in the City of Santa Barbara since 1867. The patterns of rainfall in the City of Santa Barbara and Montecito are almost identical, except for the fact that the Santa Barbara average annual rainfall is 18.01 inches, about 1.90 inches less than that in Montecito. It is seen in Figure 7 that there have been 12 droughts during the instrumental period. The average drought duration was 4.6 years and the longest drought lasted 9 years (in the second half of the 19th century).

The highly variable and drought-prone climate of Santa Barbara County must be taken into account in the management of Montecito's water resources. The rainfall data herein presented demonstrate that the current drought is average insofar as its duration is concerned.

Groundwater extraction in the MGWB by the four wells that are sources of potable water to the MWD rose rapidly, more than fivefold, as rainfall dwindled during the drought. Figure 8 depicts the combined annual groundwater extraction by the MWD's Amapola, Ennisbrook 2, Ennisbrook 5, and Paden 2. It is seen in Figure 8 that the MWD's four municipal wells extracted nearly 500 AFY in water years 2013-2014 and 2014-2015 from storage unit 3. The MWD extraction data shown in Figure 8 are at odds with Table 1 of the Santa Barbara County's 2014 Groundwater Basins Status Report which lists the MGWB as having an annual "draw" equal to 500 acre feet of groundwater, and zero surplus or overdraft. The County's 500 AFY represents a gross underestimation of the groundwater extraction in the MGWB. It was estimated above by this Contractor that groundwater extraction in storage unit 3 alone is close to about twice the County's basin-wide estimate of 500 AFY. The 2014 Groundwater Basins Status Report stated the following (in its page 12) concerning long-term measured groundwater levels in the MGWB: "The hydrograph from the Montecito Basin shows a consistent decline over the period of record (since the early 1960s) and, with the exception of a couple of data points which may not reflect accurate measurements, shows a historic low water elevation". This condition of long-term declining groundwater level (with

concomitant adverse impacts, as shown by this Contractor in this report) is called overdraft. Further confusion is created by the County of Santa Barbara's 2015 Environmental Thresholds and Guidelines Manual (ETGM) that lists in its Table 1, page 73, an overdraft MGWB equal to 426 AFY in the MGWB, in clear contradiction of the 2014 Status Report's contention that the MGWB has zero surplus or overdraft. Section 8 of this report demonstrates that the MGWB is in state of overdraft.

It is common for water purveyors and private well owners to increase groundwater extraction during droughts as they seek to compensate for reduced surface water sources and meet rising water use. Their strategy is to resort to groundwater storage to mitigate temporary shortfalls of surface water, with the expectation that rainfall will return to replenish aquifer storage and restore normalcy. This strategy is jeopardized when a drought lasts longer than usual, say, longer than three years in our area, because groundwater storage may be severely depleted, leading to well failures, heightened seawater intrusion, and other adverse impacts on groundwater resources. The strategy of increasing groundwater extraction during drought poses special risks in coastal groundwater sub-basins, such as storage unit 3 of the MGWB. Table 1 listed recent groundwater levels in the four MWD potable-production wells in storage unit 3 that are substantially below sea level. Seawater migrates in the direction of decreasing hydraulic head, that is, landward, as groundwater elevation is lowered below sea level by wells in a coastal sub-basin, storage unit 3 being a case in point. Pervasive seawater intrusion may render coastal aquifers useless as water sources for human, industrial, and irrigation uses unless desalination technology is deployed to remove salts from contaminated groundwater. In spite of the existence of technological fixes, their deployment raises a number of issues such as brine disposal, elevated energy and operational costs, the contamination of natural freshwater sources, and the violation of environmental safeguards (Loáiciga et al., 2012).

Section 5 of this report presents an analysis of seawater intrusion in storage unit 3 of the MGWB and deconstructs the fallacious notion that there is an offshore barrier to seawater intrusion along its southern perimeter. Section 5 provides evidence from studies that have established that natural seaward discharge of groundwater in the MGWB is needed to protect the coastal freshwater aquifer. Seaward discharge is not wasted freshwater as insinuated by consulting geologist

A. Simmons in an October 15, 2014, presentation to the Montecito Planning Commission and in an undated presentation to Commission staff. Instead, seaward discharge of groundwater reflects a natural condition necessary to preserve groundwater quality in storage unit 3.

This report focuses on the possible impacts that the three proposed and appealed wells (Schlesinger, Makarechian, Hair) could have in storage unit 3 of the MGWB. These wells share, for all practical purposes, nearly identical profiles in regards to their potential to (i) exacerbate groundwater-level decline near the coastline and contribute to seawater intrusion, and (ii) induce further well-interference that could impact existing wells. Potential adverse impacts on San Ysidro Creek's stream flow must be taken into account in the case of the Schlesinger well.

5. Seawater intrusion in storage unit 3 of the MGWB.

There have been several hydrogeologic studies of the South Coast groundwater basins of Santa Barbara County. A few of them specifically targeted the MGWB. Others assessed neighboring groundwater basins (the Carpinteria Groundwater Basin (CGWB), the Santa Barbara Groundwater Basin (SBGWB)) that share very similar conditions as those found in the MGWB insofar as the threat of seawater intrusion is concerned. The findings of a few of those hydrogeologic studies were pertinent to the Contractor's scope of work in the development of this report. It is not part of this report's scope to repeat a very large body of information already available elsewhere, but rather, to highlight critical previous knowledge relevant to its stated purpose, which has to do with determining possible hydrologic impacts of the proposed Schlesinger, Makarechian, and Hair wells. The following are excerpts from previous reports that touched on the issue of seawater intrusion in the MGWB or nearby basins:

(i). Upson, J. E. (1951). "Geology and ground-water resources of the south-coast basins of Santa Barbara County, California, with a section on surface-water resources, by H. G. Thomasson, Jr." U.S. Geological Survey (USGS) Water-Supply Paper 1108. This was the earliest USGS hydrogeologic investigation of groundwater basins of the south coast of Santa Barbara County. On page 3, Upson stated that the possibility of sea-water encroachment (herein called seawater intrusion) "exists along the shore west of Carpinteria and such encroachment will

doubtless occur if excessive pumping is continued, although there was no evidence of such contamination as of 1946”.

(ii). Muir, K.S. (1968). “Groundwater reconnaissance of the Santa Barbara-Montecito Area, Santa Barbara County, California”. US Geological Survey Water Supply Paper 1859A. This was the first USGS hydrogeologic report focused on the MGWB (it also surveyed the SBGWB). Muir stated on pages 1 and 2 that: “Most groundwater in the Santa Barbara-Montecito area is suitable for general use. However, groundwater in some of the consolidated rocks and in the shallow unconsolidated deposits adjacent to the coast is too saline for most uses. Seawater intrusion has occurred in the Santa Barbara area and the western part of the Montecito area”. On pages 23-24, Muir wrote that “the groundwater outflow to the ocean required to prevent seawater intrusion seems to be about 100-300 acre feet per year”. Muir’s Figure 2 (herein numbered as Figure 9) and Figure 3 (herein Figure 10) show early hydrogeologic interpretations of basin delineation and aquifer stratigraphy, respectively. These Figures are reproduced in this report because they contain useful conceptual understanding of potential seawater intrusion in the MGWB.

Figure 9 portrays an early delineation and interpretation of the MGWB, the SBGWB, and the RCF fault trending east-west about 1,000 feet offshore from the coastline in storage unit 3 of the MGWB. Geologic section E'-E is depicted in Figure 10. There is no physical separation between the MGWB and the SBGWB, as was stated in section 4 (see also the CDWR’s (2003) Bulletin 118). Notice that storage unit 3 (which contains different, stratified, groundwater-bearing formations) extends under the sea floor until encountering the upthrown (U) side of the Rincon Creek fault. Seawater is in contact with the surficial, permeable, layers of the storage unit 3 in the area comprised between the coastline and the fault, and most likely with deeper deposits through submarine canyons eroded over geologic time by streams flowing through the RCF. In addition, fractures in consolidated rocks on and near the RCF allow the motion of submarine fluids (those below the sea floor) through the fault. The direction of flow depends on the hydraulic heads in the storage-unit 3 strata (aquifers). The flow is seaward as long as the hydraulic gradient drives groundwater flow towards the sea.

Muir's storage unit 4 shown in Figure 10 comprises part of what is now called storage unit 3 (the southern or coastal sub-basin) and all of storage unit 2 (the central sub-basin). Muir's storage unit 5 is currently known as storage unit 1 (the northern sub-basin). Groundwater flow is seaward as long as hydraulic head in the aquifer is sufficiently higher than the sea level on the coast. Otherwise the seawater wedge (red, dotted, line in Figure 10) advances landward, a phenomenon called seawater intrusion.

Figure 11 (Muir's 1968 Figure 4) depicts hydrogeologic conditions prevailing in storage unit 3 of the MGWB in 1964, when the water level (hydraulic head) near the coast had fallen below sea level. This, in Muir's opinion, caused seawater to move laterally and vertically in a landward direction, as depicted by the red arrows added by this Contractor.

(iii) Geotechnical Consultants, Inc. (1974). "Hydrogeologic Investigation of Montecito groundwater basins, Santa Barbara, County, California, for Montecito County Water District". This Contractor's review of pertinent literature revealed that the myth of a seawater barrier on the southern perimeter of the MGWB can be traced to the Geotechnical Consultants' (1974) report. The following excerpt was taken from the Geotechnical Consultants' (1974) report, page 21: "The other major fault, the east-west trending Rincon Creek Thrust, is known from oil field logs to be located approximately $1,000 \pm$ feet offshore near Montecito (see geologic section A-A', Plate A4.1). The southern side of the fault has been upthrown over the northern side with the fault dipping southwardly at angles ranging from 50 to 70 degrees; displacement is as much as 3,000 to 5,000 feet. Evidence from Carpinteria Basin reveals that the fault thrusts consolidated Tertiary rocks over late Pleistocene deposits, indicating relatively recent movement. This condition also probably exists near Montecito and would tend to create a barrier to the seaward movement of groundwater or the landward movement of seawater [emphasis added by this Contractor]. Hence, the trace of the fault is utilized as the southern boundary of Montecito Basin".

Geotechnical Consultants' (1974) interpretation of the Rincon Creek Fault (RCF) as a barrier to seawater intrusion influenced others. In a 1977 report entitled "Adequacy of the groundwater basins of Santa Barbara County" by the Santa Barbara County Water Agency (see page 7 of the report) the topic of seawater

intrusion into coastal basins was addressed. The 1977 report described the MGWB as having a “faulted barrier” to seawater intrusion.

What other authors call “connate” (brackish) groundwater in the MGWB (see Geotechnical Consultants, 1974) this Contractor interprets as the presence of a seawater-freshwater mixing zone on the north (downthrown) side of the RCF.

Furthermore, on page 39 of Geotechnical Consultants’ (1974) report it is stated that: “All previous investigations, including that of the USGS, have indicated that the offshore Rincon Creek Thrust Fault is an effective barrier to seawater intrusion into the deeper water-bearing zones [emphasis added by this Contractor]. In spite of this statement, the GTC (1974) states on page 39 that: “Previous historical occurrences of seawater intrusion and degradation of water in wells located in the Carpinteria Basin-Toro Canyon Subunit do not appear to be as severe as wells located in Montecito Basin.” On its page 39 the GTC (1974) report attributed the salinization of groundwater in the MGWB as follows: “the saline wedge apparently leaked into shallow deposits through the fault”

Figure 12 depicts a geologic section through the MGWB presented in Geotechnical Consultants’ (1974) report that represents a revision of the earlier interpretation of storage units proposed by Muir (1968).

(iv). Hutchinson, C.W. (1979). “Groundwater Monitoring at Santa Barbara, California, Phase 1”. US Geological Survey Open-file Report 79-923. This study was devoted to the portion of the SGWB that is contiguous to the western portion of the MGWB. On page 23 of this report it is written that: “Saltwater intrusion is a potentially serious problem in the Santa Barbara groundwater basin. It is important that the initial stages of seawater stages be recognized so that steps be taken to contain or reverse the situation. Chloride is the major anion of seawater and it is not readily absorbed to aquifer materials; therefore, it moves through the aquifer at about the same rate as groundwater. Increases in chloride concentration are probably the first indication of seawater intrusion in the aquifer. The chloride concentrations in samples collected from various zones tapped by the coastal monitoring wells (350 to 2,800 mg/L), significantly higher than in the municipal supply wells (25-130 mg/L), indicate possible saltwater intrusion”. Figure 13 portrays a generic geologic section presented in Figure 2 of Hutchinson (1979)

where the seawater wedge is positioned on the northern side of the Rincon Creek Fault.

(v). Martin, P. (1984). "Groundwater monitoring at Santa Barbara, California, Phase 2". US Geological Survey Water Supply Report 2197. This was a continuation of the seawater-intrusion studies in the SBGWB started by the USGS in 1979. Page 1 of Martin's (1984) report states that:

"From July 1978 to January 1980, water levels in the southern part of the Santa Barbara ground-water basin declined more than 100 feet. These water-level declines resulted from increases in municipal pumping since July 1978. The increase in municipal pumping was part of a basin-testing program designed to determine the usable quantity of ground water in storage. The pumping, centered in the city less than 1 mile from the coast, has caused water-level declines to altitudes below sea level in the main water-bearing zones. As a result, the ground-water basin would be subject to saltwater intrusion if the study period pumpage were maintained or increased. Data indicate that saltwater intrusion has degraded the quality of the water yielded from six coastal wells. During the study period, the six coastal wells all yielded water with chloride concentrations in excess of 250 milligrams per liter, and four of the wells yielded water with chloride concentrations in excess of 1,000 milligrams per liter. Previous investigators believed that saltwater intrusion was limited to the shallow part of the aquifer, directly adjacent to the coast. The possibility of saltwater intrusion into the deeper water-bearing deposits in the aquifer was thought to be remote because an offshore fault truncates these deeper deposits so that they lie against consolidated rocks on the seaward side of the fault. Results of this study indicate, however, that ocean water has intruded the deeper water-bearing deposits, and to a much greater extent than in the shallow part of the aquifer. Apparently the offshore fault is not an effective barrier to saltwater intrusion. No physical barriers are known to exist between the coast and the municipal well field. Therefore, if the pumping rate maintained during the basin-testing program were continued, the degraded water along the coast could move inland and contaminate the municipal supply wells [emphasis added by this Contractor]. The time required for the degraded water to move from the coast to the nearest supply well is estimated, using Darcy's equation, to be about 20 years". Figure 14 shows a map of the Santa Barbara groundwater basin depicting the western side of the MGWB, which has similar

hydrogeologic conditions to those of the Santa Barbara groundwater basin. The separation between the Santa Barbara groundwater basin and the MGWB is purely an administrative boundary: there is no physical separation of the two basins.

The importance of Martin's (1984) study is that it was a controlled experiment of groundwater extraction that established that the offshore fault is neither a barrier to shallow seawater intrusion nor to deep seawater intrusion into the adjacent coastal basin.

(vi). Hoover, M. (1980). "Safe yield evaluation of the Montecito Basins and Toro Canyon Area". This was a study commissioned by the MWD to consulting geologist M. Hoover. Figure 15 presents a copy of Hoover's (1980) plate 14 depicting two wedges of salinized groundwater in the MGWB, one shallow wedge and one deep wedge. Figure 15 also shows wells previously cited in this Contractor's report as being active in storage unit 3, namely the Chase well and one of the Biltmore Hotel's wells. This Contractor posits that the brackish groundwater in the shallow and deeper wedges are not separated by freshwater, but, rather, are vertically connected as shown by the added dotted red line, whose exact location remains to be determined. The location of the seawater wedge could be most economically prospected with geophysical surveys.

It is relevant at this juncture to cite a written professional opinion dated May 13, 2008, by consulting geologist M. Hoover to Mr. Dave Ward of the Planning and Development Department of Santa Barbara County concerning a proposed well intended to supply landscape-irrigation water and laundry water to the Miramar Beach Resort and Bungalows project. The well would have been located in storage unit 3 of the MGWB. Geologist Hoover wrote in his opinion that: "There is a significant likelihood for seawater intrusion at the Miramar Hotel site. Over pumping at nearby sites such as Santa Barbara Cemetery, Hill Road, Biltmore Hotel, and Toro Canyon have resulted in elevated chloride levels, a clear indication of seawater intrusion". The Miramar site is located about 1,500 feet west of the appealed Schlesinger well.

