

12. GROUNDWATER THRESHOLDS MANUAL FOR ENVIRONMENTAL REVIEW OF WATER RESOURCES IN SANTA BARBARA COUNTY

(Prepared by Brian Baca, Registered Geologist, revised and updated August 20, 1992)

A. Introduction.

1. **Threshold of Significance.** The Threshold of Significance 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. This 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. Note that 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 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 most recent editions of this manual, the threshold has been calculated from a standard formula which included factors of available storage and overdraft. In this update of the manual, a new methodology developed by the Planning and Development Department is used. 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 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. This criteria has 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.

2. **Water resources in Santa Barbara County.** Water supplies in Santa Barbara County come from two sources:
 - a. Surface water impounded behind dams on the Santa Ynez River augmented by infiltration into delivery tunnels drilled through the Santa Ynez Mountains.
 - b. Groundwater pumped primarily from the fourteen alluvial basins. Additional water is produced from bedrock aquifers in the hills which surround the alluvial basins.

These supplies are limited. Long-term average annual yields of the surface reservoirs, as currently constructed, are fixed values subject only to downward adjustment due to siltation or the occurrence of a new worst-case drought. Groundwater supplies are limited in terms of the annual amount of water which can be withdrawn without causing a long term drop in water levels ("Safe Yield") and in the amount of total storage of a basin which can be removed without significant environmental effects ("Available Storage"). These limits make conservative use of water a necessary policy in Santa Barbara County in order to avoid or minimize significant and lasting adverse environmental effects.

Figures 1a and 1b illustrate the location of the major alluvial basins in Santa Barbara County. Also shown are the Ellwood/Gaviota and Gaviota/Point Conception areas dominated by bedrock pumpage.

3. **Environmental concerns in alluvial basins.** Adverse environmental effects which can be caused by overdraft of an alluvial groundwater basin include:
 - a. **Degradation of water quality.** Water quality varies considerably from one basin to another. In general, water quality in the groundwater basins of Santa Barbara County is declining with continued use of the resource, particularly in areas where the water table has been significantly lowered. Factors attributable to man which contribute to continuing degradation include pollution by agricultural runoff waters laden with fertilizers and pesticides, percolation of water from public and private sewage treatment systems, use of imported water which increases the salt load on a basin, percolation of polluted urban runoff, the reduction of the natural "flushing" effect of water through-flow caused by lowered water levels and the upward or lateral influx of connate brines by over-pumping of the freshwater aquifers. Preventive measures are the best way to address the ongoing deterioration. In general, the amount of pollutants placed in the ground, and the level of overdraft in the basins, should be minimized.
 - b. **Saltwater intrusion.** Intrusion of marine salt water is a problem which could affect all of the coastal basins of Santa Barbara County. Unfortunately, few data are available on its occurrence in the past. Recent USGS studies have shown that salt water has intruded a few hundred feet onshore in Storage Unit No. 1 of the "Santa Barbara City Basin." Computer modeling conducted as part of this work indicated that the rate of salt water advance was four times greater than the rate at which the salt water could be flushed out by natural processes. Prevention of salt water intrusion is thus a key concern of projects supported by coastal pumpage.
 - c. **Land subsidence.** Land subsidence can occur in alluvial basins where water levels have dropped due to pumpage. Substantial evidence has not been reported in Santa Barbara County. Subsidence in the overdrafted Goleta Basin has undoubtedly occurred but most of it probably took place many decades ago when the lower aquifers were first penetrated (according to the County Water Agency). Land subsidence can be a significant problem which can damage structures erected above a local cone-of-depression caused by extensive pumping.
 - d. **Loss of well yield.** Dropping water levels in a basin due to overdraft will reduce the rate at which individual wells will be able to produce water. Drilling more wells or deeper wells are the two methods of maintaining groundwater production to service a particular municipal or agricultural demand. There are, however, technical, legal and economic limitations on the ability of individuals or public or private purveyors to use these methods. With these limitations, it is likely that continued drop in water levels due to overdraft will cause loss of agriculture and a reduction in the ability of water districts to serve existing demand.
 - e. **Well interference.** New pumpage as part of a proposed project may cause a loss of well yield in nearby wells due to 1) a drop in water level as a cone-of-depression develops, or 2) a drop in water level due to storage depletion in a small isolated area. This could result in the current use on adjacent parcels being no longer supportable by the existing well(s).

- f. **Reduction of surface water available to support biological resources.** Pumpage of groundwater causes fluctuations over time in the elevation of the groundwater table. Lowering of the water table can effect biological resources on the land surface by reducing access to water by deep-rooted native vegetation or by reducing discharge of groundwater (baseflow) in streambeds. Even if a basin were pumped at a hydrologic "safe yield" rate (long-term water levels remain stable) a drop in water levels during a drought could adversely affect biologic resources.

In nearly all cases, an individual project's effect on biological resources would not have a discernable local effect as the new pumpage would add incrementally to the regional change in water levels. Thus, the thresholds of significance included herein would adequately address this impact. Under certain conditions, however, a local pumping depression could adversely affect a specific habitat area. In this case, the effects would need to be analyzed in the biologic resources section of the project environmental document.

4. **Environmental concerns in consolidated rock aquifers.** Consolidated rock aquifers are generally less extensive and have much smaller annual safe yield values than the alluvial basins. Environmental concerns associated with these aquifers include degradation of water quality, long-term loss of well yield, well interference and effects on biological resources. The discussion of these concerns presented above for alluvial basins applies to consolidated rock aquifers except for biological resources. Pumpage of consolidated rock aquifers has a direct effect on average annual flows downstream of the well site. This is because a pumpage-related drop in water levels (from native conditions) will lessen or eliminate baseflow out of the aquifer and induce groundwater recharge by stream flows. The reduction in flows represented by typical safe yield (potential average annual recharge) values estimated for hardrock aquifers is usually only a small proportion of the total average annual streamflows and would not likely result in substantial impacts on downstream riparian habitat. In certain cases where the proposed pumpage would cause a substantial reduction (as determined by the Planning and Development Department geologist) in streamflow and an environmentally sensitive habitat were present downstream, the effects on that habitat should be addressed in the biological resources section of the environmental document. The existence of a local critical habitat supported by aquifer baseflow and occupied by a rare or endangered species would also need to be addressed in the biologic resources section.

The basis for the assessment of impacts on groundwater resources due to pumpage of consolidated rock aquifers is the avoidance of overdraft (see discussion on Thresholds, this document).

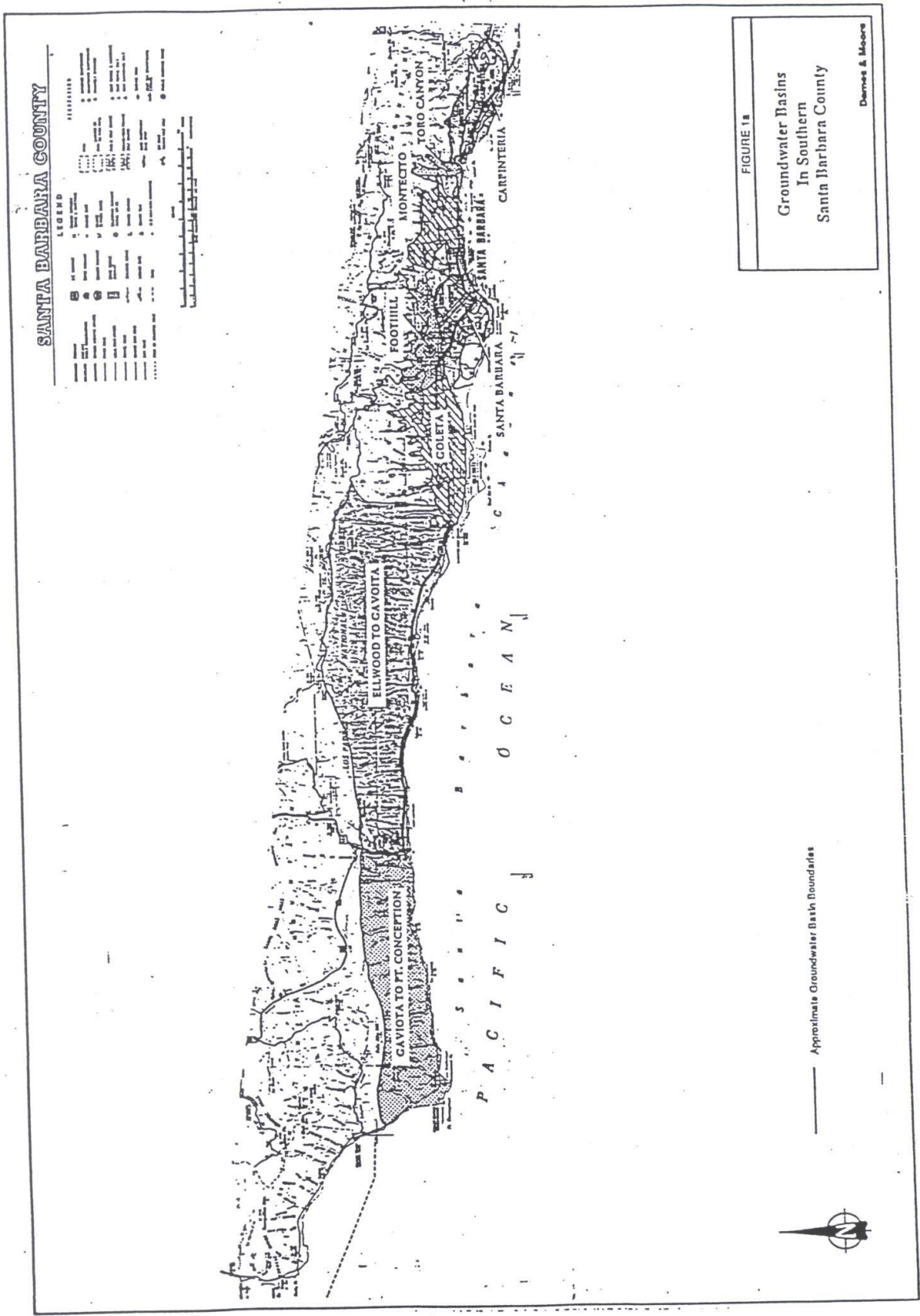




TABLE 1 – SUMMARY OF GROUNDWATER BASIN CONDITIONS
 Data from County Water Agency and Division of Environmental Review as of March 1992
 By Brian R. Baca, 6/92 (file thresh4.wk3) Revised 8/92

Basin	Return Flow Factor (Gross-To-Net)	Available Storage	Gross Pumpage (AFY)			Net Pumpage (AFY)		
			Current Use	Estimated Safe Yield	Surplus (Overdraft*)	Current Use	Estimated Safe Yield	Surplus Overdraft
Carpinteria	.90	50,000	4238	4294	56	3814	3865	51
Montecito	.90	16,000	1823	1350	473*	1641	1215	426 *
Toro Canyon	.90	650	242	300	58	218	270	52
Foothill	.95	5000	1095	953	142*	1040	905	135*
City of Santa Barbara	.95	10,000	619	847	228	588	805	217
Goleta North/Central	.95	18,000	5167	3600	1567*	4908	3420	1488*
Goleta West	.95	10,000	See note below					
More Ranch	.90	600	24	84	60	22	76	54
Buellton Uplands	.74	153,800	2898	1766	1132*	2133	1300	833*
Santa Inez Uplands	.78	900,000	14,100	11,500	2600*	10,998	8970	2028*
Lompoc	.67	170,000	31,087	28,537	2550*	23,386	21,468	1918*
San Antonio	.75	800,000	19,441	8667	10,774*	15,431	6500	8931*
Santa Maria	.70	1,100,000	149,300	118,500	30,800*	103,800	83,800	20,000*
Cuyama	.75	1,500,000	48,700	10,667	38,033*	36,525	8000	28,525*
S. Y. River Riparian	N/A	90,000	Not subject to overdraft*					

Note on the Goleta North/Central Basin: The overdraft status of the Goleta North/Central Basin is based on pumpage by various private and public entities over the last decade. Overdraft of this basin is not projected to continue as a result of the court judgment in the Wright vs. Goleta Water District lawsuit and the efforts of the GWD to comply with the judgment. The judgment requires that the GWD return the basin to a state of hydrologic balance by 1998. GWD actions to meet this mandate include:

1. Adoption of the Water Supply Management Plan.
2. Adoption of ordinance 91-2 ("WET" Initiative: Desalination Supply).
3. Voter approval of revenue bonds for the State Water Project.
4. construction of the GWD/GSD waste water reclamation plant.
5. permanent water conservation programs.