(vii). Slade, R.M. (1987). "Hydrogeologic assessment proposed water augmentation measures item No. 8 seaward migration of groundwater: for Montecito Water District". Slade's (1987) study assessed the feasibility of

developing additional groundwater supplies for the MWD by installing wells along the southern margin of storage unit 3 of the MGWB. Seawater intrusion was a key consideration of Slade's (1987) study. Slade's (1987) report addressed the role of the Rincon Fault Creek as a possible barrier to subsurface flow. It stated on pages 4 and 5 that: "Because bedrock is thrust upward on the southern side of the fault, it may create at least a partial barrier to seawater intrusion in the deeper aquifers of this storage unit; the shallow aquifer zone do remain, however, open to potential invasion by seawater". Furthermore, Slade (1987) stated: "There are unfortunately, no data whatsoever on the effectiveness and/or integrity of the Rincon Creek Thrust Fault as a continuous barrier to landward migration of seawater in the deeper, Santa Barbara Formation-type deposits". It is evident that hydrogeologist Slade was unaware of the Martin's (1984) USGS report that had established through experimental evidence that seawater intrusion had occurred deep through the Rincon Creek Fault in the neighboring SBGWB.

The Slade (1987) study recommended quantitative criteria ((a) and (b) below) to be observed to prevent seawater intrusion in storage unit 3 of the MGWB:

- (a). A seaward hydraulic gradient not less than 1/100 in coastal aquifers;
- (b). Groundwater levels in new wells must not be allowed to drop below about elevation + 5 feet (above mean sea level) to maintain a positive seaward gradient of fresh water.

The groundwater levels measured in the Spring 2015 at MWD's production wells, which are listed in Table 1, show that the wells' levels were at least 25 feet below the recommended safe elevation recommended by Slade (1987).

Slade (1987) calculated the groundwater discharge to the sea floor in storage unit 3 as being equal to 74 acre feet /year through the use of Darcy's law. He used a discharge thickness equal to 6 ft., a length of discharge zone equal to 11,000 feet (along the coastline), a hydraulic gradient of 1/100, and a hydraulic conductivity equal to 100 gpd/ft² (= 13.36 ft/day) in the calculation of the seaward groundwater discharge. It is noteworthy that the Slade's (1987) recommended groundwater discharge to the coastal zone in storage unit 3 is less than the 100 to 300 AFY recommended in Muir's (1968) study needed to prevent seawater intrusion into the

MGWB. Figure 16 shows the MGWB and its storage units delineated by Slade (1987).

The seaward groundwater discharge calculated by Slade (1987) is not water that would be wasted to the ocean, as implied by geologist Adam Simmons in an October 15, 2014, presentation to the Montecito Planning Commission and in an undated 2014 presentation to Commission staff while arguing in favor of permitting the proposed Schlesinger, Makarechian, and Hill wells. Rather, this groundwater discharge is maintained by seaward hydraulic gradient that prevents seawater intrusion into storage unit 3, a fact recognized decades ago by USGS hydrogeologist Muir (see Muir, 1968) and consulting hydrogeologist Slade (1987), who studied the MGWB, by USGS hydrogeologists Hutchinson (1979) and Martin (1984), who worked in the neighboring Santa Barbara groundwater basin, and, more recently, by this Contractor (see Loáiciga, 2014), who worked in the neighboring Carpinteria groundwater basin (CGWB).

(viii). Loáiciga, H.A. (2014). Review of the “Carpinteria Groundwater Basin Hydrogeologic Update and Groundwater Model Project: Final Report by Pueblo Water Resources Inc. June 2012”. This was a review commissioned by the Carpinteria Valley Association, a non-profit citizens’ group, to this Contractor to evaluate a report written by Pueblo Resources Inc. (PWR) in 2012 for the Carpinteria Water District (CWD) about various aspects of the Carpinteria Groundwater Basin (CGWB), which borders the MWGB along its western perimeter. This contractor also evaluated recent (that is, prior to 2014) hydrogeologic reports by Fugro Inc. to the CVWD. Figure 17 depicts a map of the CGWB, including the Rincon Creek Fault, its two groundwater storage units, and a few features added by this Contractor showing the direct contact of the aquifer in storage unit 1 of the CGWB with the ocean. Figure 18 presents hydrogeologic section B-B’ delineated in Figure 17. The Fugro Inc.’s 2012 and 2013 annual reports showed wells with high TDS (total dissolved solids) and chloride concentrations. For example, well number 4N/25W-19M1 was reported to have TDS equal to 2500 mg/L and chloride equal to 400 mg/L in the 2013 Fugro Inc. hydrogeologic report, as seen Figure 19.

(ix). This Contractor reviewed a dataset of chloride measurements made in wells of the MGWB by the USGS and the State of California. The measurements show that

wells in the MGWB have reached high chloride concentrations at various times from 1949 through 2012. The high chloride concentrations ranged between 312 mg/L to 1,220 mg/L, which are typical of groundwater contaminated with seawater. Two of the MWD's wells, Ennisbrook 2 and Ennisbrook 5, shown in Figure 2, exhibited high chloride concentrations in recent surveys. The former well had a chloride concentration equal to 540 mg/L in February 2014, and the latter well had a chloride concentration equal to 490 mg/L in May 2015. These chloride levels constitute evidence of seawater intrusion that is factual and pertinent to this report's evaluation of adverse impacts by new wells. Yet, it is stressed that water quality and water-level monitoring in the MGWB is inadequate. It seems appropriate to make measurements of various indicator chemicals in well water, including chloride among them. This should be done at least once a year, preferably in early Autumn following elevated groundwater extraction during Summer. Those measurements should be made principally, but not uniquely, in wells near the coastline in storage unit 3 that are actively extracting groundwater. Ideal wells for such measurements are those owned by the Montecito Sea Meadows Mutual Water Company, the Biltmore Hotel, and the MWD. The County of Santa Barbara's 2014 Groundwater Basins Status report stated that the County maintains a well-monitoring cooperative program with the USGS. The program provides for annual monitoring of about 300 wells in Santa Barbara County. This Contractor recommends that wells in the MGWB be added to that cooperative monitoring program and actively sampled for groundwater level and water quality assessment.

The evidence reviewed in this section establishes that there is not such a thing as an impervious seawater barrier on the southern perimeter of the MGWB. This report's findings refute statements made by geologist Adam Simmons to the Montecito Planning Commission on October 15, 2014, and to the Commission staff in an undated presentation asserting that the Rincon Creek Fault "blocks seawater". This section's evaluation strongly suggests that applications for new well construction in storage unit 3 of the MGWB—including those for the three appealed wells- must demonstrate that they would not aggravate seawater intrusion in that part of the basin. The three appealed wells are very close (less than 400 feet) from the high-tide sea level in storage unit 3. Section 9 deals with the well interference and drawdown that would be caused by the appealed wells and

highlights the threats posed by these wells to exacerbating seawater intrusion in storage unit 3 of the MGWB.

6. The safe yield of the MGWB.

The CDWR's (2003) **Bulletin 118** defined safe yield (= perennial yield = basin yield) as “the maximum quantity of water that can be continuously withdrawn from a groundwater basin without adverse effect”.

The safe yield was defined in the ETGM of the County of Santa Barbara (revised July 2015) as follows:

“Safe yield (the same as Perennial Yield): the maximum amount of water which can be withdrawn from a groundwater basin (or aquifer) on an average annual basis without inducing a long-term progressive drop in water level”.

The CDWR definition of safe yield is more comprehensive than that of the ETGM in the sense that it is not restricted to declining groundwater level, but, rather focuses on the avoidance of “adverse effect” as a defining condition for the safe yield. This Contractor considers declining groundwater level during long droughts as an adverse effect because this is the condition most likely to cause significant adverse impacts on coastal groundwater resources within the MGWB.

Another definition pertinent to this section is that of **representative climatic base period** used for safe yield determination. Pueblo Resources Inc. (2012) defined representative climatic based period as follows: “One which should represent long-term average hydrologic conditions, must include at least one period each of overall wet conditions and overall dry conditions relative to average annual conditions, and have an average precipitation that is close to the average precipitation for the entire period of record that subsumes the base period. In addition, the beginning of the base period should be an interval of relatively dry conditions to eliminate the potential for any transitory recharge water”.

The safe yield of the MGWB has been estimated by previous authors. Muir (1968) estimated the safe yield to be about 2,500 AFY using a water-balance approach. Geotechnical Consultants (1974) revised downward Muir's 1968 estimate to 1,200 AFY, arguing that Muir's (1968) estimate of percolation to the MGWB was too high, being based on data from Blaney (1933) for Ventura County.

Hoover (1980) reported two estimates of the MGWB's safe yield. These estimates deserve scrutiny because one of them, the larger of the two, was accepted in the MWD's 1998 Groundwater Management Plan as its basin's safe yield. The first estimate of the safe yield was calculated using the base period 1950-1979, which, according to Hoover (1980) meets criteria set forth above for representative climatic base period. This first estimate was equal to 1,122 AFY. The approach followed to arrive at the 1,122 AFY safe yield estimate is based on a hydrologic budgeting method (see Pueblo Resources Inc., 2002), whereby a representative climatic based period is chosen and the safe yield is calculated as the average annual groundwater extraction plus (or minus) the average gain (or average reduction) of groundwater storage during the base period. In Hoover's (1980) calculations the average groundwater extraction and average gain of storage during the 1950-1979 were equal to 909 and 123 AFY, respectively, thus, the safe yield equals 1,122 AFY.

Hoover's (1980) second estimate of safe yield was equal to 1,650 AFY. The safe yield was arbitrarily made equal to the estimated amount of groundwater extraction in the MGWB in 1929, which equaled 1,658 AFY, and was rounded off to 1650 AFY (see Table 8 of Hoover, 1980). This Contractor believes that setting the safe yield equal to 1,650 AFY was a gross overestimation because it set the safe yield equal to the groundwater extraction during a dry year (1929) during which pumpage was unusually high and incompatible with a representative climatic base period. In fact, year 1929 fell during one of the driest periods in Santa Barbara County.

To prove this point, Table 2 presents data obtained from the MWD's 1998 Groundwater Management Plan, which remains current to this date (see Table 5 of the 2014 Groundwater Basins Status Report by the County of Santa Barbara). Table 2 lists the estimated groundwater extractions in the MGWB in various years. It is seen in Table 2 that year 1929 was the highest-pumpage year known prior to 1990.

Table 2. Groundwater extraction in selected years (source: MWD's Groundwater Management Plan, 1998, Table 3.7.1).

Year	Estimate groundwater extraction (AFY)
1929	1658
1954	1322
1962	872
1979	458
1980-1990	940

There are other reasons for rejecting Hoover's 1,650 AFY safe yield. They have to do with the climatic conditions in the 1920s, unsuitable for determining the safe yield. Figure 20 shows the cumulative difference of average rainfall from the long-term average annual rainfall in the MGWB during the instrumental period 1925-2015. The cumulative-difference graph is commonly used in the analysis of climatic conditions over time in a basin. It is seen in Figure 20 that year 1929 fell in a downward sloping part of the cumulative-difference graph. The period 1950-1979, on the other hand, exhibits a relatively dry beginning and encompasses periods of increasing and decreasing rainfall with an overall relatively steady pattern. Hoover (1980) rejected his estimate of the safe yield equal to 1,122 AFY derived for the representative climatic period 1950-1979 on the grounds that it encompassed wet periods during which there would be "rejected recharge", and, thus underestimated the safe yield. In fact, the accepted definition of a representative climatic period (written above) presumes the occurrence of both dry and wet periods, although it precludes the representative climatic period from beginning with a full groundwater basin. The fact that the cumulative-difference graph for the MGWB exhibits a declining trend prior to 1950 establishes that it was not likely to be full at the beginning of the 1950-1979 period.

Figure 21 reaffirms the arguments made about the proper choice of 1950-1979 as a representative climatic period and the inappropriate use of pumpage in year 1929 as the safe yield. Figure 21 depicts the cumulative difference of annual rainfall from the long-term average annual rainfall in the City of Santa Barbara using the instrumental period. The City of Santa Barbara exhibits an almost identical temporal pattern to that of rainfall in Montecito. It is seen in Figure 21 that year

1929 fell in a long-term dry period that started in 1917 and ended in 1933. It is also evident from Figure 21 that the 1950-1979 period was preceded by dry years and later experienced increases and decreases of rainfall to end with a cumulative difference in 1979 approximately equal to the starting one in 1950.

The corollary of this analysis of the safe yield is as follows. Muir's (1968) overestimated percolation of rainfall in the MGWB and grossly inflated its safe yield. Geotechnical Consultants' 1974 revised downward Muir's (1968) safe-yield by about one half to 1,200 AFY. Hoover (1980) arrived at two estimates of the safe yield, 1,122 AFY and 1,650 AFY. The former estimate –this Contractor has proven above- was the correct one with the data available in 1980. The latter –herein proven to be an unjustified gross overestimation- was the one recommended by Hoover (1980) and adopted by the MWD. It is noteworthy that Hoover's (1980) Table 16 provided safe-yield estimates equal to 550, 100, 700, and 300 AFY for the storage units 1, 2, 3, and Toro Canyon, respectively, adding up to a basin-wide safe yield equal to 1,650 AFY in the MGWB. This Contractor did not find a quantitative description in Hoover (1980) about how the storage-unit safe yields were arrived at. The 2009 Groundwater Resources Section of the County of Santa Barbara's Conservation Element (page 10) assigned a safe yield equal to 1,215 AFY to the MGWB without explanation. The 2015 revision of the County of Santa Barbara's ETGM lists in its Table 1, under gross pumpage, a safe yield of the MGWB equal to 1,350 AFY, without explanation about its calculation. This Contractor uses Hoover's (1980) estimate of the safe yield equal to 1,122 AFY obtained from data for the representative climatic base period 1950-1979 in the remainder of this report because it is the best estimate of the safe yield of the MGWB so far reported.

The concept of safe yield is a valuable baseline number if it is accurately estimated and wisely applied as a management tool. It tells whether or not a groundwater basin is being used in a sustainable manner: one that assures long-term beneficial use without adverse impacts and economic hardship. On the other, hand, this Contractor and other professionals (see Lohman, 1979; Sophocleous 1997) have argued that sound management of groundwater basins requires adjustment as conditions change from wet or average climatic conditions to protracted drought conditions, because the safe yield, as demonstrated in this report, might not be safe when aquifer recharge is severely reduced during long droughts. Section 7 shows

how to adjust the safe yield in the MGWB during long droughts. This adjustment has direct bearing on the evaluation of the three appealed wells in storage unit 3.

Lohman (1979) wrote that: “The term “safe yield” has about as many definitions as the number of people who have defined it. There are questions as to the validity of the term, but if it is valid there remains the question as to who should determine it –groundwater hydrologists or groundwater managers?” Furthermore, Lohman wrote: “I have a definition which I taught at US Geological Survey Groundwater Short Courses beginning in 1952, namely: the amount of groundwater one can withdraw without getting into trouble. “Withdraw” may mean from flowing or pumped wells, and it may mean continuously, as for many industrial or municipal suppliers, or seasonal, as for irrigation. “Trouble” may mean anything under the sun, such as (1) running out of water, (2) drawing in salt water, or other undesirable water, (3) getting shot, or shot at, by an irate nearby well owner or landowner, (4) getting sued by a less irate neighbor, or (5) getting sued for depleting the flow of a nearby stream for which the water rights have been appropriated.”

7. Revised safe yields of the MGWB’s storage units.

This section presents revised safe yields of the MGWB’s storage units. There has been a recognition within the hydrogeologic community in recent decades that sustainable groundwater use must be adaptive and respond to changing conditions that threaten groundwater basins, such as those that arise during long drought (see, for example Sophocleous, 1997; Loáiciga, 2006; Loáiciga, 2008). This section applies adaptive groundwater management to derive revised yields in the MGWB. The revised safe yields are used in developing accurate estimates of the remaining lives and the groundwater thresholds of significance in the storage units of the MGWB, with emphasis on storage unit 3, the coastal sub-basin of the MGWB where the three appealed wells are located. The approach followed to arrive at the revised safe yield relies on the concept of usable storage. Hydrogeologist R. Slade defined usable storage in his October 1991 report titled “Original Report and Addendum, Hydrogeologic Assessment: Determination of Groundwater in Storage Within the Montecito Water District” (prepared for the MWD) as follows: **the volume of groundwater “having a satisfactory quality for prevailing beneficial uses and occurring in sufficient quantity in the underground reservoir to be available**

without uneconomic yield or excessive drawdown”. Slade (1991) reviewed previous hydrogeologic investigations in the MGWB (including those by Geotechnical Consultants (1974) and Hoover (1980)) and proposed usable storage estimates that depended on the status of a basin, that is, estimates of the usable storage were given for full-basin conditions (this is Slade’s maximum usable groundwater in storage, prevailing in the Spring 1983) and for long-drought conditions (this is Slade’s current usable groundwater in storage, prevailing in February/March 1991). Table 3 lists Slade’s 1991 usable storages in storage units 1, 2, and 3, Toro Canyon, and in the MGWB (see Slade’s (1991) Table 4).

Table 3. Slade’s (1991) estimates of usable storage (columns (2) and (3)) in the MGWB.

Sub basin or storage unit (1)	Maximum Usable storage (full basin) (2)	Usable storage (long drought) (3)	Average usable storage (this report) (4)
	Acre feet	Acre feet	Acre feet
1	8,770	2,830	5,800
2	730	70	400
3	4,990	3,710	4,350
Toro Canyon	1,620	1,150	1,385
MGWB	16,110	7,760	11,935

Notice in Table 3 the very limited usable storage equal to 70 AFY during drought conditions in storage unit 2.

The revised safe yields are calculated based on (i) what this Contractor’s has proven in section 6 to be the best estimate available of the MGWB’s safe yield, that is 1,122 AFY, and (ii) scaling ratios that are applied to the basin-wide safe yield. The scaling ratios equal the average usable storage in each storage unit divided by the basin-wide average usable storage (11,935 AFY, see Table 3). The revised safe yield in each storage unit is then calculated by multiplying the storage unit’s scaling ratio by the basin-wide safe yield. Table 4 lists the calculations.

Table 4. Calculation of the safe yield of the MGWB's storage units.

Sub basin (1)	Average usable storage (from Table 3) (2)	Weighting ratios (3)	Safe yield (4) = (3) x 1,122
	Acre feet		AFY
1	5,800	$5,800/11,935 = 0.486$	545
2	400	$400/11,935 = 0.034$	38
3	4,350	$4,350/11,935 = 0.364$	409
Toro Canyon	1,385	$1,385/11,935 = 0.116$	130
MGWB	11,935		1,122

The safe yields listed in Table 4 differ from those recommended in Hoover (1980) that were adopted by the MWD. Table 5 lists the two sets of safe yields for comparison purposes.

Table 5. Comparison of safe yields in the MGWB.

Sub basin	Safe yield (this report) (AFY)	Safe yield (recommended by Hoover, 1980, Table 16) (AFY)
1	545	550
2	38	110
3	409	700
Toro Canyon	130	300
MGWB	1,122	1,650

The revised safe yield in storage unit 3, equal to 409 AFY, is currently less than the amount extracted by the four MWD's municipal wells currently active, which, as shown in Figure 8, extracted about 500 AFY in the last two water years. To the MWD's pumpage one must add the private groundwater extraction, which was estimated in section 4 to be about 500 AFY, perhaps more than that. Therefore, it is very likely that the net overdraft in storage unit 3 is at least $1,000 - 409 = 591$ AFY. The implications of this level of overdraft for the estimation of the

groundwater threshold of significance for new wells in storage unit 3 are explained in section 8.

8. Groundwater thresholds in the MGWB: implications for new wells in storage unit 3.

Several definitions are necessary for the development of this section. These definitions are from the County of Santa Barbara's Environmental Thresholds and Guidelines Manual (ETGM, revised July 2015). The ETGM contains a procedure for calculating the groundwater threshold of significance in alluvial basins of the County of Santa Barbara, which includes the storage units of the MGWB. The groundwater threshold of significance for new wells is the maximum amount that a new well is allowed to extract in an overdrafted basin. The ETGM lists the MGWB as an overdrafted basin. The groundwater threshold of significance provides, in the view of this Contractor, a baseline for limiting new groundwater extraction in an overdrafted basin. However, it must not be the only baseline. Instead, the site-specific impacts of any new proposed well must be evaluated prior to permitting it. These issues are elaborated upon below in the context of storage unit 3 and the three appealed wells.

“Available Storage (ETGM): the volume of water in a particular basin which can be withdrawn without substantial environmental effects. This storage reflects the amount of water in the basin on a long-term basis (a point on a long-term trend line) not the current storage level in the basin. The number is periodically updated by the Planning and Development Department and the County Water Agency as new information becomes available”.

It is important to recognize the difference between the ETGM's available storage and Slade's (1991) definition of usable storage. The former has a long-term connotation, whereas the latter takes consideration of prevailing conditions in a groundwater basin that might limit the amount of groundwater that can be used beneficially, for example, by preventing seawater intrusion or losses of well yield. The ETGM's available storage is used by the County of Santa Barbara as a planning parameter in its method to determine groundwater thresholds on a long-term basis. Slade's (1991) usable storage is pertinent in the determination of groundwater thresholds that would protect groundwater basins' beneficial use

under all conditions, especially those that prevail during protracted drought. The adaptive nature of sound groundwater management was applied in section 7 to derive revised yields in the MGWB.

“Net Annual Overdraft (ETGM): is the amount by which average long-term demand on a basin exceeds the safe yield of the basin after allowances have been made for return flows. The "demand" figure will generally include commitments of supply such as approved projects not yet constructed with the estimated current level of pumpage”.

This Contractor’s definition of net annual overdraft is broader than that of the ETGM because it includes the amount by which groundwater extraction exceeds the safe yield during long droughts, and not simply during the loosely defined “long-term” periods. This broader definition is consistent with the adaptive approach to groundwater management that accounts for protracted significant departures from average climatic conditions.

“Groundwater Threshold of Significance (ETGM): is the point at which a project's estimated contribution to the overuse of groundwater in an alluvial basin or other aquifer is considered significantly adverse. The Groundwater Threshold Manual documents the methods used to establish the threshold values for groundwater extractions from the various alluvial basins and consolidated rock aquifers in Santa Barbara County. The California Supreme Court has ruled that an EIR must be prepared whenever it can be fairly argued on the basis of substantial evidence that a project may have a significant environmental impact.

Implementation of the California Environmental Quality Act (CEQA) requires that a lead agency (such as the county) determine what constitutes a potentially significant effect. In the past, thresholds for the alluvial basins have been determined based on a fixed number of acre feet per year (AFY), a percentage of existing overdraft, or a percentage of safe yield. In the 2015 version of the Manual a new methodology developed by the County of Santa Barbara’s Planning and Development Department is used to calculate the groundwater threshold in an alluvial basin. A threshold was chosen for an idealized "Standard Reference Basin" based on a percentage loss of the remaining life of the available storage.

Thresholds for the other basins are proportional to this value based on relative size and remaining life. This method was developed to simplify the calculations and

more clearly link the various threshold levels to the environmental circumstances specific to each basin. The idealized Standard Reference Basin has overdraft and storage characteristics similar to those of the Santa Ynez Uplands groundwater basin (SYUGWB). The Threshold of Significance for consolidated rock ("bedrock") aquifers is considered the amount of new pumpage by a proposed project which would place the aquifer in a state of overdraft. These criteria have remained the same since adoption of the first thresholds manual in 1983. The groundwater Thresholds of Significance apply to all projects subject to discretionary review by the County of Santa Barbara".

Figure 22 presents a map of the groundwater basins of Santa Barbara County, which includes the SYUGWB and the MGWB.

Table 3 in section 7 introduced Slade's (1991) estimates of the usable storage in the MGWB for full-basin conditions (this is Slade's maximum usable groundwater in storage, prevailing in the Spring 1983) and for long-drought conditions (this is Slade's current usable groundwater in storage, prevailing in February/March 1991). Table 2 (page 74) of the ETGM calculated the groundwater threshold in the MGWB (basin-wide estimate) to be equal to 4 AFY. The calculation was based on an arbitrary formula developed by County of Santa Barbara's geologist B. Baca in 1992 that includes weighting ratios and the consideration of an idealized standard reference groundwater basin (SRGWB) with characteristics similar to those of the Santa Ynez Uplands groundwater basin (SYUGWB, see map in Figure 22). Basically, the ETGM proposed that the SRGWB has a net groundwater overdraft and available storage equal to 2,000 AFY and 900,000 acre feet, respectively, so that the remaining life of the SRGWB equals $900,000/450 = 2,000$ years. Next, the ETGM proposed that the threshold of significance in the SRGWB is such that it would reduce its remaining life by 3%. The formula to determine the threshold of significance (R) in the SRGWB is then:

$$\frac{900,000}{2,000+R} = 450 \cdot 0.97 \quad (1)$$

From which the groundwater threshold of significance in the SRGWB is solved for:

$$R = \frac{900,000}{450 \cdot 0.97} - 2,000 = 61.856 \text{ AFY} \quad (2)$$

The determination of groundwater thresholds of significance in alluvial basins in Santa Barbara County uses a formula that assigns weights equal to 0.75 and 0.25 to the ratio of the remaining life of an overdrafted basin to that of the SRGWB and to the ratio of the available storage in an overdrafted basin to that of the SRGWB, respectively. The last step in the calculation of the groundwater threshold of an alluvial basin is to multiply the result of the weighted formula by the threshold of significance of the SRGWB ($R = 61.856$ AFY), as follows:

$$threshold = \left(0.75 \frac{remaining\ life}{450} + 0.25 \frac{available\ storage}{900,000} \right) \cdot 61.856 \quad (3)$$

The ETGM assigned a net overdraft and available storage equal to 426 AFY and 16,000 acre feet to the MGWB. Therefore, the remaining life of the MGWB equals $16,000/426 = 37.559$ years. The groundwater threshold for the MGWB is then:

$$threshold = \left(0.75 \frac{37.559}{450} + 0.25 \frac{16,000}{900,000} \right) \cdot 61.856 = 4.147\ AFY \quad (4)$$

which was rounded off to 4 AFY in the ETGM. Notice that formula (3) for the groundwater threshold in alluvial basins applies to overdrafted basins. Basins that are not overdrafted have an indefinitely long remaining life, and, therefore, an undefined groundwater threshold.

The threshold given by formulas (3 and (5) is basin wide, even though there are substantial differences in the impacts that new wells might have depending on the storage unit in which they are installed. For example, new well applications in storage unit 1 of the MGWB would be treated in exactly the same manner as new applications in its storage unit 3, even though the former unit may experience well-yield losses but not seawater intrusion, whereas the latter unit may experience well-yield losses and seawater intrusion. New wells each with an extraction rate equal to 4 AFY could be approved because each well does not exceed the groundwater threshold of significance. Yet, the cumulative adverse impacts of well extraction in storage unit 3 could be irreversible. Another drawback of formula (3) for the groundwater threshold of significance is that it does not account for changes in climatic conditions affecting a basin. Thus, the groundwater threshold is calculated in exactly the same way when average climatic conditions prevail as when long drought prevails.

The following calculations show groundwater thresholds adjusted for drought conditions. Specifically, using the MWD's high estimate of private use equal to 1,000 AFY cited in section 4 of this report, plus the MWD potable groundwater production equal to about 500 AFY (see Figure 8) and non-potable groundwater production (estimated at 50 AFY by this Contractor), the overdraft in the MGWB would be 1550 AFY (total pumpage) - 1,122 AFY (the safe yield) = 428 AFY, which is very close to the ETGM's net overdraft equal to 426 AFY reported in its Table 1, page 73. In the absence of measurements need to quantify overdraft in each storage unit, this Contractor estimates them by applying ratios equal to the drought-impacted usable storages (column (3) in Table 3) over the MGWB's total drought-impacted usable storage (equal to 7,760 acre feet in Table 3) to the net, basin-wide, overdraft equal to 428 AFY. Table 6 shows the application of the ratios and the calculation of the net overdrafts in each storage unit during drought conditions.

Table 6. Calculation of net overdraft in each storage unit during drought periods. The basin-wide net groundwater overdraft = 428 AFY.

Sub basin or storage unit (1)	Usable storage (long drought) (2)	Weighting ratios (3)	Net overdraft in each storage unit (4) = (3) x 428
	Acre feet		AFY
1	2,830	$2,830/7,760 = 0.365$	156
2	70	$70/7,760 = 0.009$	4
3	3,710	$3,710/7,760 = 0.478$	205
Toro Canyon	1,150	$1,150/7,760 = 0.148$	63
MGWB	7,760		428

The values of drought-impacted usable storage (column (2) of Table 6) and the net overdraft in each storage unit (column (4) of Table 6) were applied to calculate the remaining life in each storage unit under drought conditions, which are listed in Table 7. The net overdraft in the storage units and MGWB used in Table 7 are those shown in column (4) of Table 6. The remaining life in each storage unit equals the usable storage divided by the next overdraft.

Table 7. Calculation of the remaining life in each storage unit during drought periods. The basin-wide net groundwater overdraft = 428 AFY.

Sub basin or storage unit (1)	Usable storage (long drought) (2)	Net overdraft in each storage unit (3)	Remaining life (4) = (2)/(3)
	Acre feet	AFY	Years
1	2,830	156	18.14
2	70	4	17.50
3	3,710	205	18.09
Toro Canyon	1,150	63	18.25
MGWB	7,760	428	18.13

The seemingly long remaining lives presented in Table 7 should be no solace to anyone because the actual total groundwater extraction in the MGWB is unknown, and, if, say, the total extraction during drought were 2,000 AFY instead of 1,550 AFY, the remaining lives shown in Table 7 would be shortened considerably.

The drought-impacted usable storages and the remaining lives listed in columns (2) and (4) of Table 7, respectively, were input into formula (3) to calculate the groundwater thresholds of significance under drought conditions. The results are listed in Table 8. Notice that the drought-impacted groundwater thresholds listed in Table 8 are about one half of the 4 AFY calculated for the MGWB in the ETGM. Yet, a 4 AFY withdrawal rate in a single well may be harmful given site-specific conditions in the storage units. A case in point in storage unit 3 is the intensely groundwater-mined area comprised between Fernald Point to the east, the Pacific Ocean to the south, Highway 101 to the north, and the Santa Barbara Cemetery to the west, where the cumulative impacts of new wells could cause irreversible damage to groundwater quality by seawater intrusion. In storage units 2 and 3 the main concerns are well-yield losses and stream depletion impacts. The former impact must be evaluated for each well application by conducting well-interference analyses of the type presented in section 9 of this report, the latter with streamflow-capture analyses.

Table 8. Groundwater thresholds of significance under drought conditions.

Sub-basin or storage unit	Usable storage	Net overdraft	Remaining life	Threshold
	acre feet	AFY	Years	AFY
1	2,830	156	18.14	1.9
2	70	4	17.50	1.8
3	3,710	205	18.09	1.9
Toro Canyon	1,150	63	18.25	1.9
MGWB	7,760	428	18.13	2.0

The groundwater threshold calculated for storage unit 3 in Table 8, which equals 1.9 AFY, is most likely an overestimate. This Contractor recalculates storage unit 3's groundwater threshold of significance under drought conditions. To achieve this we use a groundwater extraction in storage unit 3 equal to 1,000 AFY during drought, which was estimated in section 4. The safe yield of storage unit 3 equals 409 AFY (see calculations of revised safe yields in section 7). The net overdraft in storage unit 3 would then be $1,000 - 409 = 591$ AFY. This would reduce the remaining life of storage unit 3 to $3,710/591 = 6.3$ years. Recall that the drought-impacted usable storage in storage unit 3 equals 3,710 acre feet (see column 2 of Table 7). Using these values of remaining life and usable storage in equation (3) produces the following drought-impacted groundwater threshold of significance for storage unit 3:

$$\text{threshold unit 3} = \left(0.75 \frac{6.3}{450} + 0.25 \frac{3,710}{900,000}\right) \cdot 61.856 = 0.71 \text{ AFY} \quad (5)$$

The groundwater threshold equal to 0.71 AFY calculated in equation (5) would be the limiting extraction to be imposed on any of the three appealed wells.

Furthermore, this Contractor recommends the evaluation of site-specific impacts of each well prior to approving their construction. Those site-specific impacts concern seawater intrusion, well interference, loss of well yield, and stream flow depletion. Site-specific impacts of groundwater extraction may reduce the groundwater threshold of significance to zero in storage unit 3, as shown in section 9.