On July 14, 1992 the Board of Supervisors determined that water service to Wright litigants and other holders of can-and-will-serve letters from the Goleta Water District does not have the potential to cause overdraft. Projects fitting in this description are therefore exempt from environmental review as it pertains to questions of groundwater overdraft.

Note on the Goleta West Basin: The status of the Goleta West Basin (or Subbasin) has not yet been resolved. This is because of uncertainty associated with several well exchange/service agreements between Planning and Development Department and Goleta Water District staff and landowners in the West Basin. The issue is the subject of ongoing discussions between the Planning and Development Department and Goleta Water District staff and is anticipated to be resolved by late 1992.

TABLE 2 - GROUNDWATER THRESHOLDS 1992 UPDATE

Revised Methodology for Determining Threshold of Significance

By Brian R. Baca, 6/92 (File "thresh2b.wk3") Revised 8/20/92

METHODOLOGY

An idealized reference basin having overdraft and storage characteristics similar to the overdraft basin with the greatest remaining life (Santa Ynez uplands) was chosen as a standard. The Threshold of Significance for this reference basin was set at an amount (61.9 AFY) that if added to the assumed overdraft would result in the loss of three percent of the remaining life of the Available Storage. The Threshold values for the actual basins are proportional to the Threshold for the reference basin based on the relative length of remaining life and the relative size of the basin. Remaining life is weighted at 75 percent; size at 25 percent. Threshold values are rounded to the nearest 1 AFY for use in project environmental review.

STANDARD REFERENCE BASIN

Net Overdraft (AFY)	Available Storage (AF)	Remaining life of Av. Strg. (Years)	Threshold of Significance Based on 3.000% Loss of Remaining Life of Avail. Stor.	Formula for Calculation of Reference Basin Threshold of Significance (x) in AFY. (3% loss of remaining life)
2000.000	900000.000	450.000	61.856 AFY	$\frac{900000 \text{ AF}}{2000 \text{ AFY} + (x)} = 450 \text{ years} * .97$
a	b	c	d	

OVERDRAFTED/OVERCOMMITTED BASINS

Basin	Net Overdraft (AFY)	Available Storage (AF)	Remaining Life of Av. Strg. (Years)	Ratio to Standard Reference Basin		Combined Ratio (1) @ 75% (2) @ 25%	Calculated Threshold of Significance (Combined Ratio x 61.856)	Applied Threshold of Significance (AFY)
				Remaining Life (R.L./c)	Available Storage (A.S./b)			
Santa Ynez Uplands	2028.00	900000.000	443.787	0.986	1.000	0.990	61.215	61
Buellton Uplands	833.000	153,800.000	184.634	0.410	0.171	0.350	21.677	22
San Antonio	8931.000	800,000.000	89.576	0.199	0.889	0.372	22.980	23
Lompoc	1918.000	170,000.000	88.634	0.197	0.189	0.195	12.058	12
Santa Maria	20,000.000	1,100,000.000	55.000	0.122	1.222	0.397	24.570	25
Cuyama	28,525.000	1,500,000.000	52.585	0.117	1.667	0.504	31.194	31
Montecito	426.000	16,000.000	37.559	0.083	0.018	0.067	4.147	4
Foothill	135.000	5000.000	37.037	0.082	0.006	0.063	3.904	4
Goleta North/Central	1488.000	18,000.000	12.097	0.027	0.020	0.025	1.556	2

BASINS IN SURPLUS (No Threshold of Significance Applies)

Basin	Net Overdraft (AFY)	Available Storage (AF)
Carpinteria	0.000	50,000.000
City of Santa Barbara	0.000	10,000.000
Toro Canyon	0.000	650.000
More Ranch	0.000	1200.000

B. Environmental Review of Water Resources.

1. **Alluvial basins.** The relative significance of proposed new withdrawals from a groundwater basin must be assessed in the preparation of an environmental document (ND, EIR) pursuant to the California Environmental Quality Act. This is done through calculation of specific "Thresholds of Significance" for each of the overdrafted basins in Santa Barbara County. No threshold is established for a basin in a state of surplus. A project in such a basin would be subject to a threshold only if it would use more than the remaining surplus. In an overdrafted basin, projected net new consumptive water use of a project which exceeds the calculated threshold for that particular basin is deemed a significantly adverse environmental impact. This determination during the initial study would require the preparation of an Environmental Impact Report. If the estimated water use remains above the Threshold of Significance in the final analysis, the impact of the project on water resources, would, as stated above, be considered significant and unavoidable and the project would require a finding of Overriding Considerations by the decisionmakers for approval.

Thresholds of Significance are calculated from hydrologic parameters for each of the basins in a state of overdraft. The size of the basin and the level of net annual overdraft are the key factors upon which the threshold is based. Current status of the basins is summarized in Table 1. The method used to establish the appropriate values for each basin involves setting a threshold for an idealized "Reference Basin" having overdraft and storage characteristics similar to the overdrafted basin with the greatest remaining life (Santa Ynez Uplands) based on a percentage loss of the estimated remaining life of the available storage. Thresholds for the other basins are proportional to this value based on the relative size and remaining life. A detailed explanation and a worksheet illustrating all the figures used in the calculation and the results are included on Table 2. Threshold values of 2 AFY to 61 AFY are herein established for the eight overdrafted/overcommitted basins in Santa Barbara County.

Definitions of the key parameters are as follows:

Safe Yield - The maximum amount of water which can be withdrawn from a basin (or aquifer) on an average annual basis without inducing a long-term progressive drop in water level.

Available Storage - Available storage is 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 will be periodically updated by the Planning and Development Department and the County Water Agency as new information becomes available.

Net Annual Overdraft - 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.

Portions of Santa Barbara County, especially the South Coast, are served by water districts which distribute both surface water from the Santa Ynez River watershed and groundwater pumped from local basins. For environmental review purposes, the surface supplies are considered to be the first element of supply committed to existing demand. Thus, the water use of a new development is assumed to come entirely from the groundwater basin.

New supplemental supplies of water in the process of development in Santa Barbara County include desalination of sea water, wastewater reclamation and importation of water through

the State Water Project. Upon determination that a new source is available over the long term, a project supported by that source would not be subject to the groundwater thresholds of significance. If water from a new source were to offset current pumpage on a long-term basis, the Threshold of Significance would be revised to reflect the lowered pumpage.

2. **Consolidated rock aquifers.** The methodology for determining the threshold of significance for water use in consolidated rock (bedrock) aquifers is based on whether the proposed usage would place the aquifer in a state of overdraft. In order to make this determination it is necessary to define the boundaries of the aquifer and to estimate the potential average annual recharge (i.e. Safe Yield) available within the defined boundary.
 - a. **Aquifer boundaries.** Bedrock aquifers in Santa Barbara County generally extend for long distances along bedding strike. On the south flank of the Santa Ynez Mountains, the Miocene and Eocene bedrock formations crop out in a continuous band crossing the intermontane watersheds from the Santa Barbara area to near Point Conception. The sandstone (and sometimes fractured shale) aquifers in these formations are variable in their hydrologic characteristics but are generally far less permeable and productive than unconsolidated alluvial sediments. They are also interbedded with relatively impermeable marine and non-marine shales and mudstones. Clearly, a well pumping at any one point cannot access the water in storage and the potential recharge (i.e. safe yield) over the entire trend. Pumping effects extending further than a few thousand feet cannot be assumed. For purposes of analysis it is necessary to divide these aquifers into units in which the storage and potential recharge attributable to that unit can be presumed to be accessed from a single location. The watershed divides (ridgelines) are designated as aquifer boundaries for purposes of environmental review. Using watershed areas to define and analyze the bedrock aquifers have several advantages: 1) the boundaries are clearly delineated, 2) most wells are drilled in canyon bottoms and, thus, the topographic divide would occur at the approximate midpoint between pumping centers and 3) the watershed area is directly related to a major source of potential recharge, stream seepage. It must be recognized, however, that the watershed boundaries, a surface feature, do not represent barriers to subsurface groundwater flow. For this reason a well located near a watershed boundary could draw water from an adjacent watershed and access the yield attributable to that watershed. Based on observed well drawdown effects in the Vaqueros Formation at two locations in the Ellwood/Gaviota area, it will be assumed in the analysis of Vaqueros aquifers that a well located within 800 feet of a watershed boundary will access the yield attributable to the adjacent watershed. The combined safe yield of the affected watersheds (and the combined existing demands) will be used to assess a project's impact on groundwater resources. A "radius of influence" greater or less than 800 feet may be used if justified based on site-specific geologic or hydrologic data. In other formations, the ridgeline boundary criteria will be used unless site-specific data is available which better defines the aquifer limits.

The boundary of the "aquifer" in the stratigraphic sense is also necessary to define. In a geologic formation or subunit predominated by sandstone (presumably fractured) a well in any part of that unit is assumed capable of accessing all of the potential recharge to that unit. Specific examples on the South Coast would be the Vaqueros and Coldwater Formations. Note that site specific geologic information could require that these formations be divided into subunits (as determined by the Planning and Development Department Geologist). In a unit comprised of interbedded permeable and

non-permeable units the aquifer is defined as the stratigraphic interval to which the well is hydrologically connected (i.e. the screened or gravel packed interval). The Sespe Formation is an example of the type of geologic unit which would be subject to this definition.

As a reasonable worst case, faults are considered to be barriers to groundwater flow. The aquifer boundaries used in environmental review would reflect this assumption.

b. Safe Yield.

- (1) Introduction.** In past Thresholds manuals, potential average annual recharge to an aquifer, or "safe yield", was estimated based on a percentage of total average annual precipitation in the watershed above the aquifer under study. A figure of 4.75 percent of the total precipitation was assigned to the aquifer as safe yield based on values obtained from the USGS study of the Ellwood to Gaviota area by Miller and Rapp (1968). The 4.75 percent figure was, however, taken out of context and used incorrectly. This figure is an estimate of field recharge (direct percolation of rainwater) over an entire watershed area and does not reflect the field recharge attributable to the outcrop area of a single aquifer (or group of aquifers) within the watershed. The field recharge of any single aquifer is generally far less than that for the entire watershed. This method also did not account for induced recharge (stream seepage and subsurface underflow) due to the drop in aquifer water level with pumpage. A new methodology which accounts for sources of direct recharge (field recharge and stream seepage) and indirect recharge (subsurface underflow) is described below. This methodology was jointly developed by the Division of Environmental Review and the County Water Agency. *(A program diskette including instructions is available from the Planning and Development Department.)*
- (2) Direct recharge.** Direct recharge refers to the infiltration of surface water into the aquifer. This can occur as either field recharge (the direct penetration of rainfall) or as seepage from flowing streams.
- (3) Field recharge.** Field recharge has been estimated by a variety of methods. Miller and Rapp (1968) made their estimate of 4.75 percent of total average annual rainfall based on groundwater discharge or baseflow out of the watersheds from Ellwood to Gaviota. Blaney (1933) measured actual recharge in an alluvial setting in Ventura County for several years and developed graphic curves ("Blaney curves") which relate annual rainfall to infiltration. Another method developed by the Soil Conservation Service (SCS) involves modeling of a "soil reservoir." When the inputs to the reservoir (rainfall) exceed output (evapo-transpiration of vegetation and runoff) and soil reservoir storage capacity deep penetration to groundwater is assumed to occur. This "Soil Moisture Balance" methodology involves the use of monthly rainfall data and allows for input of site specific parameters such as vegetation type, soil type and the amount of irrigation water applied to the surface outcrop. The Blaney Curve method uses only annual rainfall data and does not allow for input of site specific data. Miller and Rapp's figure is very general and averages together aquifers and non-aquifers with different vegetation, soil types and average rainfall. Given these comparisons, Soil Moisture Balance analysis is considered the best method for estimating field recharge and will be applied to aquifer outcrop area when adequate (as determined by the Planning and Development Department) monthly rainfall data is available.

In the absence of such data one of the other two methods (Blaney Curves, Miller and Rapp) will be used.

Estimates of field recharge using the soil moisture balance method involve preparation of a computer spreadsheet which applies monthly values of rainfall, applied water (if any), runoff and potential vegetation evapotranspiration to a model of the "soil reservoir" based on rooting depth and soil moisture holding capacity. An example of this spreadsheet is presented as Table 3. Key parameters used in this analysis are described below:

- (a) **Applied water.** Monthly irrigation amount applied to crop planted on top of aquifer outcrop. Monthly amounts based on 1) total annual use divided proportional to the monthly values for plant potential evapotranspiration or 2) crop irrigation schedule according to Cooperative Extension or California Dept. of Water Resources.
- (b) **Rainfall.** Values from an appropriate nearby rain gauge(s) monitoring by the Santa Barbara County Flood Control District. (Refer to Precipitation Data Report, 1990).
- (c) **Runoff factor.** The portion of precipitation which goes to runoff is not available for deep percolation. Until detailed studies are completed an average figure of 20 percent (80 percent effective rainfall) will be used. This figure is rounded from the 19 percent cited by Miller and Rapp (1968).
- (d) **Moisture capacity.** This figure refers to the ability of a particular soil type to hold water by capillary force. It is measured in inches of water per inch of soil. The figure used in the analysis will be that listed for the aquifer outcrop area in the SCS soil survey for Santa Barbara County. If an SCS value is unavailable, a value determined by the Planning and Development Department geologist will be used.
- (e) **Rooting depth.** Vegetation rooting depth equals the thickness of the soil reservoir. The values used are based on USGS reports, information provided by the farm advisor and other studies.
- (f) **Soil reservoir capacity.** This figure is the product of the moisture capacity times the rooting depth. It represents the total amount of water (in inches) that can be held in the soil reservoir. If additional water is added beyond this amount it is presumed to percolate to groundwater.
- (g) **Potential evapotranspiration.** The potential evapotranspiration annual curve used in the analysis will be based on USGS reports, evapotranspiration measurements at CIMIS stations, vegetation water use studies by the State Department of Water Resources or other related studies.

Water yield shown in the last column on Table 3 represents the amount of water available to the soil reservoir in excess of the moisture holding capacity of the soil reservoir and the potential evapotranspiration of the vegetation. The monthly values are averaged over a long period of time (decades) to obtain a figure for average annual recharge in AFY per acre of aquifer outcrop. This figure is multiplied times the aquifer acreage and rounded to the nearest one AFY to obtain average annual field recharge.

- (4) **Stream seepage.** Under native conditions (no pumping) bedrock aquifers in mountain areas (e.g. the Santa Ynez Mountains) have water levels at or near the elevation of the streambed. During and after the rainy season, water which has infiltrated into the aquifer as field recharge, discharges into the creek (baseflow). Seepage from streams does not occur because the aquifer is full and, at times, spilling. A drop in aquifer water level due to well pumpage will induce recharge from stream flows as well as reducing (or eliminating) baseflow out of the aquifer.

Magnitude of potential stream seepage depends on stream flow rates, streambed geometry, a seepage rate and the length of stream which crosses the aquifer outcrop. The County Water Agency (CWA) has developed a model which relates all of these factors and provides an estimate of long-term average annual recharge attributable to stream seepage. This model is based on 39 years of daily flows recorded at the USGS gauging station in San Jose Creek. It contains a function which calculates daily stream width (wetted surface width) at various flow rates over the 39 year period for a given channel geometry. Using this function and a stream seepage rate in gallons per day per square foot of wetted surface area a potential annual average seepage figure (in AFY) can be obtained. The information needed to perform this analysis on any particular aquifer is listed below (Table 3).

- (a) **Stream flows.** Average annual runoff in the watershed above the aquifer under analysis is estimated using the procedure developed by Crippen in USGS Professional Paper 417-E (1965). This method accounts for elevation, watershed area, potential evapotranspiration, the isohyetal distribution of rainfall and rock type. The average annual runoff ("recoverable water") estimated by this method for San Jose Creek in Goleta was compared to the actual average runoff measured by the USGS daily flow gauge on that creek over a 39-year period (1940-79). The "Crippen estimate" of 1569 AFY (Table 4a) was very close to the 1576.8 AFY measured by the gauge. However, the gauged values are approximately five percent lower than they would be under native conditions because of stream diversions and minor percolation losses to the Goleta Groundwater Basin upstream of the gauging station. Thus, the average annual flows used for the seepage analysis will be the Crippen calculated value increased by five percent. Table 4b is an example recoverable water worksheet for San Onofre Creek. The estimated average annual flows for a watershed are distributed on a daily basis over the 39-year modeling period using the daily gauged flows at San Jose Creek. The runoff at a watershed under study (Crippen plus five percent) is divided by the 1576.8 AFY measured at the San Jose gauge to obtain a "San Jose Creek Multiplier". This multiplier is applied to the gauged daily flows at San Jose Creek to obtain a model of daily flows at the aquifer under analysis.

The point along the stream where flows are estimated (the downstream limit of the "watershed") will be placed near the downstream contact or limit of the aquifer 20 percent of the distance from that point to the upstream contact of the aquifer. This location is incorporated into the seepage modeling discussed below.

TABLE 3
Example Soil Moisture Balance Analysis Spreadsheet

VAQUEROS FORMATION, ELLWOOD CANYON
SOIL MOISTURE BALANCE ANALYSIS

Rainfall data 1941-1979 (modified from Dos Pueblos Ranch)

Oaks and brush veg. cover (Rooting depth = 14')

Sandy soil (Moisture Capacity = .07 in./in. from SCS)

Soil reservoir capacity = 11.76 inches (14' x 12"/ft x .07"/in.)

Runoff as % of precipitation = 20

Month	Applied Water	Rainfall (Inches)	Runoff factor (.9 = 10% runoff)	Effective rainfall (inches)	Initial Soil Moisture (Inches)	Total Available Moisture (Inches)	Potential ET (Inches)	Final Soil Moisture (Inches)	Water Yield
1940 Aug	0	0	0.8	0	0	0	8.71	0	0
Sept	0	0	0.8	0	0	0	5.25	0	0
Oct	0	0.95	0.8	0.76	0	0.76	2.07	0	0
Nov	0	0.54	0.8	0.432	0	0.432	1.21	0	0
Dec	0	11.26	0.8	9.008	0	9.008	1.21	7.798	0
Jan	0	12.22	0.8	9.776	7.798	17.574	1.64	15.934	4.174
Feb	0	10.37	0.8	8.296	11.76	20.056	2.87	17.186	5.426
Mar	0	14.79	0.8	11.832	11.76	23.592	4.54	19.052	7.292
Apr	0	6.94	0.8	5.552	11.76	17.312	6.17	11.142	0
May	0	0.01	0.8	0.008	11.142	11.15	8.33	2.82	0
June	0	0	0.8	0	2.82	2.82	7.79	0	0
Jul	0	0.04	0.8	0.032	0	0.032	8.64	0	0
1941 Aug	0	0.01	0.8	0.008	0	0.008	8.71	0	0
Sept	0	0	0.8	0	0	0	5.25	0	0
Oct	0	1.12	0.8	0.896	0	0.896	2.07	0	0
Nov	0	0.56	0.8	0.448	0	0.448	1.21	0	0
Dec	0	6.31	0.8	5.048	0	5.048	1.21	3.838	0
Jan	0	1.01	0.8	0.808	3.838	4.646	1.64	3.006	0
Feb	0	0.95	0.8	0.76	3.006	3.766	2.87	0.896	0
Mar	0	2.22	0.8	1.776	0.896	2.672	4.54	0	0
Apr	0	4.03	0.8	3.224	0	3.224	6.17	0	0
May	0	0	0.8	0	0	0	8.33	0	0
June	0	0	0.8	0	0	0	7.79	0	0
Jul	0	0	0.8	0	0	0	8.64	0	0
1942 Aug	0	0	0.8	0	0	0	8.71	0	0
Sept	0	0.04	0.8	0.032	0	0.032	5.25	0	0
Oct	0	1.82	0.8	1.456	0	1.456	2.07	0	0
Nov	0	0.78	0.8	0.624	0	0.624	1.21	0	0
Dec	0	1.72	0.8	1.376	0	1.376	1.21	0.166	0
Jan	0	16.21	0.8	12.968	0.166	13.134	1.64	11.494	0
Feb	0	5.32	0.8	4.256	11.494	15.75	2.87	12.88	1.12
Mar	0	3.69	0.8	2.952	11.76	14.712	4.54	10.172	0
Apr	0	1.16	0.8	0.928	10.172	11.1	6.17	4.93	0
May	0	0.04	0.8	0.032	4.93	4.962	8.33	0	0
June	0	0	0.8	0	0	0	7.79	0	0
Jul	0	0	0.8	0	0	0	8.64	0	0
•									
•									
•									
1977 Aug	0	0	0.8	0	0	0	8.71	0	0
Sept	0	0	0.8	0	0	0	5.25	0	0
Oct	0	0	0.8	0	0	0	2.07	0	0
Nov	0	0	0.8	0	0	0	1.21	0	0
Dec	0	6.1	0.8	4.88	0	4.88	1.21	3.67	0
Jan	0	11.39	0.8	9.112	3.67	12.782	1.64	11.142	0
Feb	0	14.81	0.8	11.848	11.142	22.99	2.87	20.12	8.36
Mar	0	14.77	0.8	11.816	11.76	23.576	4.54	19.036	7.276
Apr	0	2.83	0.8	2.264	11.76	14.024	6.17	7.854	0
May	0	0	0.8	0	7.854	7.854	8.33	0	0
June	0	0	0.8	0	0	0	7.79	0	0
Jul	0	0	0.8	0	0	0	8.64	0	0
1978 Aug	0	0	0.8	0	0	0	8.71	0	0
Sept	0	1.12	0.8	0.896	0	0.896	5.25	0	0
Oct	0	0	0.8	0	0	0	2.07	0	0
Nov	0	3.55	0.8	2.84	0	2.84	1.21	1.63	0
Dec	0	1.58	0.8	1.264	1.63	2.894	1.21	1.684	0
Jan	0	6.16	0.8	4.928	1.684	6.612	1.64	4.972	0
Feb	0	6.81	0.8	5.448	4.972	10.42	2.87	7.55	0
Mar	0	5.95	0.8	4.76	7.55	12.31	4.54	7.77	0
Apr	0	0	0.8	0	7.77	7.77	6.17	1.6	0
May	0	0	0.8	0	1.6	1.6	8.33	0	0
June	0	0	0.8	0	0	0	7.79	0	0
Jul	0	0	0.8	0	0	0	8.64	0	0
TOTAL = 918.21									
ANN.AVG.= 23.5438462 inches/yr									
							TOTAL=	62.674	
							ANN. AVG.	in./year	1.60702564
							RECHARGE	AFY/acre	0.1339188

TABLE 4a - Example of Recoverable Water Worksheet

SAN JOSE CREEK WATERSHED RECOVERABLE WATER WORKSHEET (FOLLOWS PROCEDURE DEVELOPED IN USGS PROFESSIONAL PAPER 417-E)

Altitude Range (ft, MSL)	Watershed Area (Acres)	Area % of Watershed	Rainfall (P) (inches)	Potential ET (E, in.)	P/E	R/E	Recoverable Water (R)	Adjusted R (= K*R)	Watershed Loss (L)
2500 - 3000	510	14.5%	30.00	54.00	0.56	0.103	5.54	7.20	22.80
2000 - 2500	1020	28.9%	29.00	55.50	0.52	0.085	4.74	6.16	22.84
1600 - 2000	637	18.1%	28.00	56.00	0.50	0.075	4.18	5.43	22.57
1200 - 1600	361	10.2%	27.00	56.00	0.48	0.067	3.73	4.86	22.14
800 - 1200	297	8.4%	25.50	55.20	0.46	0.058	3.22	4.19	21.31
400 - 800	404	11.5%	24.00	53.50	0.45	0.053	2.84	3.70	20.30
150 - 400	297	8.4%	22.00	51.00	0.43	0.047	2.39	3.11	18.89
TOTALS	3526	100.0%							
Weighted Avgs.			27.30	54.79			4.11	5.34	21.96

ADJUSTED RECOVERABLE WATER = 5.34 inches (weighted average over watershed).
 WATERSHED AREA = 3526 acres.
 WATERSHED RUNOFF IS ESTIMATED @ 1569 Acre Feet / Year.