The groundwater-threshold approach used by the County of Santa of Barbara in overdrafted alluvial basins for permitting new wells should not be applied in

isolation. Instead, it should be implemented in conjunction with the evaluation of site-specific impacts of each proposed well and the assessment of the current status of each storage unit. If significant adverse impacts would be caused by a new well then it should not be permitted, not even with a groundwater threshold equal to the calculated 0.71 AFY for storage unit 3 of the MGWB. The criteria proposed by Slade (1987) to protect against seawater intrusion are exemplary about effective ways to protect groundwater resources in storage unit 3 of the MGWB. Those criteria specified minimal seaward hydraulic gradient, minimal groundwater levels, and minimal seaward groundwater discharge to protect the coastal groundwater resource.

This section has shown that the MGWB and its components storage units are in a state of overdraft. The County of Santa Barbara's 2015 ETGM's groundwater thresholds section states that the MGWB is in overdraft. Perhaps the County of Santa Barbara has not issued an official declaration of overdraft for the MGWB – as geologist Adam Simmons declared in a presentation to the Montecito Planning Commission on October 15, 2014, and in an undated presentation to Commission staff- but the fact is that the key County document dealing with the assessment of basin overdraft, remaining life, and groundwater threshold of significance, that is, the 2015 ETGM, classifies the MGWB as being in a state of overdraft. This section has shown that the 2015 ETGM's estimate of overdraft in the MGWB is less than the actual extent of overdraft.

9. Drawdown and well interference in storage unit 3 of the MGWB.

This section presents calculations estimating the lowering of water levels (called drawdown) and well interference associated with the three appealed wells. Geologist Adam Simmons suggested pumping rates for the Hair and Makarechian wells of about 5 gpm in memorandum to Commission staff on May 11, 2015. A similar pumping rate was indicated by geologist Simmons for the Schlesinger well in another memorandum dated May 14, 2015, to Commission staff. This section evaluates the lowering of aquifer levels at the appealed-wells sites and in their vicinities, and takes into account the existence of active wells near the proposed new-wells sites. The effect on groundwater level by a new extraction well is to magnify the lowering of the groundwater level caused by existing wells. The existing wells, conversely, magnify the lowering of the groundwater level caused

by the new well. This mutual superposition of the influences on the groundwater level by neighboring wells is called well interference. Drawdown is the depth to which the hydraulic head or groundwater level is lowered in a well (or any other part of an aquifer) by groundwater extraction relative to the initial hydraulic head that would prevail if groundwater were not extracted from the aquifer (that is, relative to a baseline condition). Well interference is magnified when there are multiple wells extracting from the same aquifer because in that instance there is superposition of the drawdowns caused by all the wells.

This section presents calculations of drawdowns and well interference in the aquifer underlying the area encompassing the Makarechian and Hair wells (see Figure 3) and the Schlesinger well (see Figure 4), both in storage unit 3 of the MGWB. The aquifer tapped by the Chase well and several other nearby active wells is prototypical of an aquifer where well interference is taking place. The Chase well takes especial notoriety in this report because geologist Adam Simmons stated in a May 11, 2015, memorandum to Commission staff that “The proposed Hair Well (and nearby Makarechian Well) will likely be very similar in depth and design as the Chase Well”. The similarity suggested by geologist Simmons is not surprising given that, by virtue of the closeness of the existing Chase well and the proposed Makarechian and Hair wells, they would be tapping the same groundwater-bearing formations. Figure 23 displays the design details of the Chase well, taken from a June 15, 1978, report from geologist Michael Hoover to Mr. and Mrs. Dan Chase. A drawdown and well interference analysis is also presented in this section for the Schlesinger well, which, according to geologist A. Simmons, would have characteristics similar to the Hair well (see memorandum from A. Simmons to Commission staff dated May 14, 2015).

Drawdown and well interference: the Hair and Makarechian wells. Geologist M. Hoover conducted pumping tests at the Chase well in 1978 and concluded that the transmissivity of the formations tapped by the well equaled 4800 gpd/ft (gallons per day per foot) = 642 ft²/day. This was substantially larger than the transmissivity implied by hydrogeologist Slade’s (1987) estimate of about 80 ft²/day. Geologist Hoover’s estimate of transmissivity was based on the Cooper-Jacob formula that approximates drawdown in confined aquifers with non-dimensional well variable $u = r^2 S / (4 T t) < 0.05$ (Fetter, 2001), where r = the radial distance from the center of the well to any point in the aquifer (r is measured on a

level plane), S = the storage coefficient of the aquifer, T = the transmissivity of the aquifer, and t = the elapsed time since pumping in the aquifer begins. We use an average value of transmissivity equal to $(642+80)/2 = 361 \text{ ft}^2/\text{day}$ to calculate drawdowns caused by the Hair and Makarechian wells.

The other aquifer property needed in calculating drawdown is the storage coefficient S . The storage coefficient was not estimated by geologist Hoover since he made measurements of drawdown in the installed Chase well instead of using a separate observation well. This Contractor's review of the pertinent literature revealed that the Pueblo Resources Inc.'s 2012 report to the CVWD estimated the storage coefficient in the CGWB to be on order of 6.6×10^{-4} in the confined area (storage unit 1 of the CGWB). One must keep in mind, however, that the groundwater bearing formations tapped by the Chase well are not completely confined, but, rather, they are semiconfined, because the formations above and between the screened and/or perforated intervals of the wells allow vertical flow of groundwater. This assertion is consistent with the CDWR's 2003 characterization of the aquifer in the southern part of storage unit 3 as a partially confined formation (see Bulletin 118). This Contractor interprets the hydraulic behavior of the Chase well aquifer as an intermediate between confined and unconfined conditions, and, therefore, assigns, a value $S = 0.001$ in the analysis of drawdown reported below. Lowering the value of the storage coefficient would make the calculated drawdowns larger than those presented below. It is noteworthy that Slate's (1987) of transmissivity is closer to those reported by Pueblo Water Resources (2012) for the confined unit of the CGWB than to Hoover's (1978) calculated transmissivity. For these reasons, the calculated drawdown in the vicinity of the Chase well presented below must be interpreted as a lower bound to the actual drawdowns that might take place.

The Cooper-Jacob formula was employed in this report to approximate the drawdowns that would be caused by the appealed Schlesinger, Makarechian, and Hair wells, and by other existing wells in storage unit 3 of the MGWB. The Cooper-Jacob formula is given by the following expression:

$$\text{drawdown} \cong \frac{2.3 Q}{4\pi T} \log_{10} \left(\frac{2.25 T t}{r^2 S} \right) \quad (6)$$

in which Q denotes the well extraction rate, and all other variables were previously defined in this report. The choice of units in formula (6) must be consistent.

Figures 24 and 25 depict the calculated drawdown exerted by a well pumping at a rate of 5 and 10 gallons per minute (gpm), respectively, as a function of the elapsed time of pumping (t) and the radial distance from the pumping well (r). The calculations were made for distances $r = 0.75, 100, 250, 500$, and 1,000 feet from the well. The distance $r = 0.75$ feet corresponds to the zone of aquifer in contact with the exterior of the gravel pack surrounding the well screen. Continuous pumping for one year (365 days) at a rate of 5 gpm (10 gpm) is equivalent to extracting 8.1 (16.2) acre feet / year (AFY) from the aquifer. It is seen in Figures 24 and 25 that: (i) for a given time of elapsed groundwater extraction, the drawdown increases with decreasing distance from the pumping well, and (ii) for a given distance from the pumping well, the drawdown increases with increasing elapsed time of groundwater extraction

It can be inferred from Figure 24 that if the Chase, Haber, Hair, and Makarechian wells were each pumping at 5 gpm continuously for 1 year (365 days) they would lower the groundwater level at a point on the coast and equidistant 500 ft from the wells by an amount equal to $4 \times 1.50 = 6.0$ feet. To this drawdown one must add that caused by the two Biltmore wells, which, according to Figure 25, extracting each 10 gpm continuously for 364 days would lower the groundwater level at a point on the coast equidistant 500 ft from the two wells by an amount equal to $2 \times 3.0 = 6.0$. Thus, the total decline of groundwater level on the coast caused by the six wells (Chase, Haber, Hair, Makarechian, and the two Biltmore wells) would be $6.0 + 6.0 = 12.0$ ft. This magnitude of water-level decline would be sufficient to induce seawater intrusion as it would lower the aquifer's hydraulic head below sea level.

Another scenario of superposition is that where the drawdowns at the Hair and Makarechian wells are calculated from formula (6). Assuming that the Hair, Makarechian, Chase, and Haber wells are separated from each other by a distance equal to 250 feet (see Figure 3) one would obtain from Figure 24 that the superimposed drawdown at each well after one year of groundwater extraction would be $3 \times 1.79 = 5.37$ ft plus the drawdown at each well caused by its own extraction, in this case at a distance equal to the radius of the borehole ($r \cong 0.75$

feet). The latter drawdown from the Cooper-Jacob formula equals 4.26 ft. We must add, also, the drawdown caused at either the Hair or Makarechian wells by pumping at the two Biltmore wells, distant about 500 ft (see Figure 3). The drawdown caused by the two Biltmore wells is obtained from Figure 25 to be $2 \times 3.0 = 6.0$ ft. Therefore, the total drawdown at the Hair and Makarechian wells would be $5.37 + 4.26 + 6.0 = 15.63$ ft. This magnitude of drawdown at the Hair and Makarechian wells would drive their water levels below sea level, and they most likely would be extracting saline water after some time of operation.

Drawdown: the Schlesinger well. The drawdown caused by the Schlesinger well is due to its own groundwater extraction and to the extraction at neighboring wells. In the absence of site-specific measurements of transmissivity we use Slade's (1987) recommended value of transmissivity equal to $80 \text{ ft}^2/\text{day}$. The storage coefficient remains at $S = 0.001$ used in the calculation of drawdowns at the Hair and Makarechian wells. Figure 26 displays the calculated drawdown caused by the Schlesinger well pumping at a rate equal to 5 gpm at distances $r = 0.75, 100, 250, 500,$ and $1,000$ ft and as a function of the elapsed time of groundwater extraction.

It was shown in Figure 4 that the Schlesinger well would be within the riparian corridor of San Ysidro Creek. It is estimated that the distance from the Schlesinger well to the nearest point on the San Ysidro Creek stream channel would be less than 100 ft. It is deduced from Figure 26 that the drawdown caused at San Ysidro Creek ($r = 100$ ft) by pumping continuously for 365 days at 5 gpm would be at least 8.41 ft. One must add to this drawdown the drawdown of aquifer levels by neighboring wells, whose rates are unknown. This level of drawdown is likely to reduce baseflow to San Ysidro Creek, a significant adverse impact to surface water resources in storage unit 3 that was not adequately addressed by consulting geologist A. Simmons in his May 14, 2015, memorandum to Commission staff. In the latter memorandum A. Simmons wrote that "The proposed well is situated at an elevation of approximately 23 feet above mean sea level with an estimated static water level of approximately 18 feet in depth. This swl is approximately 6 feet below the bottom of San Ysidro Creek and is therefore unlikely to cause any issues with any riparian corridor given the distance to the creek, depth of the concrete sanitary seal, and low yield of 5 gpm or less. Therefore the proposed well would have no or negligible impacts on any existing or proposed water wells and/or riparian corridors". Mr. Simmons's analysis of the Schlesinger's well impacts on

San Ysidro Creek was incorrect. Comparing the static water level at the Schlesinger well with the bottom of the San Ysidro Creek at an undetermined location is not meaningful. Figure 26 clearly shows that the drawdown that would be caused by the Schlesinger would propagate long distances from the well, capturing groundwater that could otherwise serve as baseflow to support stream flow in San Ysidro Creek when hydrologic conditions allow flow in the creek.

Other drawdowns of interest that would be caused by the Schlesinger well are those at his own location ($r = 0.75$ ft) and on the coastline ($r = 250$ ft). Figure 26 implies that these drawdowns would equal 17.76 and 6.65 ft, respectively. With these levels of drawdown the Schlesinger most likely would be pumping saline groundwater after some time of operation.

10. Conclusions.

This Contractor concludes that applications for new wells in storage unit 3 of the MGWB must demonstrate that proposed extraction of additional groundwater would not adversely impact the groundwater resources of this overdrafted basin. This report has shown that the groundwater threshold of significance in storage unit 3 equals 0.71 AFY according to the County of Santa Barbara's procedure and zero based on site-specific impacts. This report has proven that the Makarechian and Hair wells would pose significant adverse impacts in the areas of well interference and seawater intrusion. The Schlesinger would pose significant adverse impacts concerning seawater intrusion and stream depletion in San Ysidro Creek.

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12. Appendix: Figures

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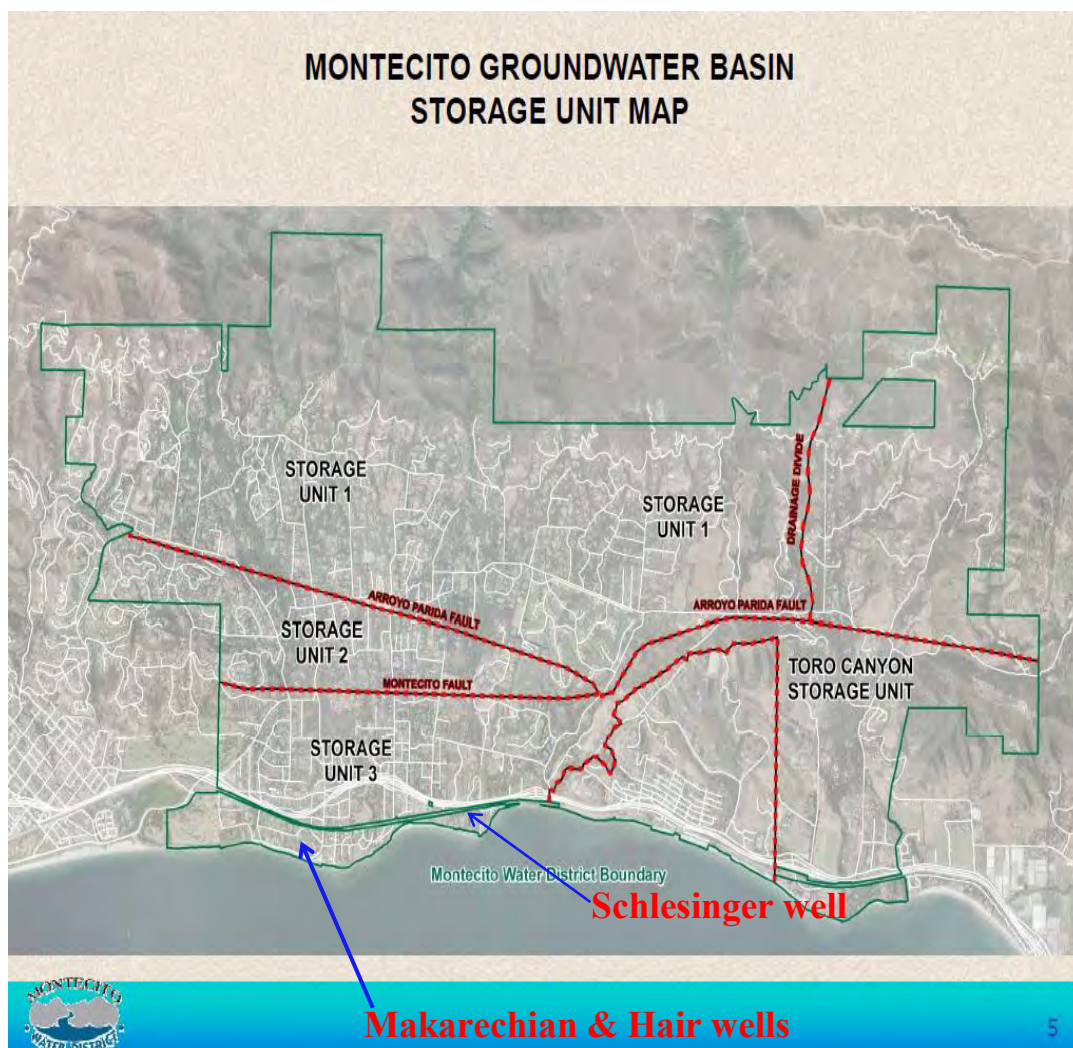