GEOLOGIC INDEX:

Category	% of watershed	Index	
A (* 10)	7%	70	
B (* 100)	0%	0	
C (* 0)	92%	0	
D (* 100)	1%	100	
E (* 10)	0%	0	
F (* 20)	0%	0	
G (* 40)	0%	0	
TOTAL GEO INDEX =		170	

The TOTAL GEO INDEX Indicates a K value of 1.3
(see CHART on page E21 of 417-E).

TABLE 4b - Example of Recoverable Water Worksheet

SAN ONOFRE CREEK WATERSHED RECOVERABLE WATER WORKSHEET (FOLLOWS PROCEDURE DEVELOPED IN USGS PROFESSIONAL PAPER 417-E)

(File "onofre2.wk3")

Altitude Range (ft. MSL)	Wtrshd Area (Acres)	Area % of Wtrshd	Rainfall (P) (in inches)	Potential ET (E, in.)	P/E	R/E	Recoverable Water (R)	Adjusted R (= K*R)	Watershed Loss (L)
2000 - 2600	264	20.8%	22.00	55.40	0.40	0.036	1.99	2.59	19.41
1600 - 2000	222	17.5%	21.00	56.00	0.38	0.030	1.67	2.17	18.83
1200 - 1600	271	21.3%	20.00	56.00	0.36	0.025	1.42	1.85	18.15
800 - 1200	305	24.0%	19.00	55.20	0.34	0.022	1.24	1.61	17.39
400 - 800	158	12.4%	18.00	53.50	0.34	0.021	1.12	1.45	16.55
150 - 400	51	4.0%	17.00	51.00	0.33	0.020	1.03	1.34	15.66
0 - 150	0	0.0%	16.00	51.00	0.31	0.017	0.85	1.10	14.90
TOTALS	1271	100.0%	19.98	55.17			1.49	1.93	18.05
Weighted Avgs.									

ADJ. RECOVERABLE WATER = 1.93 inches (Watershed weighted mean runoff depth).
 WATERSHED AREA = 1271 Acres.
 CALCULATED WATERSHED RUNOFF IS 205 Acre Feet / Year.
 WATERSHED RUNOFF IS ESTIMATED @ 215 Acre Feet / Year.

GEOLOGIC INDEX:

The TOTAL GEO INDEX indicates a K value of 1.3
 (see CHART on page E21 of 417-E).

Category	% of wtrshd	Index
A (* 10)	7%	70
B (* 100)	0%	0
C (* 0)	93%	0
D (* 100)	0%	0
E (* 10)	0%	0
F (* 20)	0%	0
G (* 40)	0%	0
TOTAL GEO INDEX =		70

SAN JOSE CREEK MULTIPLIER = 0.136243
 Vaqueros
 Aquifer name
 Aquifer length along stream (L) = 300
 Effective aquifer length along stream = 600
 (Up to 300' added to (L) for subsurface underflow)
 POTENTIAL STREAM RECHARGE = 11.80314
 (see Stream Seepage Curves)

- (b) **Streambed geometry.** The streambed geometry incorporated into the model is based on field measurements of the creek in Ellwood Canyon at the northern outcrop of the Vaqueros Formation. This channel geometry is considered representative of creeks on the South Coast. Narrower channels occur in some areas which would allow for less seepage per unit of flow. Ellwood Canyon geometry will, however, be used unless site specific data is available.
- (c) **Seepage factor.** A seepage factor of 10 gallons per day per square foot of wetted surface area is used in the analysis. This factor is based on measurements of seepage made during controlled releases down Mission Creek in the City of Santa Barbara (Martin, 1984). This factor is used as the best available information but may be higher than the actual rate for consolidated rock aquifers. A figure of 15 gpd/ft² was measured in river gravels by the County Water Agency. Such gravels are far more permeable (orders of magnitude) than bedrock aquifers or the alluvial sediments in Mission Creek.
- (d) **Streambed length.** This length is measured from the upper to the lower geologic contacts of the aquifer along the streambed as delineated on the USGS topographic map.

A table of monthly flow values calculated with the stream flow model for San Onofre Creek is presented in Table 5 based on the multiplier determined with the recoverable water worksheet. A table of seepage values is presented in Table 6. The seepage figures are generated from the estimated flows, the stream length and the seepage factor and streambed geometry parameters discussed above. The relationship between average annual potential stream seepage and the San Jose Creek multiplier is presented graphically on Figure 2. The stream seepage curves shown on this graph plot the multiplier versus the average annual potential seepage per 100 feet of aquifer exposed along the stream for various total effective exposure lengths. The different curves required for each value of effective aquifer exposure length reflects the fact that the stream flows in the downstream parts of an aquifer are reduced by percolation into the upstream parts the aquifer. As aquifer exposure length increases the average percolation per 100 feet of that exposure length progressively declines. The curves shown on Figure 2 are based on estimated flows at a point located 20 percent of the distance from the downstream contact or limit of the aquifer to the upstream contact of the aquifer. All analyses will incorporate this parameter.

In summary, once the appropriate multiplier and stream length are known, the potential seepage is readily estimated from the curves on Figure 2. For purposes of environmental review all values are rounded to the nearest 1 AFY.

A geologic circumstance which occurs in some canyons is where a thin body of alluvium partially fills the valley over the bedrock aquifer under study. It can be reasonably argued that clay layers within the alluvium prevents seepage of stream water into an underlying aquifer. It can also be reasonably argued that the alluvium enhances the potential recharge by increasing the area of hydrologic connection through which stream flow or underflow in the alluvium could recharge a bedrock aquifer. It would require detailed long term records of stream flows, water levels and pumpage along with several monitoring wells to document

either effect. This data is rarely, if ever, available. For purposes of environmental review, the model-derived value will be used as the estimate of potential seepage from stream flow and underflow.

- (f) **Indirect Recharge.** A drop in aquifer water level due to pumpage can induce underflow from adjacent consolidate rock units. Given that most of the sandstone aquifers in the county are either bounded by or interbedded with generally impermeable shales and mudstones, underflow cannot be counted on to provide substantial amounts of recharge. The stratified nature of the bedrock formations requires that water would have to flow across the bedding planes and through the least permeable stratigraphic layers. Increments of safe yield would be added by dropping water levels over an area of the adjacent formation such that additional direct recharge from rainfall or stream seepage be accessed. To account for potential recharge due to subsurface underflow, the area accessed by a well will be considered to extend 300 feet (measured horizontally) into the formation up-gradient of the aquifer, as defined using the guidelines in this manual, if that formation contains water-producing horizons (e.g. fractured sandstones). The estimation of field recharge and potential stream seepage will be adjusted to allow for larger aquifer surface area and greater effective aquifer stream length.

Table 5 - Estimated Monthly Flows @ San Onofre Creek Based Upon SBCWA San Jose Creek Flow Model

Estimated monthly STREAM FLOW at San Onofre Creek, Vaqueros Formation:

San Jose multiplier = .13624

Formation exposure length (feet) = 600; Channel Geometry = Ellwood Creek

WtrYear	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Totals
1940-41	0	0	52	159	255	306	201	22	11	7	5	4	1022
1941-42	3	4	31	11	4	6	34	7	2	1	0	1	104
1942-43	2	3	3	246	49	76	13	6	2	2	1	1	404
1943-44	2	2	8	3	71	43	6	6	2	1	1	1	146
1944-45	2	30	4	4	56	15	6	3	1	1	0	0	121
1945-46	0	1	29	2	4	24	5	3	0	0	0	0	69
1946-47	0	41	30	1	1	3	1	1	0	0	0	0	79
1947-48	0	0	0	0	0	3	2	0	0	0	0	0	4
1948-49	0	0	2	1	1	24	1	9	1	0	0	0	38
1949-50	0	2	6	7	16	3	2	1	0	0	0	0	37
1950-51	0	1	1	2	1	2	1	1	0	0	0	0	9
1951-52	0	0	13	298	8	125	20	8	3	1	3	2	483
1952-53	3	10	33	21	3	4	4	4	2	0	0	1	84
1953-54	0	3	3	20	10	13	6	5	1	0	0	0	62
1954-55	0	2	7	16	6	5	8	11	2	0	0	0	58
1955-56	0	1	99	128	18	7	21	23	3	1	1	0	303
1956-57	0	0	1	22	36	12	19	14	2	1	0	0	107
1957-58	1	2	44	31	167	158	235	12	4	3	2	1	659
1958-59	1	1	2	15	37	4	2	2	2	1	0	0	65
1959-60	0	0	1	8	10	5	8	2	0	0	0	0	35
1960-61	0	11	4	6	2	2	1	0	1	1	1	0	28
1961-62	0	3	8	5	404	25	5	3	2	1	1	0	458
1962-63	2	2	2	3	35	12	10	5	4	1	1	1	77
1963-64	1	10	3	7	3	4	9	2	1	1	0	0	42
1964-65	1	4	30	11	2	6	79	4	3	1	1	1	143
1965-66	1	172	114	27	11	5	3	2	1	1	1	0	337
1966-67	1	11	196	192	25	32	72	15	5	2	3	2	556
1967-68	2	7	6	4	4	17	11	2	1	1	0	0	54
1968-69	1	2	3	273	203	65	42	12	10	3	3	3	620
1969-70	2	5	4	13	33	60	3	1	2	1	0	0	125
1970-71	1	16	21	8	4	5	3	4	3	1	0	0	66
1971-72	1	2	51	7	3	2	1	1	1	0	0	0	71
1972-73	1	26	2	88	180	84	12	11	5	2	1	1	413
1973-74	1	4	7	62	5	26	8	3	3	2	1	1	123
1974-75	1	2	44	3	94	97	9	5	3	2	0	0	261
1975-76	1	1	2	1	32	14	3	3	1	0	0	4	63
1976-77	4	3	2	18	2	3	1	10	1	0	0	0	46
1977-78	0	0	20	205	213	312	62	17	7	4	5	10	855
1978-79	7	8	8	16	31	54	13	5	4	3	1	1	149
Average	1	10	23	50	52	43	24	6	2	1	1	1	215