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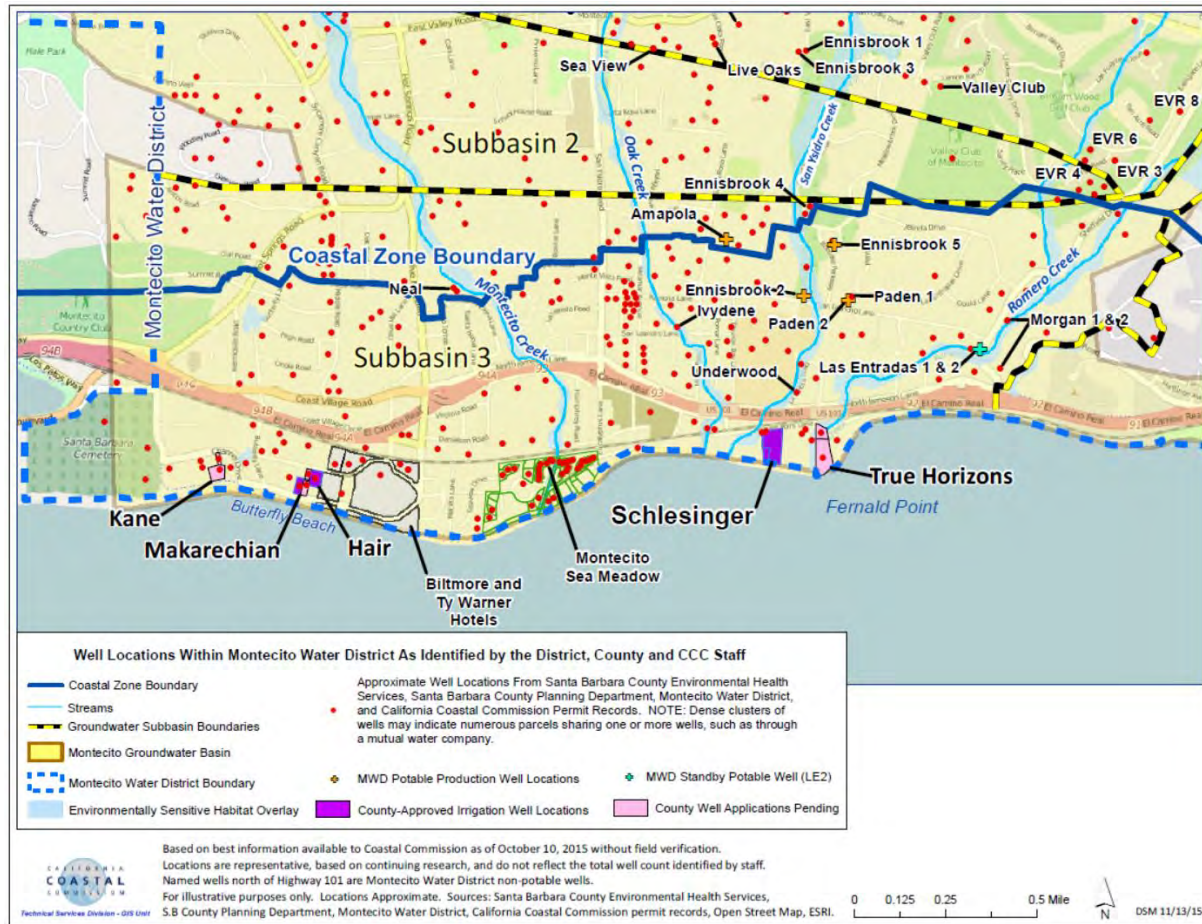


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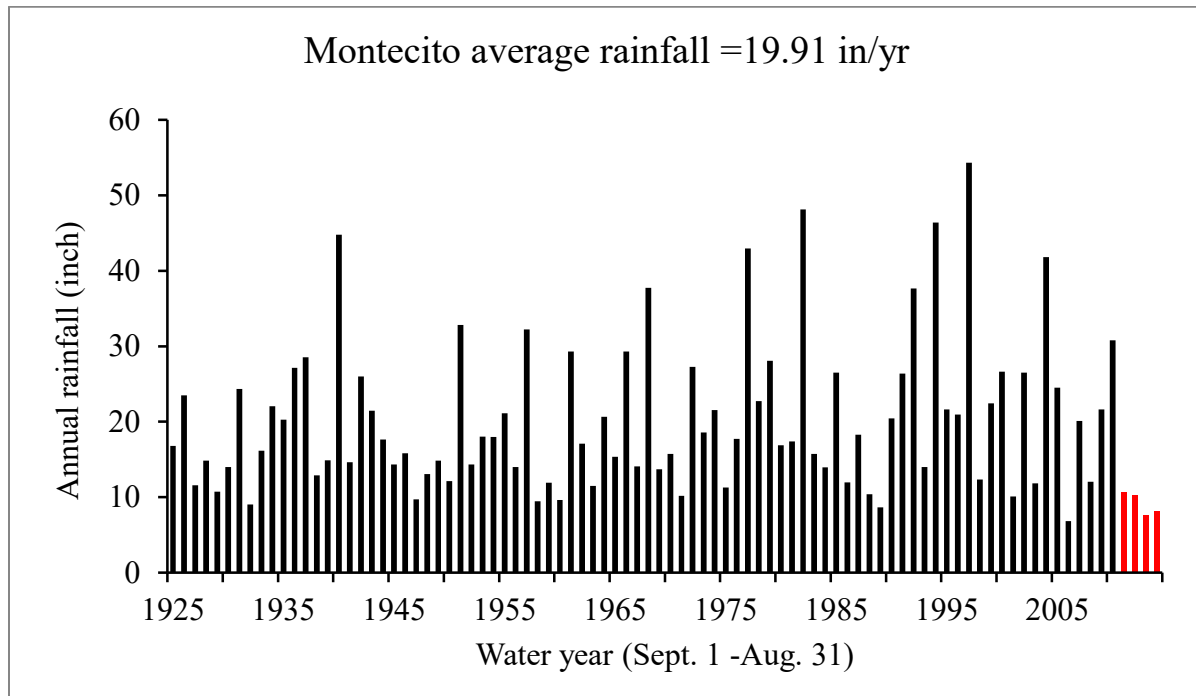


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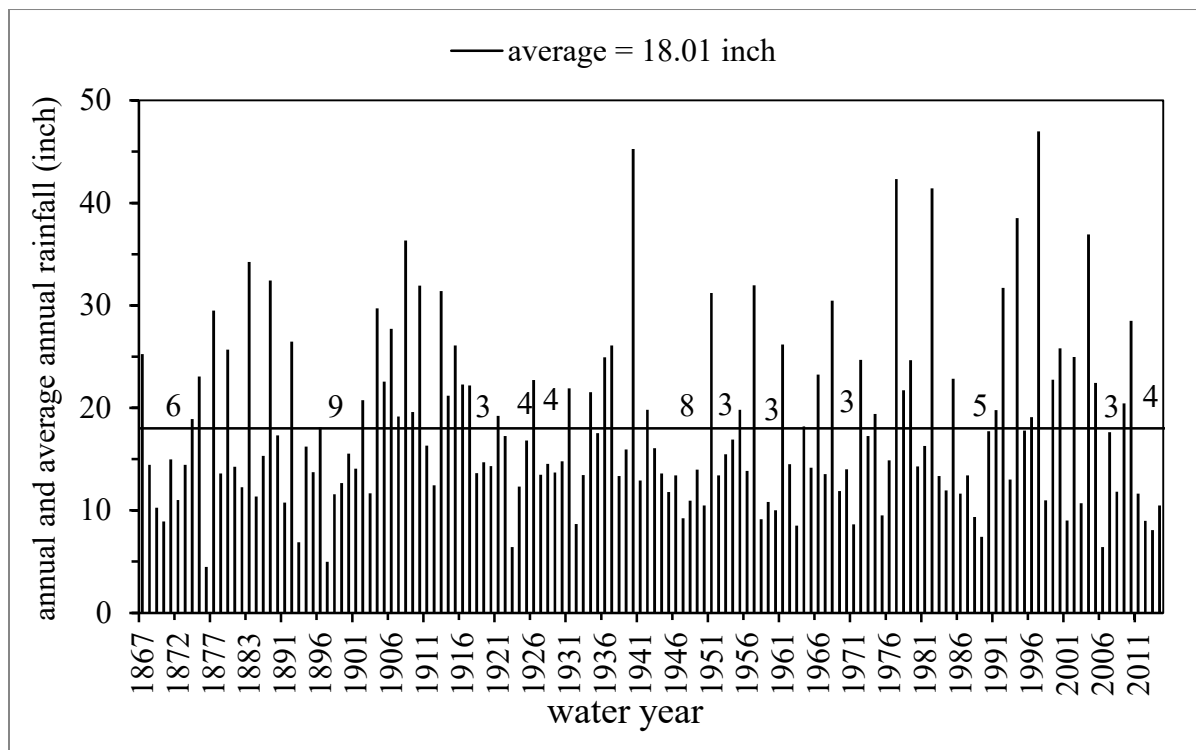


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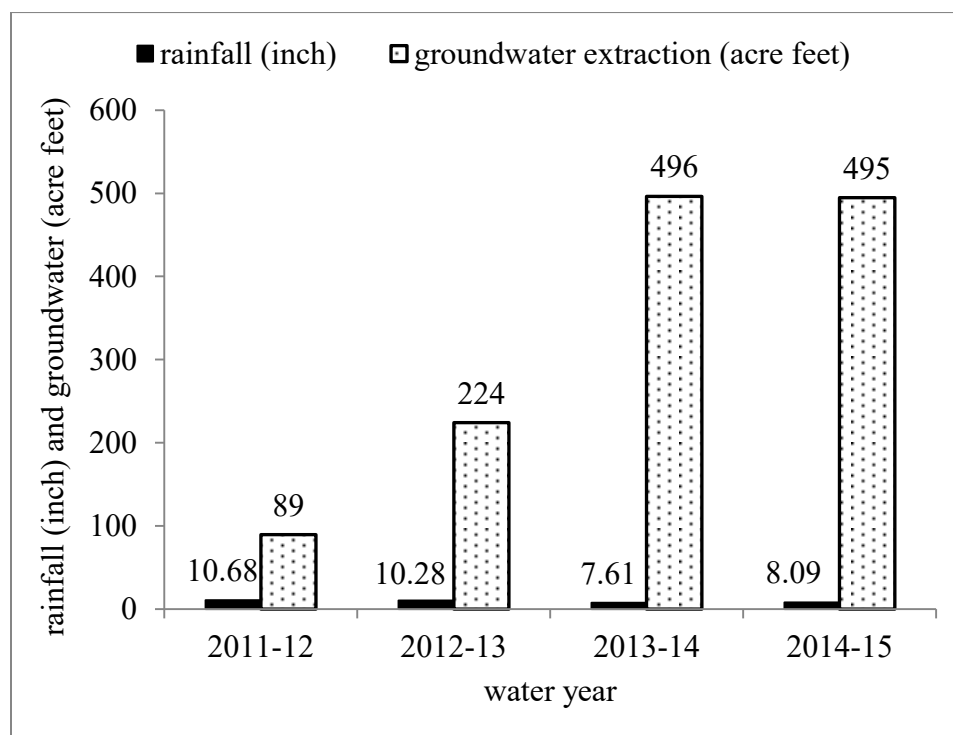


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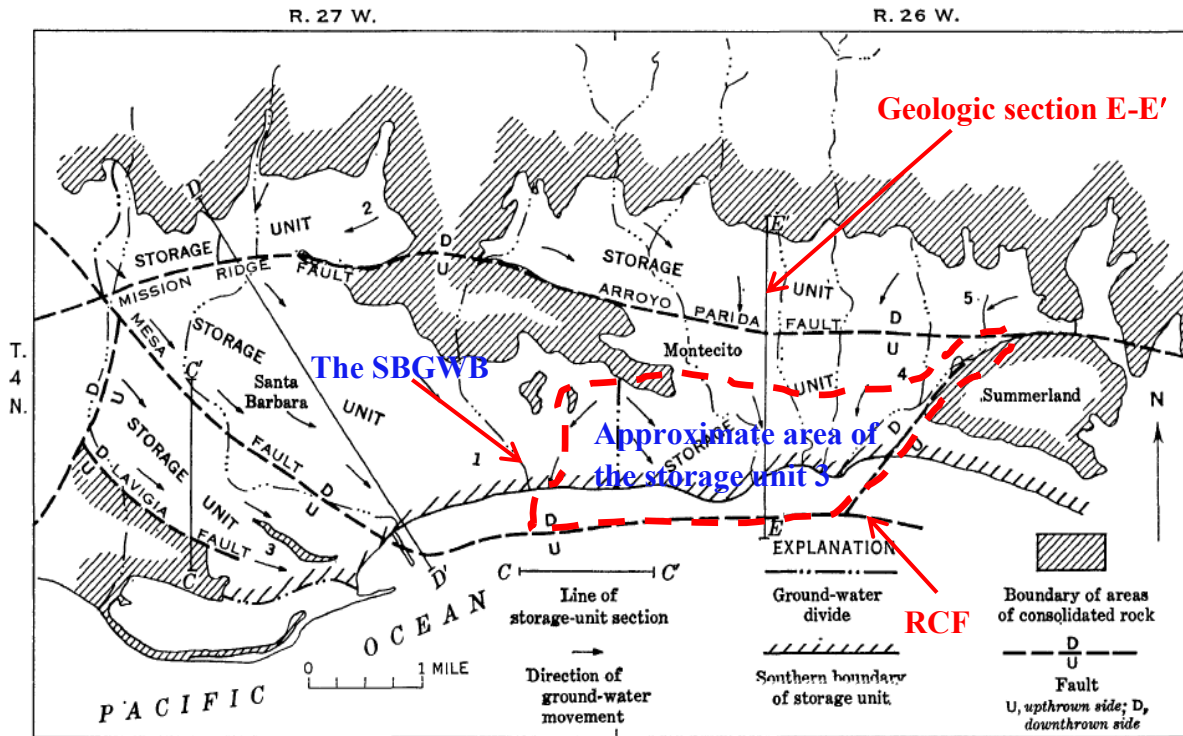


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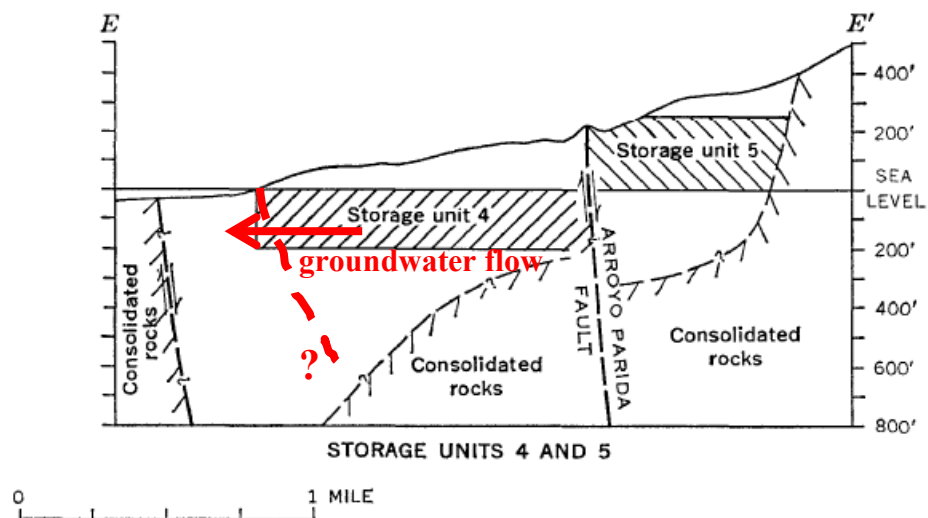


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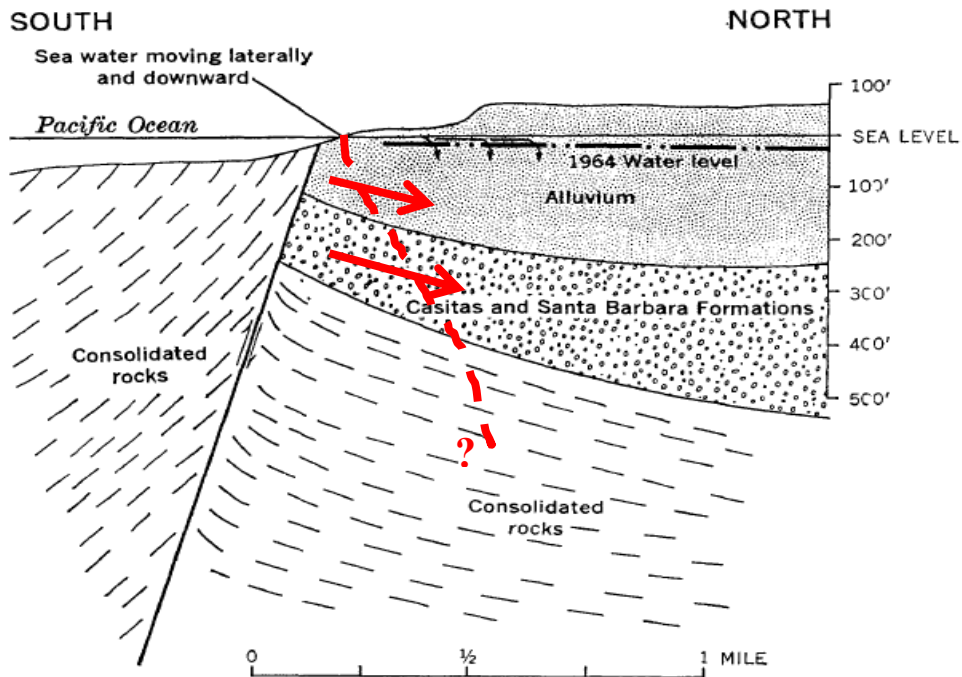


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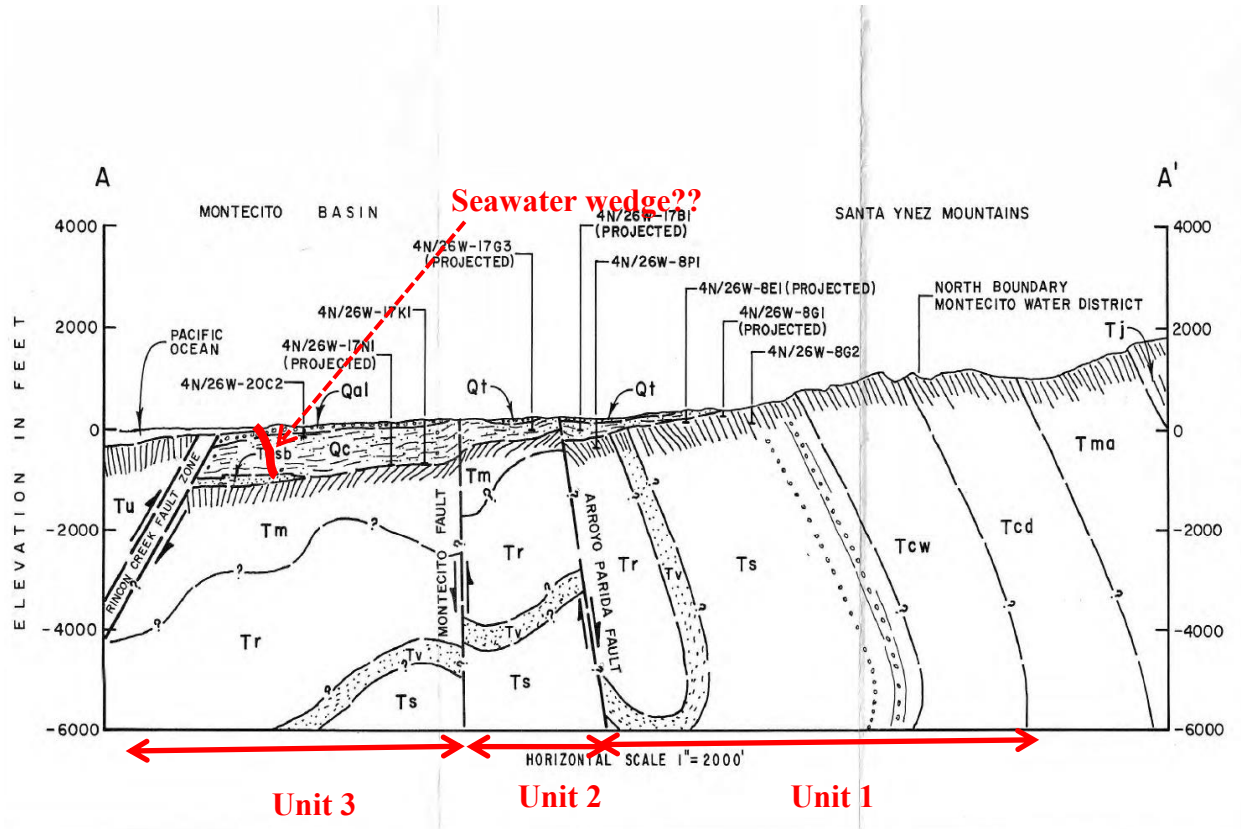


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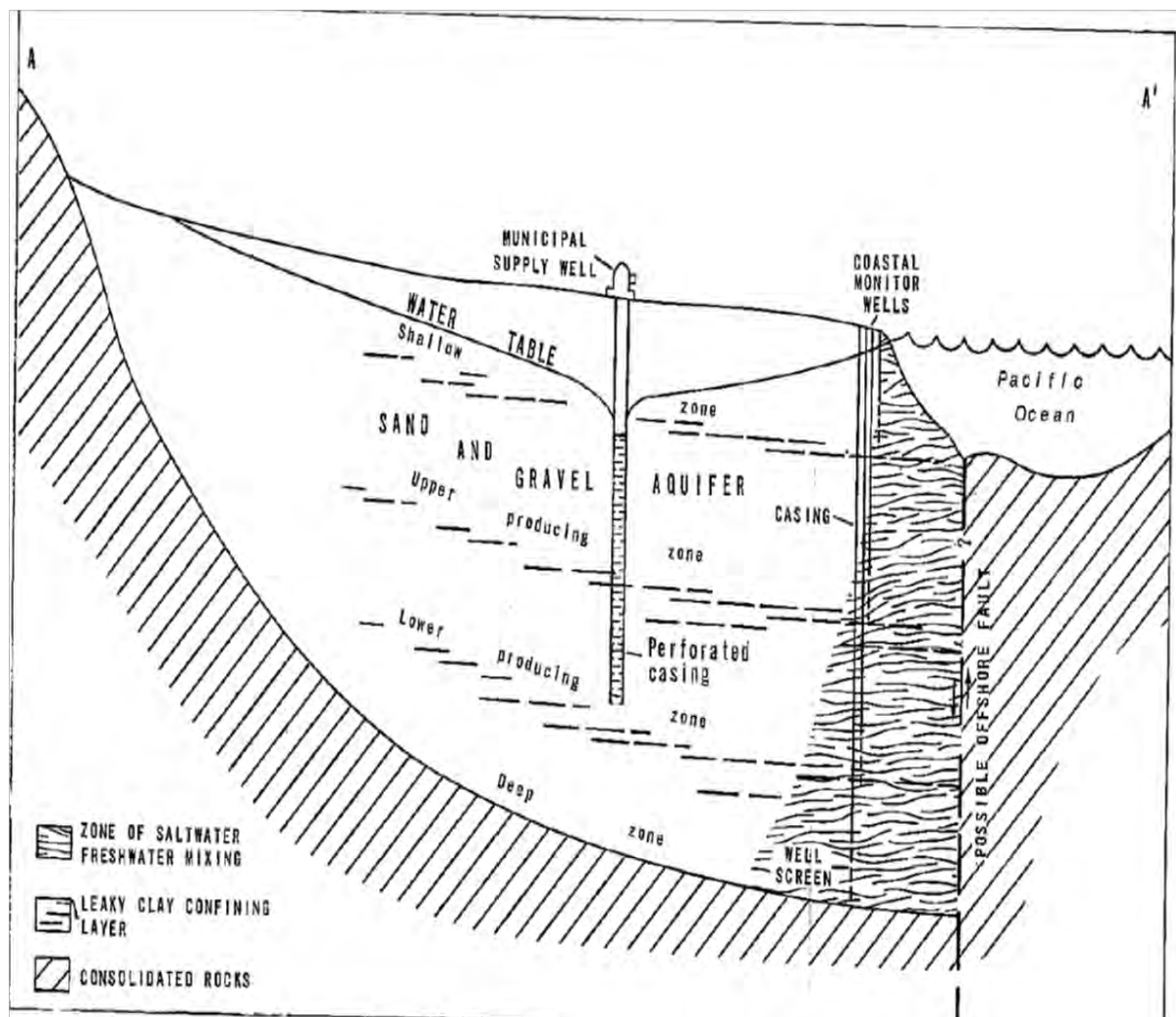


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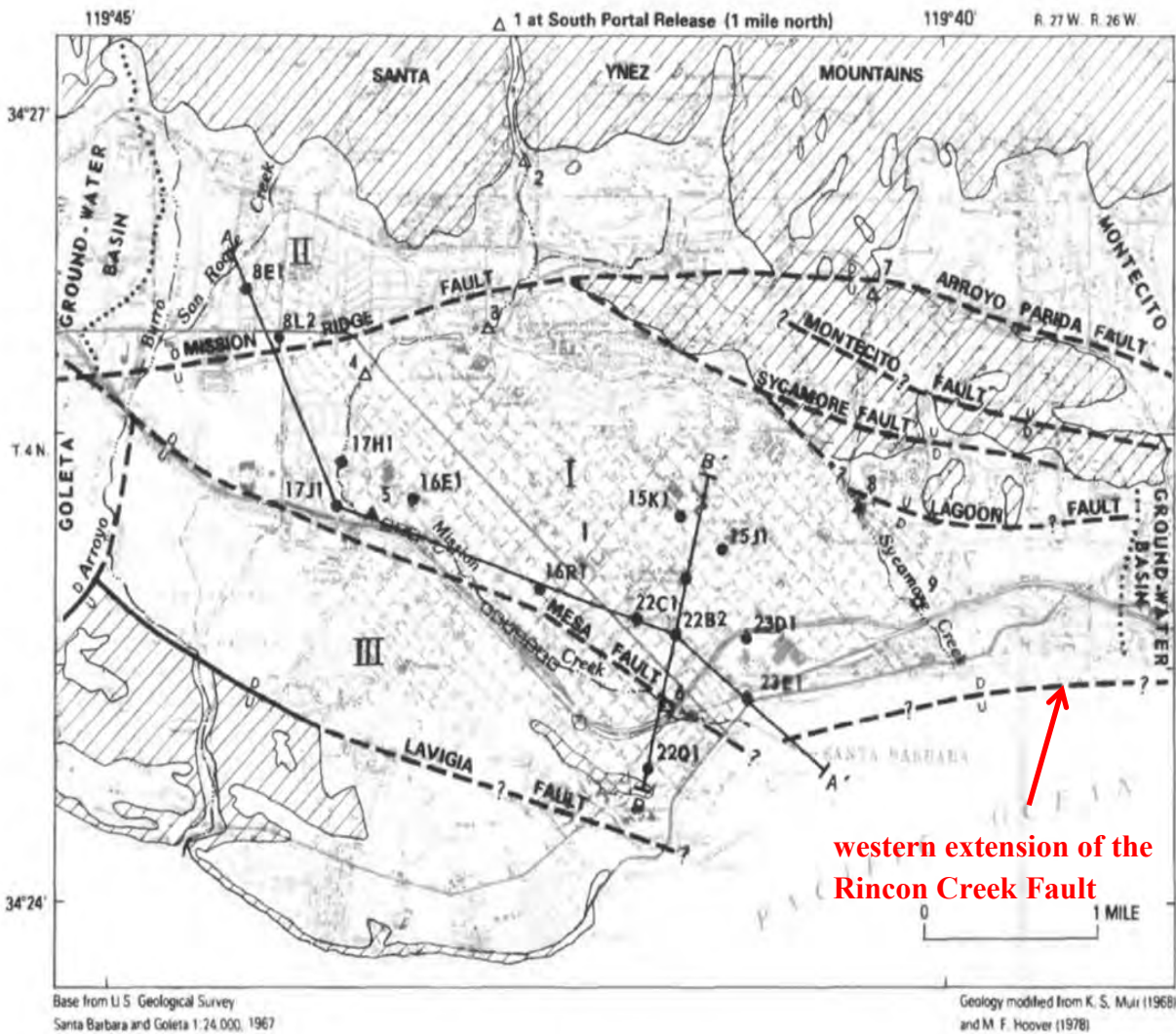


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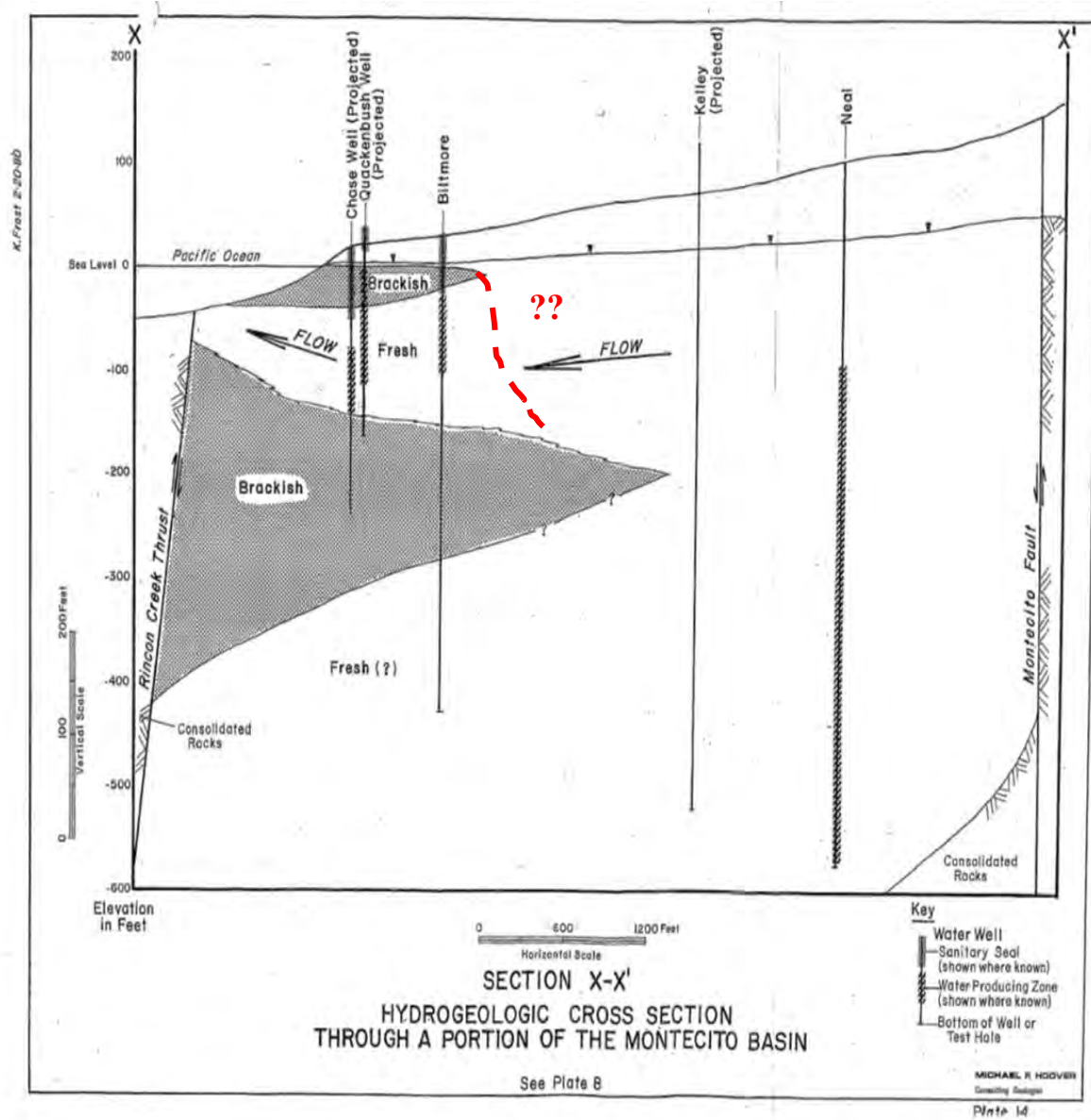