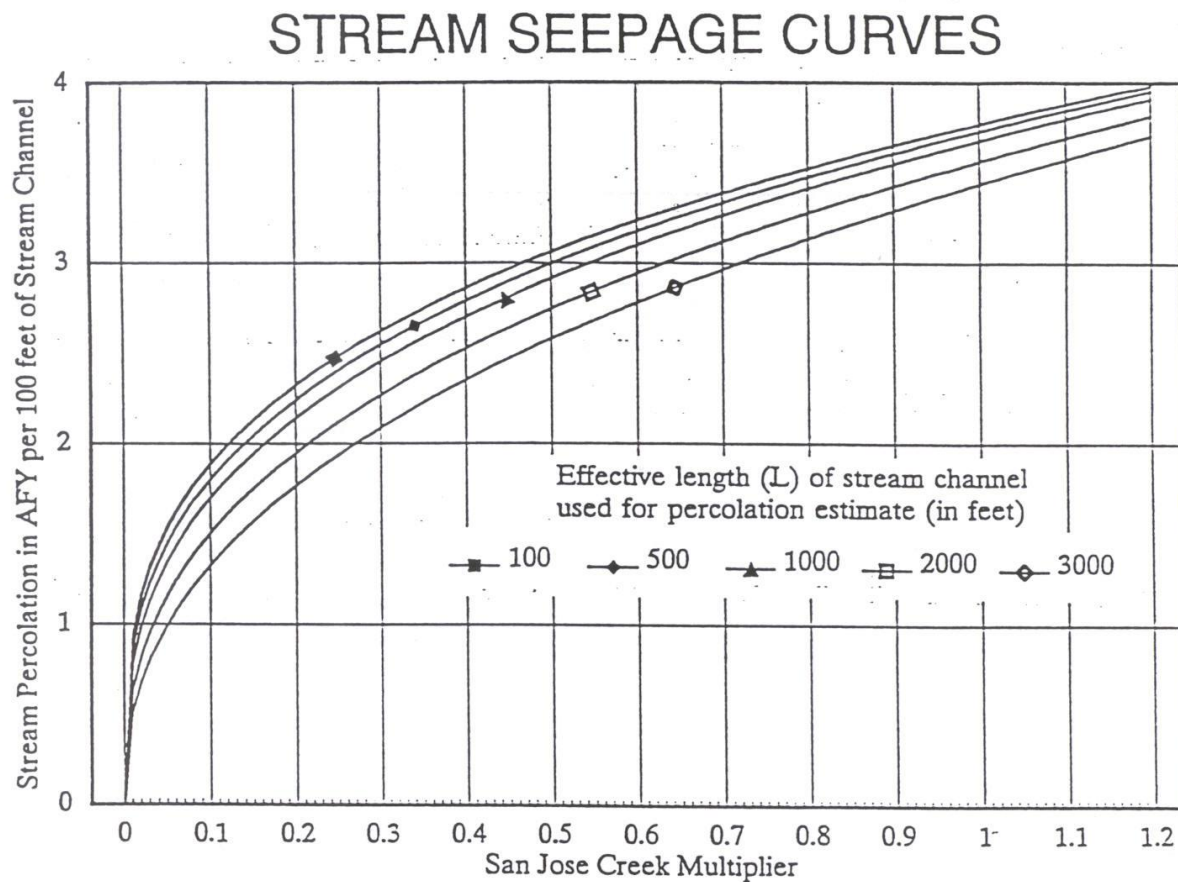
Table 6 - Estimated Monthly Stream Seepage (Percolation) Based Upon SBCWA San Jose Creek Flow Model

Estimated monthly STREAM PERCOLATION, San Onofre Creek Vaqueros Formation:

San Jose multiplier = .13624

Formation exposure length (feet) = 600; Channel Geometry = Ellwood Creek

WtrYear	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Totals
1940-41	0.0	0.0	1.1	2.7	3.5	3.9	3.4	2.0	1.6	1.4	1.2	1.1	22.0
1941-42	1.1	1.1	1.7	1.6	.9	1.1	1.9	1.4	.8	.7	.4	.7	13.3
1942-43	.7	1.0	1.1	2.3	2.0	2.7	1.7	1.3	.9	.9	.5	.6	15.6
1943-44	.9	.8	1.2	1.0	2.0	1.9	1.2	1.3	.9	.6	.5	.4	12.8
1944-45	.8	1.4	1.2	1.2	1.3	1.4	1.3	1.1	.4	.6	0.0	.1	10.9
1945-46	.1	.7	1.4	.8	.8	1.1	1.1	1.0	0.0	0.0	0.0	0.0	7.0
1946-47	0.0	1.2	1.5	.6	.4	1.0	.7	.7	0.0	0.0	0.0	0.0	6.1
1947-48	0.0	0.0	0.0	0.0	.1	.4	.6	0.0	0.0	0.0	0.0	0.0	1.1
1948-49	0.0	0.0	.3	.7	.4	1.3	.5	.7	.5	0.0	0.0	0.0	4.4
1949-50	0.0	.1	.8	1.1	1.1	1.1	.9	.4	.2	0.0	0.0	0.0	5.7
1950-51	0.0	.4	.8	.9	.7	.8	.3	.6	0.0	0.0	0.0	0.0	4.6
1951-52	0.0	0.0	.8	3.1	1.4	2.7	1.9	1.5	1.0	.5	1.1	.9	14.7
1952-53	1.0	1.4	1.9	1.8	.8	1.2	1.1	1.1	.8	.1	.3	.6	12.1
1953-54	.1	.9	1.1	1.1	1.0	1.2	1.3	1.3	.3	.1	0.0	0.0	8.5
1954-55	0.0	.8	1.3	1.4	1.1	1.2	1.1	1.5	.7	.1	0.0	0.0	9.3
1955-56	0.0	.7	1.9	2.1	1.7	1.4	1.8	1.8	1.0	.8	.6	.2	14.1
1956-57	0.0	.3	.6	1.5	1.4	1.3	1.4	1.6	.7	.5	0.0	0.0	9.4
1957-58	.4	.9	1.4	1.5	2.8	3.2	3.3	1.6	1.1	1.1	.9	.7	18.8
1958-59	.7	.7	.8	1.4	1.8	1.1	.9	.8	.8	.5	0.0	.3	9.8
1959-60	.2	.4	.6	1.3	1.3	1.2	1.0	.9	.2	.1	.2	.1	7.5
1960-61	0.0	1.3	1.1	1.2	.8	.8	.5	.4	.5	.5	.4	0.0	7.4
1961-62	.1	.7	1.2	1.1	3.5	2.1	1.3	1.0	.9	.7	.6	.3	13.7
1962-63	.9	.8	.8	1.0	1.5	1.5	1.4	1.3	1.1	.8	.7	.6	12.4
1963-64	.8	1.2	1.1	1.2	1.0	1.1	1.2	.8	.7	.6	.1	0.0	9.8
1964-65	.6	1.0	1.5	1.5	.9	1.1	2.3	1.1	1.0	.7	.6	.6	12.9
1965-66	.4	2.1	1.9	1.9	1.5	1.2	1.1	1.0	.7	.6	.6	.4	13.5
1966-67	.7	1.1	2.5	2.4	1.9	2.0	2.8	1.7	1.2	.9	1.0	.9	19.2
1967-68	.9	1.2	1.3	1.1	1.0	1.5	1.5	.9	.7	.5	.2	.3	11.1
1968-69	.7	.9	1.1	2.8	3.2	2.7	2.2	1.7	1.5	1.1	1.0	1.0	19.9
1969-70	.8	1.2	1.2	1.6	1.7	1.9	1.0	.8	.9	.6	.2	.3	12.1
1970-71	.5	1.0	1.5	1.4	1.1	1.2	1.0	1.2	1.0	.6	.3	.2	10.9
1971-72	.6	.9	1.8	1.4	1.0	1.0	.7	.7	.6	.2	.2	.3	9.2
1972-73	.6	1.4	1.0	2.0	3.0	2.9	1.6	1.6	1.2	1.0	.7	.8	17.7
1973-74	.4	.8	1.0	2.1	1.2	2.0	1.4	1.0	1.1	.9	.7	.7	13.4
1974-75	.5	.8	1.5	1.1	2.3	2.4	1.4	1.3	1.0	.9	.3	.1	13.6
1975-76	.5	.7	.9	.8	1.4	1.5	1.0	1.0	.5	.2	.2	.8	9.6
1976-77	1.1	1.0	.9	1.4	.8	1.1	.7	1.2	.7	.3	.1	.1	9.5
1977-78	0.0	.1	.5	2.8	3.1	3.8	2.6	1.9	1.4	1.2	1.3	1.6	20.3
1978-79	1.4	1.4	1.5	1.7	1.9	2.1	1.6	1.3	1.1	1.0	.8	.4	16.2
Average	.5	.8	1.2	1.5	1.5	1.7	1.4	1.1	.8	.5	.4	.4	11.80



Curve Formulas

Symbols: Y = Average stream percolation per 100 feet of stream channel.
 X = San Jose Creek Multiplier
 L = Effective length of stream channel

$$Y = A(X^B)$$

$$A = aL^2 + bL + c \quad (a = -6.27 \times 10^{-9}; b = -9.54131 \times 10^{-5}; c = 3.7822)$$

$$B = aL + b \quad (a = 3.896525 \times 10^{-5}; b = .296611)$$

Figure 2 - Stream seepage curves based on the San Jose Creek flow model.

- (5) **Summary and Discussion.** The safe yield value assigned to a consolidated rock aquifer will be the sum of the estimated field recharge and potential stream seepage as calculated by the above methods. An alternative to the above "inventory" analysis is the Pumpage versus Change-in-Storage method. This method involves observing change in the amount of water stored in an aquifer over a long-term base period representing average hydrologic conditions. The change in storage is compared to the amount pumped and the difference is attributed to recharge. If sufficient site-specific, long-term water level and pumpage data is available for the aquifer under study (as determined by the Planning and Development Department geologist) the Pumpage versus the Change-in-Storage method will be used. Desired data for a Pumpage versus Change-in-Storage analysis would include detailed records of pumpage volumes and water levels at several points in the watershed for a period of at least ten years. This data is rarely available. Meaningful information on yield can be obtained, however, with detailed records over a shorter period. Three years of such records could allow for analysis of one or more of the three elements of recharge (field recharge, stream seepage and underflow). As an example, three years of data during a drought may only provide information on subsurface underflow. The estimated underflow would be added to the field recharge and stream seepage values calculated by the standard methods to obtain a safe yield figure. Available information on recharge obtained from site-specific geologic or well data will be considered in all analyses.

3. **Well interference threshold.** The impact of a net increase in pumpage, either from an existing well or a new well is potentially significant if:
- a. The production rate of a pre-existing nearby well as presently constructed would drop as a result of interference (cone of depression) to a level which would not support the existing use on that parcel or would not support a planned use for which a discretionary or ministerial permit has been granted.
 - b. The proposed new pumpage would result in a substantial degradation of water quality such that an existing use on a nearby parcel or a planned use for which a discretionary or ministerial permit has been granted could no longer be supported.

This impact will be analyzed by the Planning and Development Department geologist during case review using standard hydrogeologic methods (e.g. Theis Equation).

4. **Water demand estimations.**

- a. **Introduction.** A proposed project's future water use can be estimated using either of two methods. The first involves water duty factors. These factors, listed in Table 7 are averages of water demand for particular categories of users based on historical records or land use surveys. The categories are defined by lot size, type of use, zoning, and rarely, soil type. A project with a proposed land use which falls within the listed categories will have its demand estimated by this method. A second method is to estimate the future water use of a project based on a summation of each specific indoor and outdoor use. This method is used if an appropriate water duty factor is not in Table 7 or can not be feasibly generated during project review. Table 8a lists estimated indoor uses per person per year. Table 8b present estimates of water demand for various outdoor and unusual uses. If specific use factors are used to estimate both the interior and exterior demand of a project, the calculated demand must be increased by 10

percent to account for emergency and unusual uses. The factors are to be used without the 10 percent contingency if a portion of the project's demand is based on a water duty factor. For example, in the case of an unusual lot size, a standard water duty factor for a smaller lot can be used. An amount of demand calculated for the additional lot area with a specific use factor would be added to the duty factor for the smaller lot. Another example would be in estimating the proportion of interior use included in a water duty factor.

In some cases, the water demand of certain agricultural crops is needed in the analysis of the net increase in water demand due to a proposed project. Table 9 lists water duty factors published by the U.C. Cooperative Extension (Farm Advisor) in 1991 for various crops grown in Santa Barbara County.

- b. Demand calculations.** A project's net new consumptive use is the figure which is compared to the Threshold of Significance to determine level of impact on groundwater resources. This figure represents the gross demand (i.e. water duty factor demand) adjusted for return flows to the groundwater basin, loss of natural recharge due to construction of impervious surfaces, increased recharge due to irrigated area or recharge basins and historic use on the site. "Historic use" is defined as the demonstrated average water use on the project site during the most recent ten years, excluding years prior to availability of water to the site. Both high and low water use years would be counted in the average. A "Project Water Demand Worksheet" is included as Figure 3. This worksheet accounts for all of the adjustments listed above and is designed for use in all areas of the County. Each of the factors used are explained on the attached instructions.

C. Mitigation Measures.

Measures that can be applied to projects in order to minimize withdrawals from a groundwater basin (i.e. conserve water resources) or reduce impacts in an overdrafted basin are listed below. These measures are modified from the *A Planners Guide to Conditions of Approval and Mitigation Measures* manual available from the Planning and Development Department.

- a. Outdoor water use shall be limited through the measures listed below.

[Planner: This is a menu; select only those conditions that apply. You may also use some of these measures as water conservation conditions without requiring a landscape and irrigation plan.]

- (1) Landscaping shall be with native and/or *[planner specify]* drought tolerant species.
- (2) Drip irrigation or other water saving irrigation shall be installed.
- (3) Plant material shall be grouped by water needs.
- (4) Turf shall constitute less than 20 percent of the total landscaped area.
- (5) No turf shall be allowed on slopes of over four percent
- (6) Extensive mulching (two inch minimum) shall be used in all landscaped areas to improve the water holding capacity of the soil by reducing evaporation and soil compaction.
- (7) Soil moisture sensing devices shall be installed to prevent unnecessary irrigation.
- (8) Permeable surfaces such as turf block or intermittent permeable surfaces such as french drains shall be used for all parking areas and driveways.

- (9) The applicant shall plumb each lot for a grey water system. Each dwelling shall contain a grey water system plumbed to front and rear yard irrigation systems.
- (10) The applicant shall contract with an agency that sells reclaimed water to provide water for all exterior landscaping. Non-reclaimed water shall not be used to water exterior landscape. Prior to ____ the applicant shall deliver the above contract to County Counsel for review and approval. The applicant shall renew the contract annually and send copies of the contract and all receipts for reclaimed water received to permit compliance staff. These documents shall be due on _ of every year commencing ____.
- (11) Separate landscape meters shall be installed.

Plan requirements: Prior to _____, a landscape and irrigation plan shall be submitted to P&D for review and approval. The applicant/owner shall enter into an agreement with the County to install required landscaping/irrigation and maintain required landscaping for the life of the project.

Timing: The applicant shall implement all aspects of the landscape and irrigation plan prior to occupancy clearance.

Monitoring: P&D shall conduct site visits to ensure installation prior to occupancy.

- b. Indoor water use shall be limited through the following measures [*Planner: This is a menu; select only those conditions that apply*]:

- (1) All hot water lines shall be insulated.
- (2) Water pressure shall not exceed 50 pounds per square inch (psi). Water pressure greater than 50 pounds per square inch shall be reduced to 50 psi or less by means of a pressure-reducing valve.
- (3) Recirculating, point-of-use, or on-demand water heaters shall be installed.
- (4) Water efficient clothes washers and dishwashers shall be installed.
- (5) Self regenerating water softening shall be prohibited in all structures. [*Required in Laguna Sanitation District.*]
- (6) Lavatories and drinking fountains shall be equipped with self-closing valves. [*Commercial only*]
- (7) Pool(s) shall have electronic pool cover(s).

Plan Requirements: Prior to ____, indoor water-conserving measures shall be graphically depicted on building and/or grading plans, subject to P&D review and approval.

Timing: Indoor water-conserving measures shall be implemented prior to _____.

Monitoring: P&D shall inspect for all requirements prior to occupancy clearance.

- c. The existing facility shall be retrofitted with water conserving showerheads (2 gpm) and toilets (1.6 gallons per flush).

Timing: Prior to land use clearance the retrofitting shall be completed by the applicant.

- d. High water consumption businesses (defined by P&D), including: _____, shall be prohibited from operating on the subject property.

Plan Requirements and Timing: Prior to _____, the applicant shall record an covenant agreeing to the prohibition with P&D for County Counsel approval to be included as a note on building plans, on lease agreements and in CC&Rs.

Monitoring: P&D shall ensure no such businesses occupy building prior to issuing land use clearance

- e. Reclaimed water shall be used for all dust suppression activities during grading and construction.

Plan Requirements and Timing: This measure shall be filed as a note with the final map and included as a note on the grading plan. Prior to the commencement of earth movement, the applicant shall submit to P&D an agreement/contract with a company providing reclaimed water stating that reclaimed water shall be supplied to the project site during all ground disturbances when dust suppression is required. *[Planner: see RECLAIMED WATER section]*

Monitoring: P&D staff shall inspect activities in the field to ensure non-potable water is being used in water trucks.

- f. All new development shall provide for on-site recharge basin(s) or shall contribute fees to an area wide program to provide for a Specific Plan Area Recharge System *[planner specify]*. On-site recharge vs. contribution of the area wide system shall be based upon on-site recharge conditions and shall be determined by P&D. Basin(s) shall be maintained for the life of the project by a Homeowners' Association. Recharge systems shall be developed in conjunction with the FCD.

Plan Requirements: Installation and maintenance for two years shall be ensured through a performance security provided by the applicant.

Timing: Recharge basins shall be installed (landscaped and irrigated subject to P&D and FCD approval) prior to __.

Monitoring: Permit Compliance shall site inspect for installation and maintenance of landscape. FCD sign off is required on final grading plans, and Permit Compliance sign off is required to release security.

- g. Water wells used on-site shall be monitored by the use of a flow meter or by analysis of electric meter records and recorded semi-annually (May 15 - June 1 and November 15 - December 1). Static water level shall be recorded for each well at the same time as the water production is recorded. *[Planners: Use only for salt water intrusion or when requested by the County hydrologist/geologist.]*

Plan Requirements and Timing: Prior to __the applicant shall record an agreement subject to P&D and County Counsel approval which agrees to the above condition and describes any future mitigation necessary should water quality degrade. The applicant shall maintain a record of meter readings and water levels, available to P&D upon request, for the life of the project.

Monitoring: P&D shall review reports and determine if future mitigation is necessary.

- h. A water quality test shall be completed by the applicant.

Plan Requirements: The applicant shall submit test to EHS and P&D for review and approval.

Timing: Test shall be completed and submitted and approved prior to well permit issuance.

- i. A pump test for the water well shall be completed by the applicant.
Plan Requirements: The applicant shall submit test to EHS and P&D for review and approval.
Timing: Test shall be completed and submitted and approved prior to well permit issuance.
- j. The owner shall complete a water quality analysis on a semiannual basis to avoid the possibility of salt water intrusion into groundwater. Pumping shall cease if the following conditions occur *[P&D specify]*.
Plan Requirements: A copy of the report shall be furnished to EHS and to P&D semiannually.
Timing: Prior to _____, the first water quality analysis shall commence.
- k. All drilling effluent shall be collected in an earthen sump (approx. 300 s.f. area, 1.5 to two feet deep) and disposed of at a location acceptable to P&D and EHS.
Plan Requirements: Prior to _____, plans for the sump and disposal areas shall be submitted to P&D and EHS for review and approval. Sump and disposal areas shall be depicted on _____ plans.
Timing: Sump and disposal areas shall be constructed prior to _____.
- l. Water well shall be solely exploratory. Any development, except for the exploration and testing thereof, is NOT approved under this Coastal Development Permit.
- m. A water meter shall be installed for the non-exploratory well(s).
Timing: Prior to the use of the well for any non-exploratory purpose, the applicant shall install a water meter.
Monitoring: The applicant shall provide proof of meter installation to P&D.
- n. Water well use shall be used solely for parcel _____. Water use on a separate parcel shall require further review and a Special Use Permit and Coastal Development Permit.
- o. The well head including all accessory equipment, shall be screened from all viewsheds and neighboring properties within 45 days of well installation.
Plan Requirements: A landscape plan indicating same shall be submitted prior to issuance of land use clearance for P&D approval. *[Planner: use landscape bond condition]*.
Timing: Landscape plan shall be implemented prior to _____.
Monitoring: P&D shall inspect site prior to _____.
- p. The applicant shall install a coastal water quality monitoring well and monitor water quality per measure #10 above.
Monitoring: P&D shall review the completion report of the well.
(to be included with reporting under measure 10. above)

Measures suggested to mitigate the potential of certain projects to degrade water quality include the following:

- q. Preparation of a fertilizer/pesticide application plan which minimizes deep percolation of chemical-laden water to be reviewed and approved by the Planning and Development Department and the Public Health Department, Environmental Health Services Division.

- r. Installation of subsurface percolation basins and traps which would allow for detection and removal of fertilizers, pesticides and other chemicals.
- s. Biannual or annual water quality analysis for the detection of organic or inorganic contaminants in production or monitoring wells.

REFERENCES

- Miller, G.A. and Rapp, J.R., 1968: Reconnaissance of the groundwater resources of the Ellwood-Gaviota area, Santa Barbara County, California; U.S.G.S. Open File Report, 50p.
- Crippen, J.R., 1965: Natural water loss and recoverable water in mountain basins of Southern California; U.S. Geological Survey Professional Paper 417-E.
- Gibbs, D.R. and Holland, P.R., 1990: County of Santa Barbara, Flood Control and Water Conservation District, Precipitation Data Report.

PROJECT WATER DEMAND WORKSHEET

(Page 1 of 4)

Environmental Thresholds and Guidelines Manual (1992 Edition)
County of Santa Barbara
Resource Management Department, Division of Environmental Review
By Brian R. Baca, 4/92
(File "threshl.wk3")

Project Name: _____

Case Number: _____

APN(s):	Parcel size (Ac)	Zone District
_____	_____	_____
_____	_____	_____
_____	_____	_____

Project Description: _____

DEMAND CALCULATIONS (Refer to instructions on pages 3 and 4)

	Water Duty Factor (AFY/Unit)	# Units	Gross Demand	Consum. Use Fac.	Net Consum. Use (AFY)
Residential					
Combined	_____	_____	_____	_____	_____
Interior	_____	_____	_____	_____	_____
Exterior	_____	_____	_____	_____	_____
Irrigation (Refers to potential agricultural activities on large lots in addition to residential demand associated with the homesites)					
AFY/parcel	_____	_____	_____	_____	_____
AFY/acre	_____	_____	_____	_____	_____
Commercial					
Combined	_____	_____	_____	_____	_____
Interior	_____	_____	_____	_____	_____
Exterior	_____	_____	_____	_____	_____

Total demand = _____ AFY

PROJECT WATER DEMAND WORKSHEET

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RECHARGE ADJUSTMENTS

* These adjustments are made only for projects which are located north of the Santa Ynez Mountains (i.e. the North County). This is because most of the basin area on the South Coast is in confined conditions. Note that there is not universal agreement as to the location and size of the recharge area of each basin. All projects will be treated as if overlying a confined basin. Any recharge credit which might be due an individual project located in an identified recharge area of a South Coast basin is considered accounted for in the increase of the Threshold of Significance from previous manuals.