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GROUND WATER STORAGE UNITS



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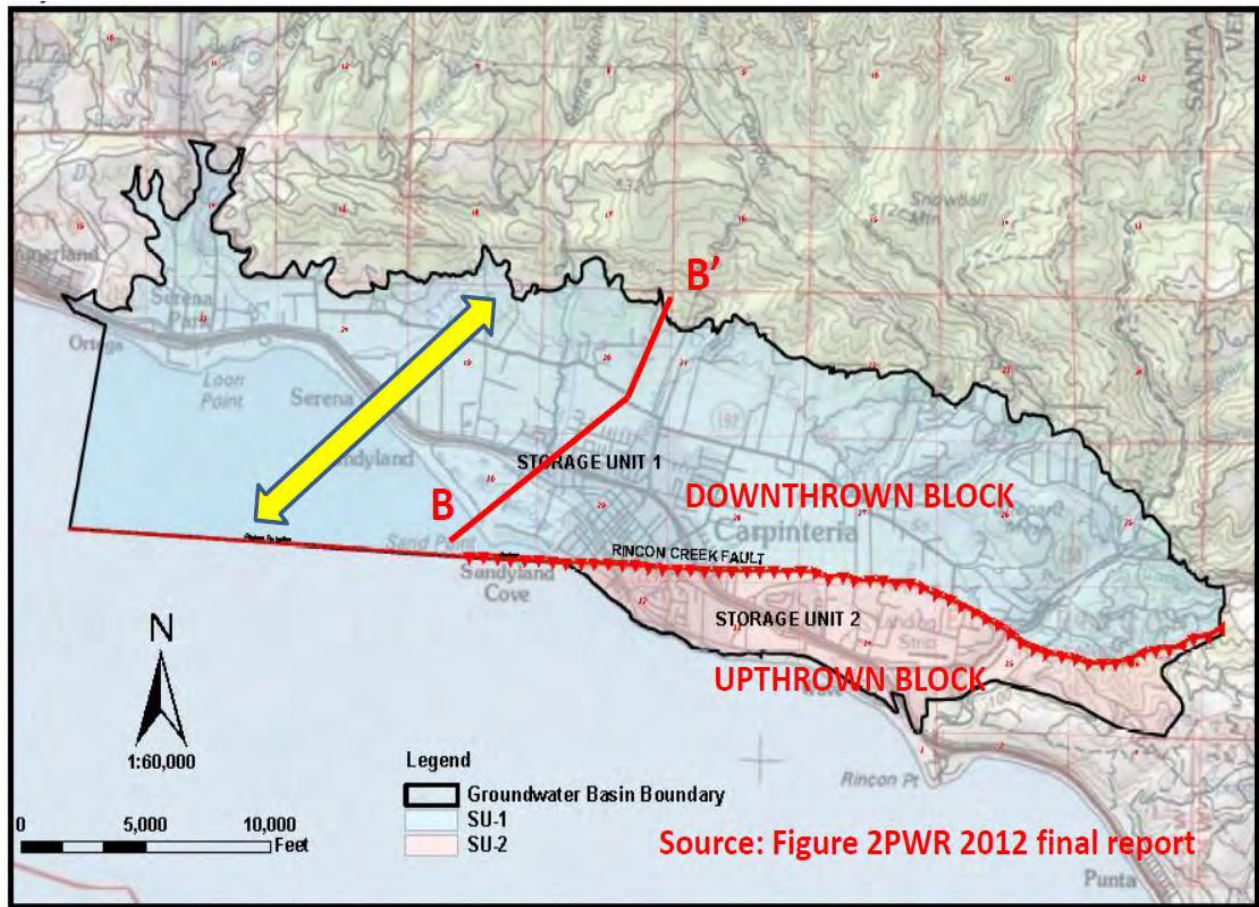


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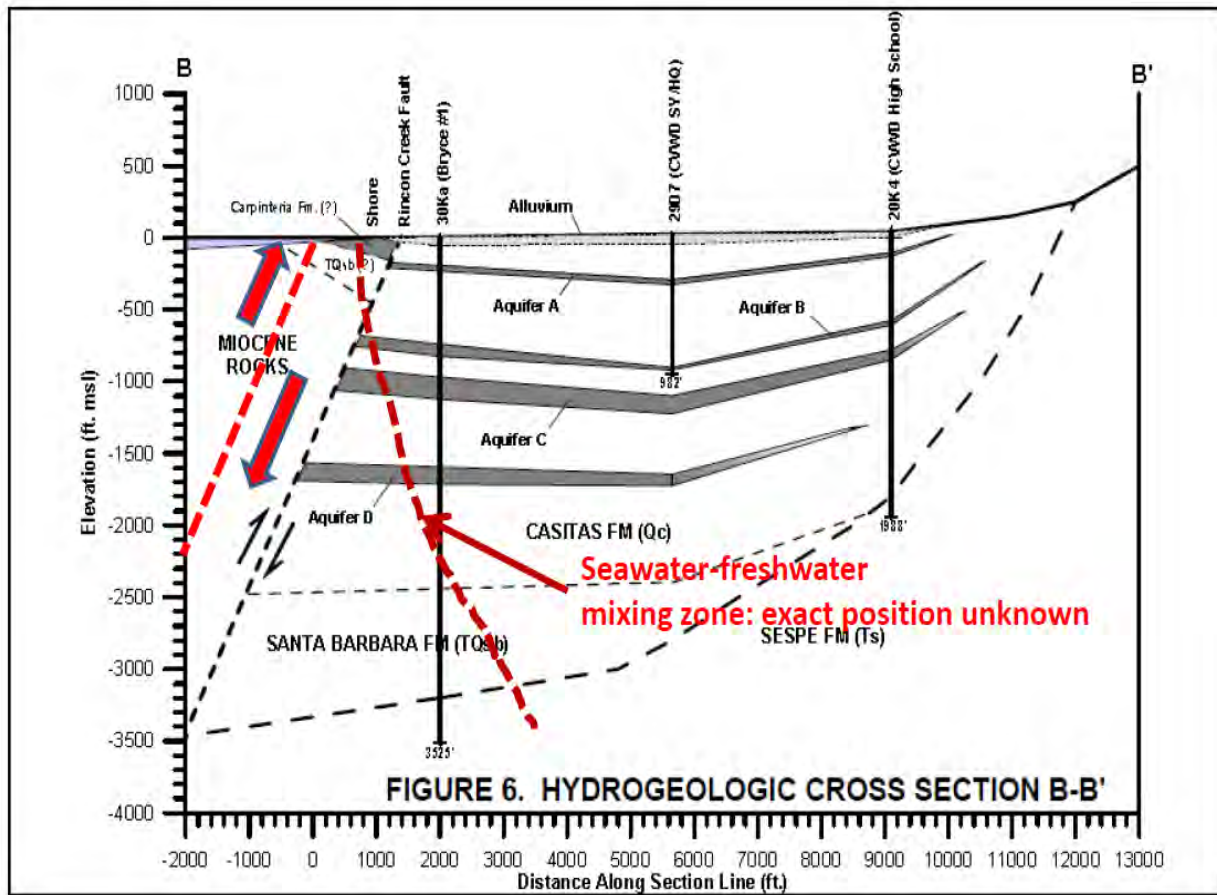


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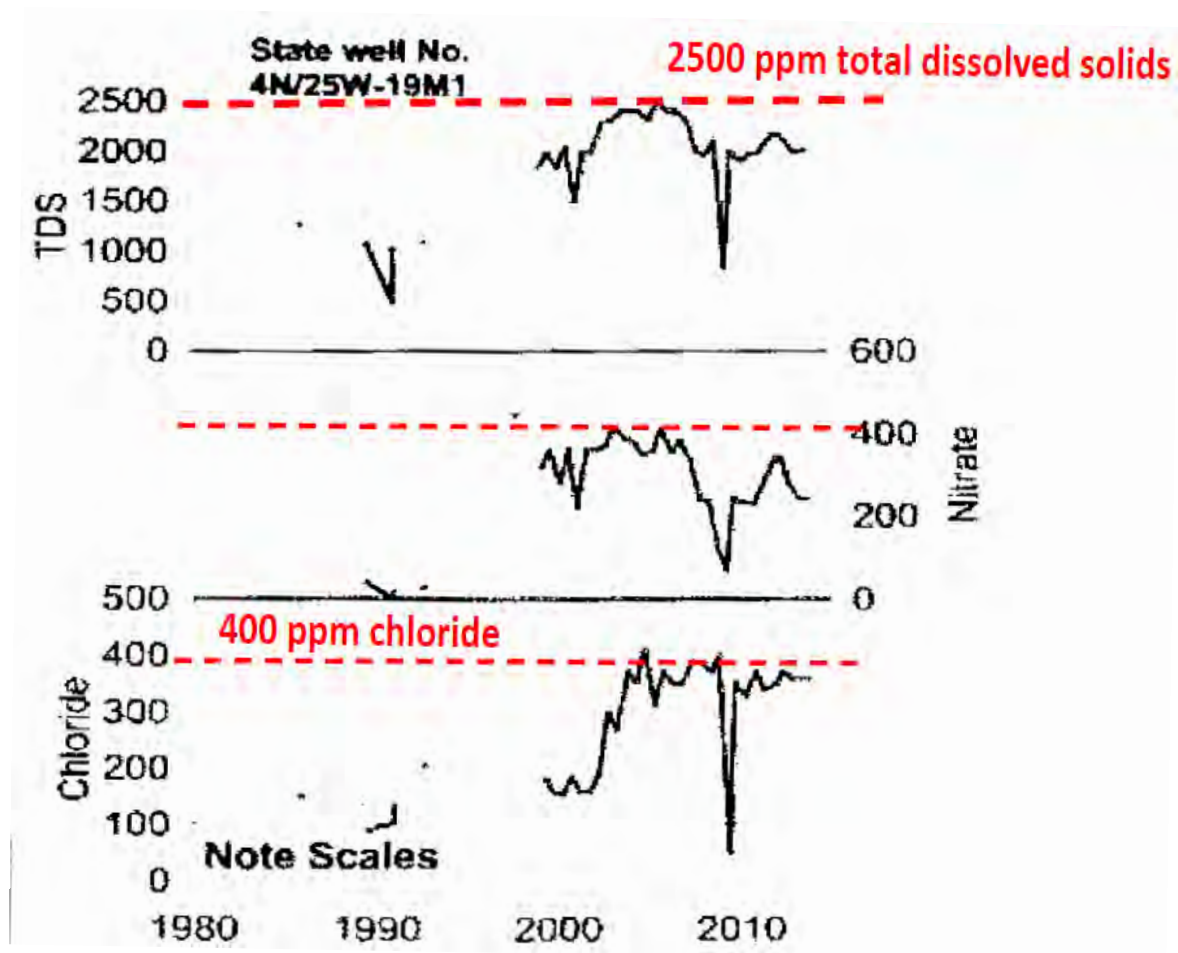


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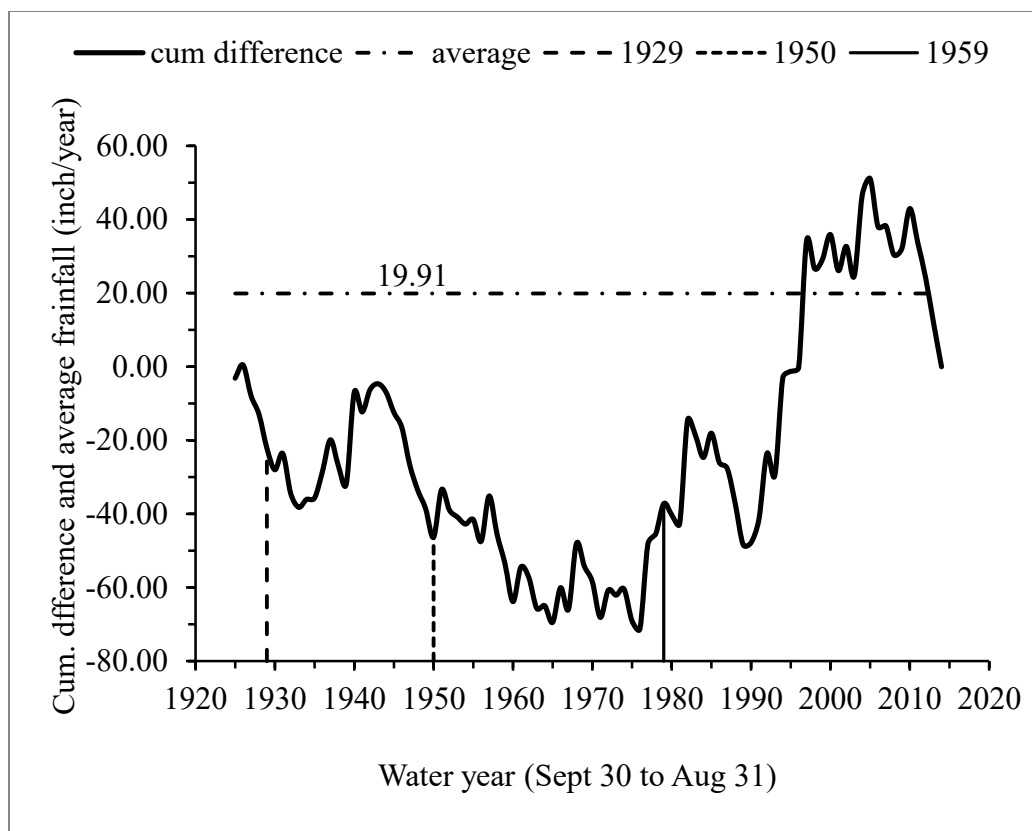


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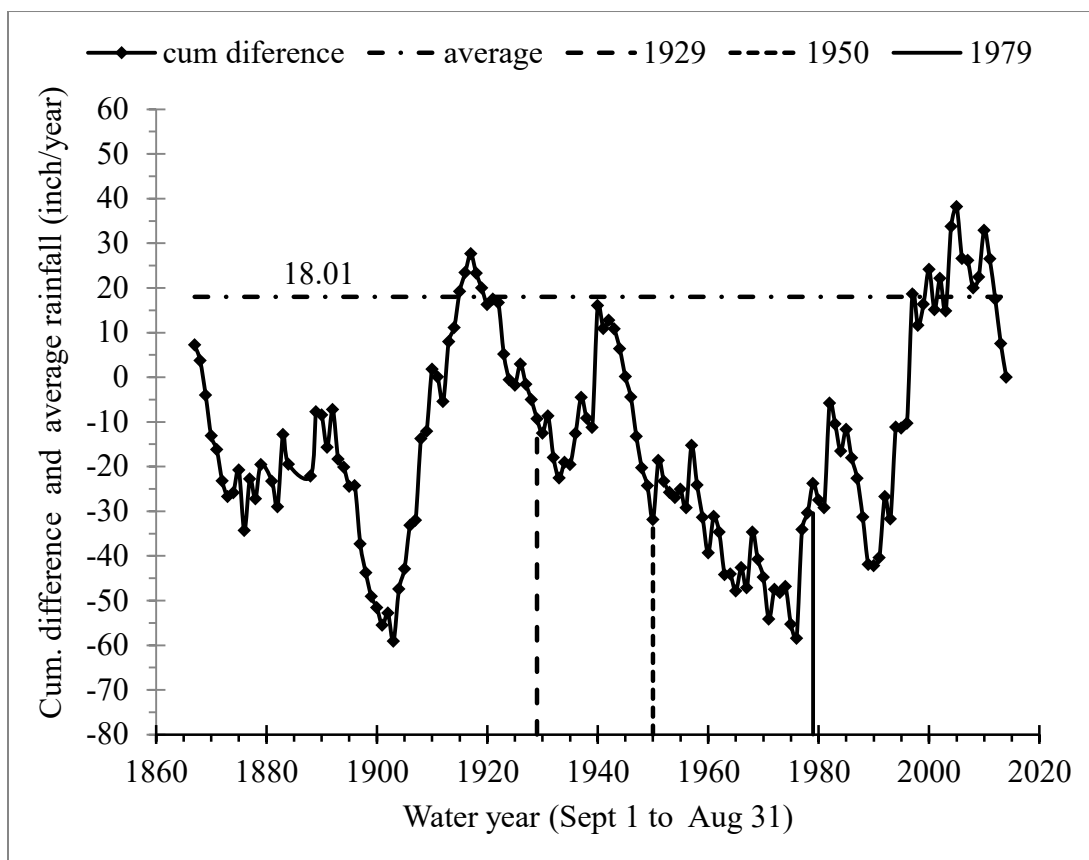