Credits (Instructions on page 4)

Field recharge increase

$$\left(\frac{\text{Irrigated infiltration rate}}{\text{(AFY/acre)}} - \frac{\text{Non-Irrigated Infil. rate}}{\text{(AFY/acre)}} \right) * \frac{\text{New Irrigated Area (Ac.)}}{\text{}} = \frac{\text{}}{\text{}}$$

Recharge basin

$$\frac{\text{Rainfall Feet/year}}{\text{}} * \frac{\text{Acres Impervious Surfaces}}{\text{}} * \frac{\text{System Eff.}}{\text{}} = \frac{\text{}}{\text{}}$$

Debits

Loss of natural recharge

$$\frac{\text{acres impervious surfaces}}{\text{}} * \frac{\text{AFY/acre infiltration rate}}{\text{}} = \left(\frac{\text{}}{\text{}} \right)$$

Total adjustments = AFY

HISTORIC USE CREDIT

$$\frac{\text{Water demand of historic land use which will be discontinued due to proposed project}}{\text{}} * \frac{\text{Consum. Use Fac.}}{\text{}} = \frac{\text{Historic Use}}{\text{}} \text{ AFY}$$

SUMMARY

$$\frac{\text{Total demand}}{\text{}} + \frac{\text{Recharge Adjustment}}{\text{}} - \frac{\text{Historic Use}}{\text{}} = \frac{\text{Net new Consumptive Use}}{\text{}} \text{ AFY}$$

Threshold of Significance

$$\frac{\text{Groundwater Basin}}{\text{}} \text{ T.O.S.} \text{ AFY}$$

Notes:

PROJECT WATER DEMAND WORKSHEET

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Worksheet Instructions (calculation parameters)

Demand

1. Water Duty Factors: Included in the DER Thresholds manual (Table 3) for a variety of land uses. In some cases appropriate water duty factors may be generated by the DER geologist during case review. Note that the term "Units" can refer to parcels, dwelling units, 1000's of sq.ft. of building coverage or acres.
2. Number of Units: Only the residential units or other land uses which will be added as a result of the project are evaluated. Existing land uses which would continue after project approval are not included in project demand.
3. Gross demand: (Water Duty Factor * # of Units)
4. Consumptive Use Factor: This factor adjusts the gross water demand to account for return flows to the groundwater basin (A C.U. Factor of .6 equals 40 % return flows). Listed below are C.U. Factors to be used:

Basin	CUF	Explanation
Montecito	1.00	Gross water demand in the South Coast Basins is considered equal to consumptive use. This is because the recharge area is a small portion of the area of the of the basins(aquifers are confined) and interior effluent is ultimately conveyed to the ocean. (Wastewater reclamation is considered a new source of supply available to the purveyor.)
Foothill	1.00	
Goleta	1.00	
Santa Ynez	0.75	Average consumptive use factor estimated by RMD Registered Geologist and County Water Agency Senior Hydrologist.
Buellton	0.75	
Lompoc	0.75	
San Antonio	0.75	
Cuyama	0.75	
Santa Maria	0.75	

Exceptions:

0.60	Areas with sandy soils (Orcutt, Careaga or equivalent formation)
0.70	Orcutt area on the Orcutt Fm. (Clay layers impede infiltration)
0.75	Vandenberg Village (area of sandy soil but some of infiltrated landscape irrigation water discharges into creek and is consumed by riparian vegetation)
0.50	Wastewater disposed in the Santa Ynez River riparian basin.
*	Long-term pumpage offsets due to acceptance of treated wastewater will be counted as a direct return to the basin. (Must be demonstrated to the satisfaction of the DER Geologist)
1.00	Projects served by consolidated rock aquifers.

5. Net Consumptive Use: (Gross demand * C.U.Factor)
6. Residential Demand: Separate factors for interior and exterior use are only used when the consumptive use factors for each are different. Generally, interior use will be based on average occupancy figures from the most recent census (3.01 people/SFD) times the per person use for the type of plumbing fixtures involved. A 10 % contingency will be added to this figure.
7. Irrigation demand: Estimated by developing a water duty factor from similar land uses in the vicinity (AFY/parcel) or by an assessment of likely uses of the onsite soil types. This analysis can be performed by the applicant and reviewed for adequacy by the DER Geologist or may be prepared entirely by the DER Geologist.
8. Commercial Demand: Based on water duty factors (AFY/1000 sq.ft.) from the Thresholds Manual or as developed during case review.

PROJECT WATER DEMAND WORKSHEET

(Page 4 of 4)

Recharge Adjustments *

* These adjustments are made only for projects which are located north of the Santa Ynez Mountains (i.e. the North County). This is because most of the basin area on the South Coast is in confined conditions. Note that there is not universal agreement as to the location and size of of the recharge area of each basin. All projects will be treated as if overlying a confined basin. Any recharge credit which might be due an individual project located in an identified recharge area of a South Coast basin is considered accounted for in the increase of the Threshold of Significance from previous manuals.

9. Loss of Natural Recharge: The infiltration rate will be calculated by the DER Geologist using the Soil Moisture Balance method or Blaney Curve method. (See listing of infiltration rates in 10. below)
10. Field recharge increase: Irrigated and non-irrigated infiltration rates are calculated by the DER Geologist (listed below). Absent a detailed site plan, the proportion of impervious area and the percentage of the remaining area to be irrigated will be estimated as follows:

Lot size (sq.ft./unit)	% Impervious Area	% of yard area irrig.
7000 - 21780	35	75
21781 - 43560	30	60

Infiltration Rates (AFY/acre)

Area	Irrigated	Non- Irrigated	Analysis Method
Orcutt	.19	.05	Blaney
Buellton	.26	.09	Blaney
Santa Ynez	.30	.11	Blaney
Los Alamos	.25	.08	Blaney
Lompoc	.21	.07	Blaney

11. Recharge Basin: System efficiency is set at a maximum of .80 to account for system losses due to evaporation, leaks, loss of permeability of recharge basin over time and spills during peak flow events. A lower figure may be will be used if analysis by the DER Geologist, or other technical information, indicates that 80% efficiency cannot be achieved in the long term. Figure for annual average rainfall to be obtained from the Precipitation Data Report (Gibbs and Holland, 1990). To obtain this credit, the runoff from the impervious surfaces of the project must be conveyed to the recharge basin through impervious drains(not an unlined drainage channel).

Historic Use Credit

12. Historic use credit is only given for existing land uses that will be discontinued upon approval of the proposed project. (Examples: Removal of orchard for a new dwelling, elimination of landscaped area through enlargement of a structure, retrofitting a older onsite structure with low flow fixtures)
13. Consumptive Use Factor: Same as figure used for the demand calculation.

Summary

14. Total consumptive demand adjusted for recharge less discontinued historic use equals net new consumptive use. This figure is compared to the Threshold of Significance established for the groundwater basin to assign the impact level disclosed in the environmental document.

TABLE 7
1992 Groundwater Thresholds Manual - Water Duty Factors

Area	Land Use Designation	Minimum Acres or Sq. Ft./Unit	AFY/Unit	AFY/Acre	AFY/1000sf	Explanation
CARPINTERIA VALLEY	1 DU/3 acre	3.00	1.64	0.55		Data from the Carpinteria Water District, 7/88. (Refer to 88-EIR-12)
	1 DU/acre	1.00	0.86	0.86		
	1.8 DU/acre	24200.00	0.60	1.08		
	3.3 DU/acre	13200.00	0.40	1.32		
	4.6 DU/acre	9470.00	0.34	1.56		
	Condominiums		0.25			
	Apartments		0.20			
	Mobile Homes		0.16			
	Office/Retail			0.95		
	Hotel			8.70		
MONTECITO	Restaurants			4.50		Data from the Montecito Water District, 1989. (81-88 average water use)
	Industrial			2.30		
	Schools			0.36		
	Parks, Irrigated Open Space			2.64		
	Greenhouses			3.00		
	Open nurseries, field crops			1.00		
	1-E-1	43560.00	1.02	1.02		
	20-R-1	20000.00	0.68	1.48		
	3-E-1	3 acres	1.70	0.56		
	7-R-1	7000.00	0.45	2.80		
SUMMERLAND	7-R-2	3500.00	0.26	3.18		Data from SCMD. (79-88 average water use)
	Less than 2500					
	2501-5000	0.20				
	5001-8500	0.21				
	8501-15000	0.27				
	15001-30000	0.30				
	30001-50000	0.40				
	50001-105000	0.71				
	105001-105000	1.10				
	Restaurant					
Public Schools Irrigation	Other					
		1.40				

TABLE 7 (Cont'd)

Area	Land Use Designation	Minimum Acres or Sq.Ft./Unit	AFY/Unit	AFY/Acre	AFY/1000sf	Explanation
CITY OF SANTA BARBARA	SFD "Small"	Up to 9999 sf/lot	0.32			Data from City of Santa Barbara Water Demand Factor and Conservation Study "USER'S GUIDE" Document No. 2
	SFD "Medium"	10000-22000	0.51			
	SFD "Large"	22000-1 Acre	0.85			
	SFD "over 1 acre lot"	More than 1 Acre	1.44			
	Multi-Family Apartment		0.24			
	Auto Repair/Auto Body Shop				0.11	
	Bank				0.17	
	Church				0.17	
	Church w/School				0.18	
	Condominium		0.28			
	Convalescent Hospital				0.11	
	Gas Station				0.29	
	Gas Station/Mini Market				0.49	
	General Office				0.10	
	Grocery Store				0.42	
	Health Club				0.32	
	Hotel/Hotel				0.13	
	Hotel/Hotel/Restaurant				0.15	
	Industrial Assembly & Manufacturing				0.09	
	Industrial R&D				0.15	
	Medical Office				0.15	
	Mixed Medical/Dental				0.23	
	Multi-Family Apartment		0.24			
	Restaurant, 24 hour				0.04	
	Restaurant, Fast Food				1.26	
	Restaurant, Sit Down				0.02	
	Retail, Large-over 20,000 s.f.				0.07	
	Retail, Small-under 20,000 s.f.				0.11	
	Retirement Facility				0.10	
	Senior Apartment		0.12			
	School-Elementary				0.02	
	School-Junior High				0.03	
	Theater				0.0047	
	Warehouse/Industrial Storage				0.07	
	Turf-grass					
	Cool-Season			2.40		
	Warm-Season			2.10		
	Orchards					
	Avocados			1.35		
	Citrus			1.53		

TABLE 7 (Cont'd)

Area	Land Use Designation	Min/Max Acres or Sq.ft./Unit	AFY/Unit	AFY/Acre	AFY/1000sf	Explanation
CITY OF SANTA BARBARA	Non-Water Conserving Groundcovers					
	Shrubs			1.80	0.04	
	Trees			1.80	0.04	
				1.50	0.03	
	Low Water Using (1/2 of above figures)					
	Groundcovers			1.80	0.04	
	Shrubs			1.80	0.04	
	Trees			1.50	0.03	
GOLETA VALLEY	1 DU/3+ acres (202 #)*	3.00	1.81	0.60		Data from the Goleta Water District, 1988, (1973-86 average use)
	1 DU/1.5 acres (20#)*	1.50	1.22	0.81		
	1 DU/1 acre (698#)*	1.00	0.70	0.70		
	20-R-1 (208#)*	20000.00	0.50	1.09		
	15-R-1 (151#)*	15000.00	0.44	1.28		
	12-R-1 (938#)*	12000.00	0.36	1.31		
	10-R-1 (1282#)*	10000.00	0.33	1.44		
	8-R-1 (2815#)*	8000.00	0.30	1.63		
	7-R-1 (3092#)*	7000.00	0.27	1.68		
	10-R-2 (66#)*	5000.00	0.22	1.92		
	7-R-2 (87#)*	3500.00	0.22	2.74		
	*SFD water duty factors are shown reduced by .10 AFY because all examples were pre-1980 construction and not subject to water efficiency ordinances currently in effect.					
	DR 1, 1.8, 2	43560-24200-21780	0.73	.73-1.31-1.46		
	DR 3.3, 3.5	13200-12446	0.41	1.35-1.44		
	DR 4, 4.6, 6	10890-9470-7260	0.30	1.20-1.38-1.80		
	DR 8, 10	5445-4356	0.30	2.40-3.00		
	DR 12, 12.3, 16	3630-3541-2723	0.26	3.12-3.2-4.16		
	DR 20, 25	2178-1742	0.23	4.60-5.75		
	DR 30	1452	0.13	3.900		
	Highway C., Neighbhd C.,					0.30
	CH, CH C2, C3, Retail C.,					0.23
	General C.					0.53
	Shopping Center-SC					0.40
	Rest.-2100(Assrs.UsrCde)					0.33
	Hotel/Hotel 0700					
	Gas Station 2500					