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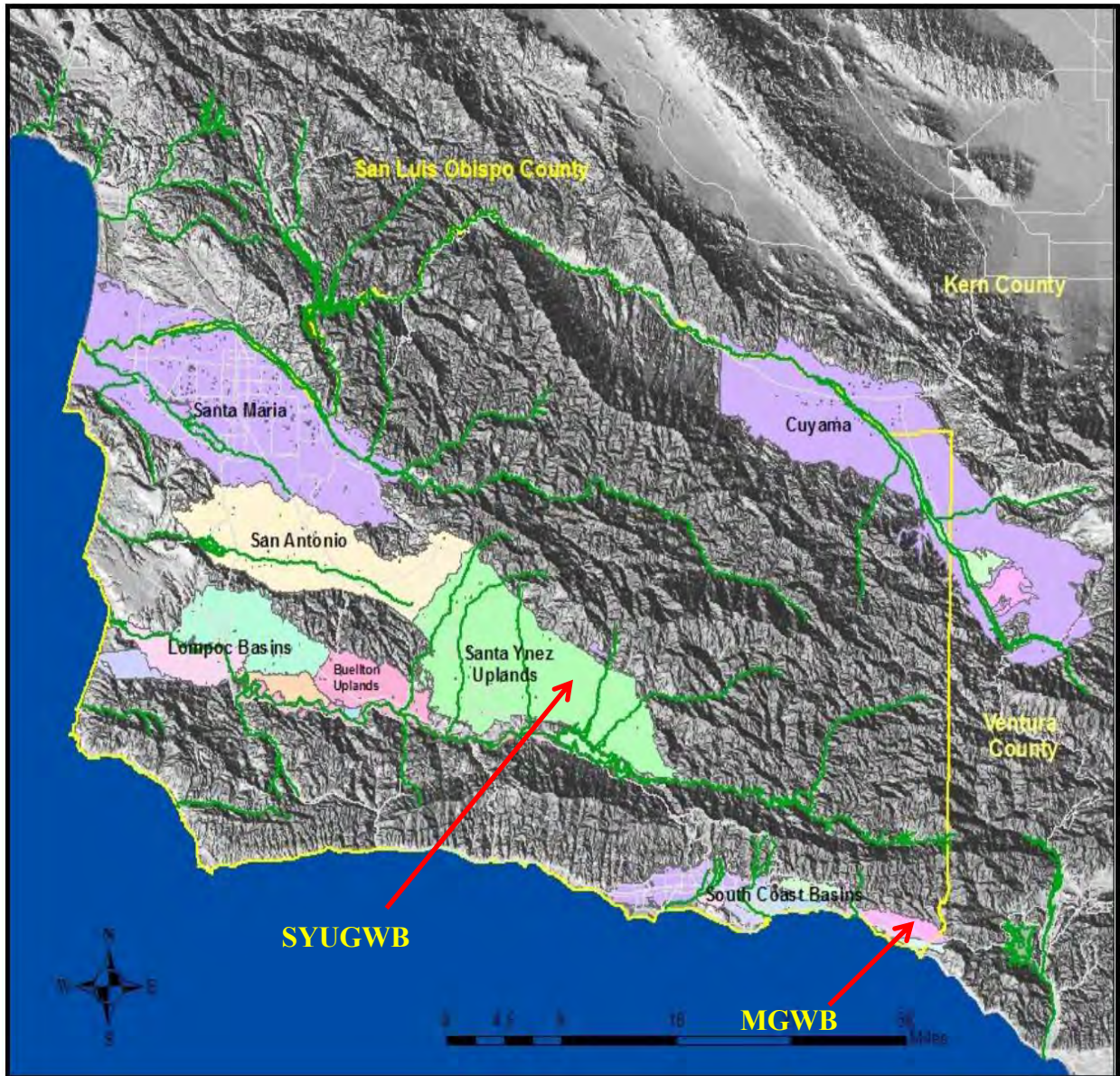


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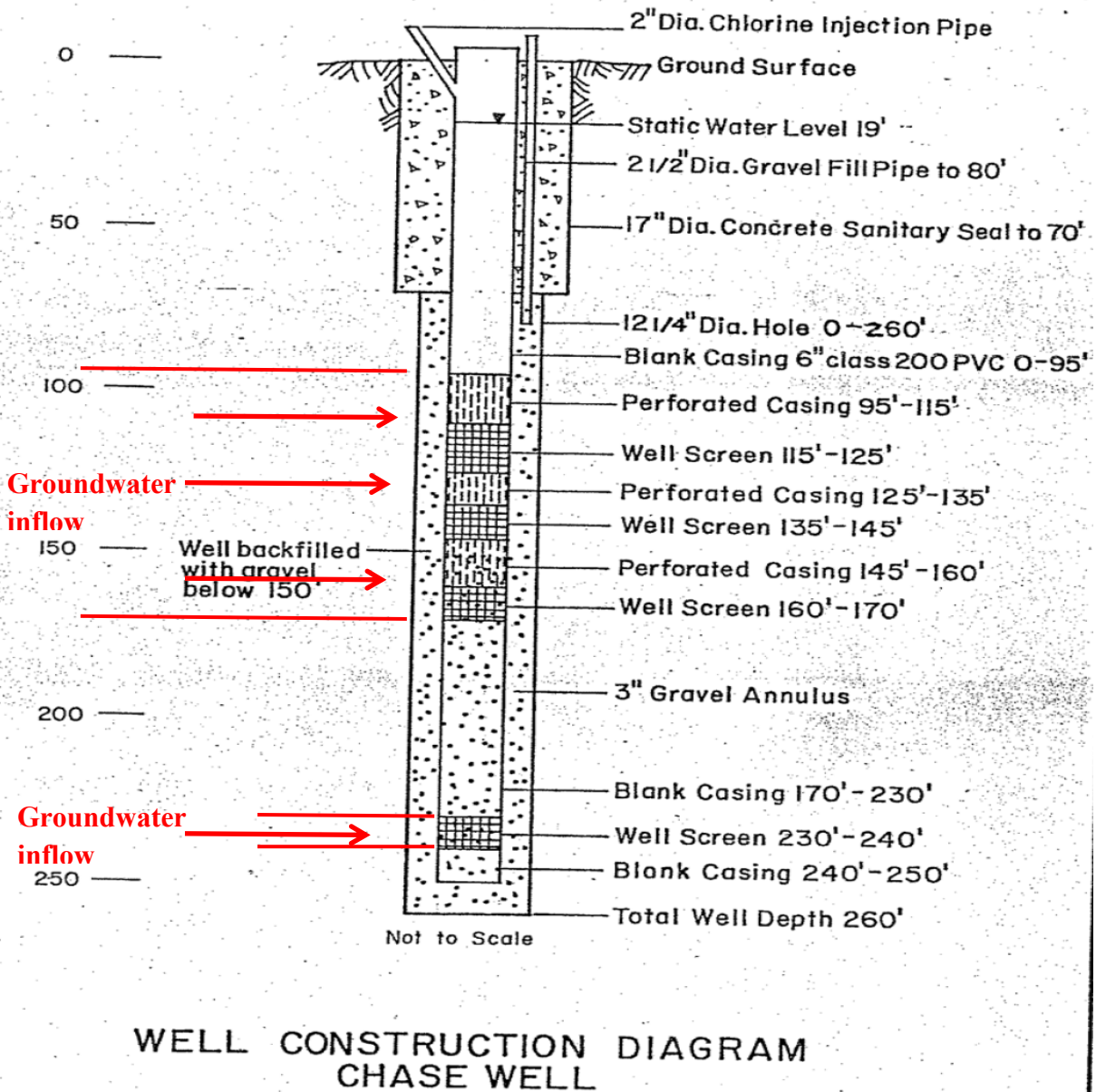


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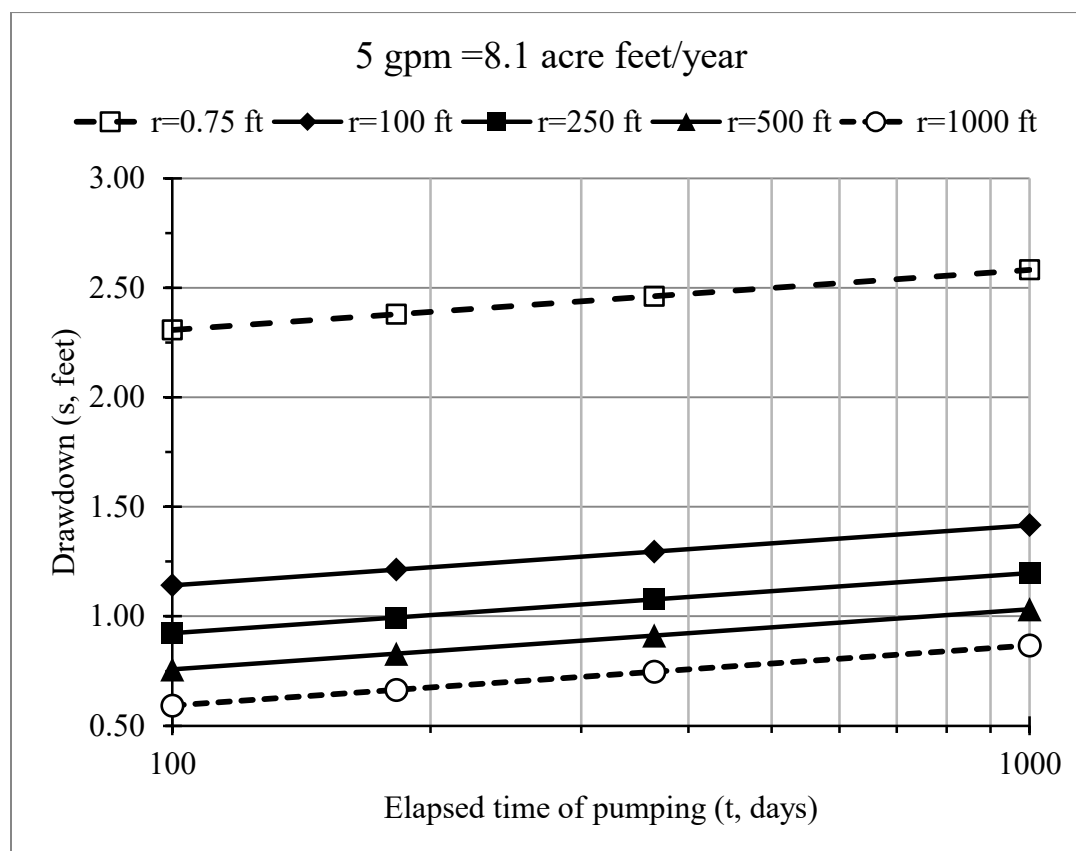


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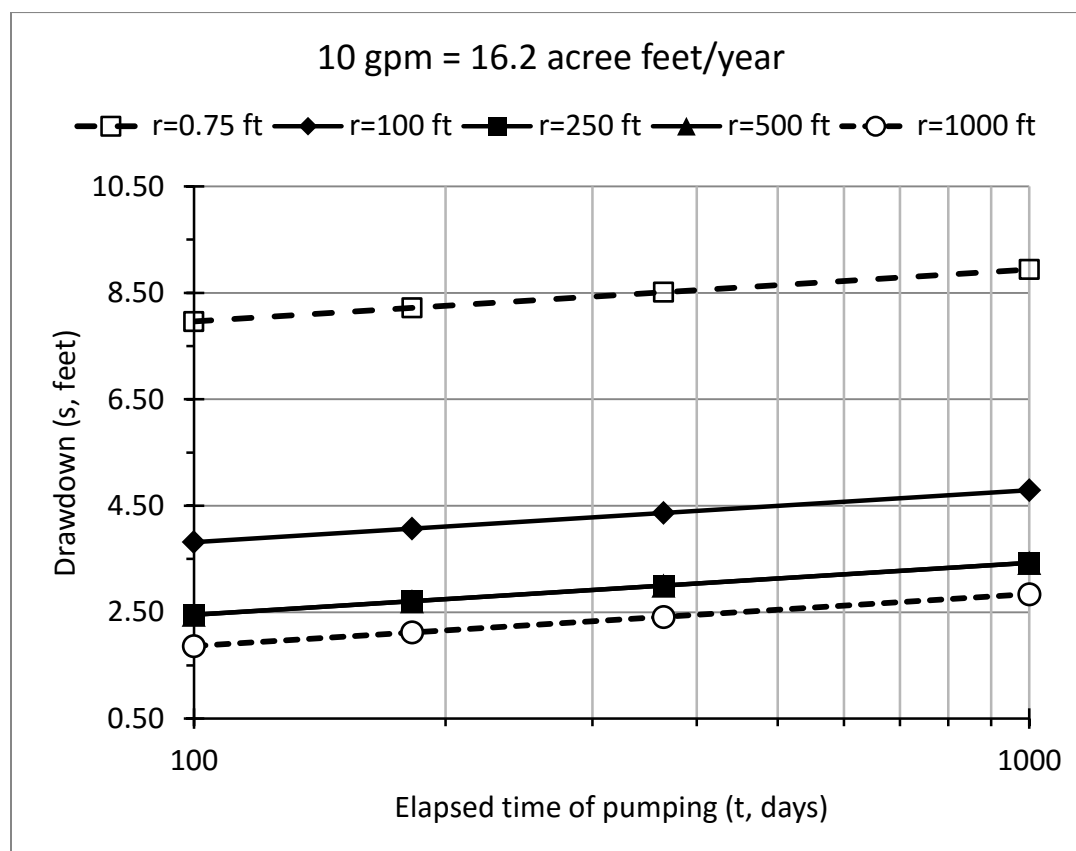


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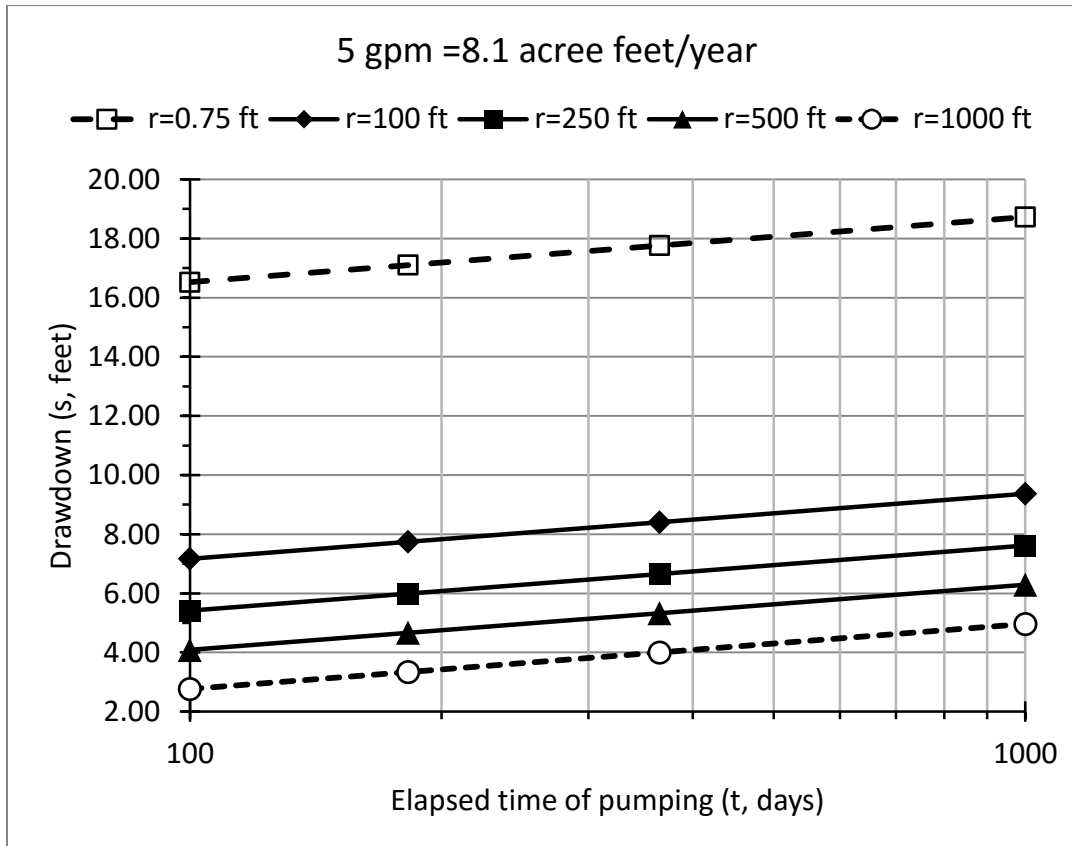


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