TABLE 7 (Cont'd)

Area	Land Use Designation	Minimum Acres or Sq. Ft./Unit	AFY/Unit	AFY/Acre	AFY/1000sf	Explanation
GOLETA VALLEY	Retail (store)	1100-1200			0.13	
	Office	1700, 1800, 2400			0.15	
	Research Park MRP				0.14	
	Light Industry M-1***				0.28	
	Heavy Industry M-2****				0.10	
	Light/Heavy Industry				0.23	
	M-1/M-2				0.14	
	Prof. Institutional P/I*****				1.1/CHURCH	
	Chrch. -7100(Assrs.UsrCd)					
	** Does not include parking lot and driveways					
SANTA YNEZ VALLEY	Residential					Data from SYRWCD, Improvement District #1 1977
	1 DU/10 acres	10.00	1.15	0.12		
	1 DU/5 acres	5.00	0.98	0.20		
	1 DU/1-4 acres	1-4	0.82	.82-.205		
	1 DU/10000-20000 ft2	10000-20000	0.52	2.27-1.13		
	1 DU/2180-7000 ft2	2180-7000	0.14	2.79-.87		
	Commercial					
	Industrial			1.64		
	Institutional			0.62		
	Agricultural			3.30		
Buellton Area	8-R-1	8000	0.57	3.10		Data from the Buellton Community Services District. (1982-91 average use)
	7-R-1	7000	0.57	3.50		
LOMPOC VALLEY	Residential					Data from City of Lompoc, 1977 ; Park Water, 1972
	1 DU/1-3 acres	1-3	.62	0.31		
	1 DU/20,000-1 ac.	1 ac.-20000 ft.2	.52-.62	1.28		
	1 DU/10,000-19,999	10,000-19,999	.30-.52	1.19		
	1 DU/3500-7000	3,500-7,000	.20-.30	2.07		

TABLE 7 (Cont'd)

Area	Land Use Designation	Minimum Acres or Sq.Ft./Unit	AFY/Unit	AFY/Acre	AFY/1000sf	Explanation
LOMPOC VALLEY	Commercial			2.46		
	Industrial			0.98		
	Public Facility			0.33		
Mesa Oaks Area	1 DU/12500	12500	0.82			Data from the Mission Hills CSD. (1982-90 water use records)
	DR-1.8	15000	0.87			
	1 DU/25000 ft.2	25000	1.00			
LOS ALAMOS VALLEY	Ag. (Non-prime soil; Irrigation demand)	100-150 ac.	25.00	.25-.17		Figure based on land use survey by DER, 1989.
	RR-5	5 ac.	0.98	0.20		
	3-E-1	3 ac.	0.91	0.30		
	1-E-1	1 ac.	0.84	0.84		Data from the LACSD, 1991 and modified from other sources. Refer to the Los Alamos Community Plan EIR.
	DR-1.8	24,200	0.73	1.31		
	10-R-1	10,000	0.62	2.70		
	7-R-1	7,000	0.57	3.55		
	DR-8	5,445	0.30	2.40		
	DR-12.3	3,540	0.26	3.20		
	PRO	15,000	0.67			
	Commercial (H-1)				0.28	
	Commercial (CII, C-2, C-3)				0.30	
	Residential		0.41	1.64		Data from So Cal. Water Co., 1977.
	4 DU/acre		0.33	1.65 - 2.64		
	5-8 DU/acre		0.25	2.25 - 3.00		
	9-12 DU/acre		1.64	2.13 - 3.61	10,890	
	13-22 DU/acre (includes trailers)					
ORCUTT AREA	Commercial		2.05			
	Industrial		3.28			

TABLE 7 (Cont'd)

Area	Land Use Designation	Minimum Acres or Sq.Ft./Unit	AFY/Unit	AFY/Acre	AFY/1000sf	Explanation
ORCUTT (1992 Update)	10-R-1	10000.00	0.86			Data from Cal. Cities Water Co., 1-90 to 2-92 use records.
		13400.00	0.94			
	20-R-1	20000.00	1.08			
		40000.00	1.40			
CITY OF SANTA MARIA	Residential					Data from the City of Santa Maria, 1982-83 records.
	Single family	3.4 pers./unit				
	Condominium	2.0 pers./unit				
	Less than 4 rooms/unit	1.7 pers./unit				
	4 or more rooms/unit	2.5 pers./unit				
	Apartment	2.1 pers./unit				
	Mobile home	2.5 pers./unit				
	H.H. without children	2.0 pers./unit				
					0.133 gcpd	
					0.117 gcpd	
Commercial/Industrial					0.117 gcpd	
					0.117 gcpd	
					0.87 gcpd	
					0.125 gcpd	
					0.06	
					0.08	

Table 8a - Water Demand Estimations Based on Individual Indoor Uses For Santa Barbara County Including Limitations of Ordinance 2948 (Applies to all areas of Santa Barbara County)

Indoor Use Per Person	gal/yr. w/5.5 gal. Toilet* 3.9 gpm shwr.	gal/yr. w/3.5 gal. Toilet* 3 gpm shwr	gal/yr. w/1.6 gal. toilet* 2 gpm shwr
Toilet 4 flushes/day - gallons/flush 5.5/3.5/1.6	8030	5110	2336
Shower .7/day - 3.9 gal/3 gal/2 gpm x 10 min.	9965	7665	5110
Tub bath .2/day tub 1/2 full = 24 gallons	1752	1752	1752
Brush teeth 1.3/day x 2.5 gal	1186	1186	1186
Shaving 1/day 25% of pop. X 4.5 gal.	411	411	411
Washing hands 5/day wet and rinse @ .2 gal/wash	365	365	365
Drinking and cooking x 1 gallon/day	365	365	365
Clothes washing .29 x 35 gallons/wash	3704	3704	3704
Dishwashing (calc. 1 person assume 2 person/household)	3285	3285	3285
auto wash .5 wash/day x 18 gallons inc. rinse			
Garbage disposal (calc. one person assume 2 person/ house .5 use/day x 1 gallon	183	183	183
Gallons/Year/Person	29,246	24,026	18,697
AFY/person	0898 AFY	.0737 AFY	.0574 AFY

* Pre-ordinance toilets have mostly 5.5 gal tanks, Larry Farwell GWD 4/15/88 and Pre-ordinance standard pipe output (showers and faucets) was 3.9 gpm Ed Justus, Co., Bldg. Dept. 4/15/88.

** Further reductions in these indoor uses can be achieved through the installation of higher efficiency plumbing fixtures, for example, changing a 3.5 gallon flush toilet to a 1.6 gallon flush toilet.

Table 8b - Outdoor Use Per Unit (Applies county wide but some areas have a higher landscaping use).

Sauna/swimming pool	.1 AFY
Sauna/swimming pool with evaporation inhibitor	.05 AFY
Washing cars - soap and rinse with running water	15 gals/wash
Washing cars - 3 gallon bucket and brief rinse	105 gals/wash
Washing driveways	25 gals/wash
Green lawns, ornamental gardens	1.5-2 AFY/acre
Not so green lawns, ornamental gardens	1-1.5 AFY/acre
Drought resistant trees and shrubs and ivy	1 AFY/acre
Household gardens - beans, tomatoes, carrots, strawberries	1-4 AFY/acre
Commercial type orchards - avocados, lemons, walnuts	
New plantings 1-3 years	1.5-2 AFY/acre
Mature trees by flooding	1.5 AFY/acre
Mature trees by drip system	1.2 AFY/acre
Dust control/rider safety in horse arenas	1.2 AFY/acre

Unusual Water Uses (per unit)

Pets - drinking - 1 gal/day bathing - .33 gal/day	1.33 gal/day
Water beds	100 gal/year
Dark room	20 gal/use
Washing floors and household cleaning	10 gal/week
Aquaria	1 gal/week 5 gal/day

If individual use factors (from Table 8) are applied by themselves, a contingency factor of 10 percent of the total indoor/outdoor use calculated should be added for darkrooms, , mopping floors, leaks in the water pipes, hoses left running accidentally, washing down the house or a boat, other occasional uses or future conversion of landscaping to higher water use plants.

**Table E 9 - Agricultural Water Duty Factors in Santa Barbara County.
Compiled by Cooperative Extension, University of California, Santa Barbara County (9-16-91)**

Irrigation Water Use by Crops in Santa Barbara County (AFY/acre)

	South Coast Area		Santa Maria & Lompoc Valleys		Santa Ynez, Los Alamos & Sisquoc Valleys		Cuyama Valley	
Crop	Range	Avg	Range	Avg	Range	Avg	Range	Avg
<u>Field crops</u>								
Beans			.5-1.3	1.0	.9-1.5	1.3	1.0-1.7	1.5
Corn, field			1.5-2.2	1.8	2.0-2.8	2.2	2.4-3.2	2.8
Grain, irrigated			.3-.7	0.5	.6-1.0	.8	1.0-1.8	1.5
Sugar beets			2.6-3.2	3.0	3.0-3.6	3.2	3.6-4.6	4.0
<u>Forages & Pastures</u>								
Alfalfa			2.6-3.3	3.0	3.0-4.0	3.5	4.0-4.6	4.3
Pasture/irrigated			2.8-3.3	3.0	3.3-4.0	3.7	4.0-4.6	4.3
Sudangrass			1.0-1.8	1.5	1.3-2.0	1.7	2.0-3.0	2.5
<u>Ornamentals</u>								
Cut flowers/field	1.5-2.3	1.8	1.5-2.3	1.8				
Flower seeds			1.5-3.0	2.3	2.0-3.5	2.7		
Greenhouse:								
Carnations	2.0-3.0	2.5						
Mums, pompom	2.0-4.5	4.0						
Mums, potted	4.5-5.5	5.5						
Turfgrass	2.5-2.8	2.7	2.5-2.8	2.7	3.0-4.0	3.5	3.5-4.5	4.0
<u>Trees and Vines</u>								
Avocados	1.0-2.0	1.6	1.1-2.1	1.7				
Deciduous fruits			1.2-2.0	1.7	1.5-3.0	2.5	3.0-4.5	3.8
Grapes			.7-1.8	1.2	1.0-3.0	2.0		
Lemons	.8-1.8	1.5	1.0-2.0	1.6				
Walnuts	1.0-2.0	1.5	1.3-2.5	1.8	2.0-3.5	3.3		
<u>Vegetables</u>								
Broccoli/cabbage			1.3-1.5	1.4*	1.5-2.0	1.7		
Cauliflower			1.5-2.0	1.7*	2.0-3.0	2.5		
Carrots			1.5-3.0	2.3	2.0-2.5	2.2	2.5-3.5	3.0
Celery			2.0-2.5	2.2*	2.0-2.5	2.2		
Lettuce			1.0-1.3	1.1*	1.0-2.0	1.5		
Potatoes			1.5-2.0	1.7	2.0-3.0	2.5		
Strawberries	2.5-3.5	3.0	2.5-3.0	2.7				
Tomatoes	1.0-2.0	1.5	1.5-2.0	1.7				

*Average two crops per year in Santa Maria Valley (multiply factor shown by 2 to obtain AFY/acre)