Appendix C

# Reclamation Needs Analysis

DRAFT

Division: **American River** | Water Needs Assessment | District: **EAST BAY M.U.D.** | Date: 12/5/00

Agricultural and M&I Water Supply

Contractor's Water Supply Sources and Quantities (acre-feet)

| Timeframe 1 | Surface Water Supply: Reference Delivery 2 | USBR Total Deliv/Max 3 | SWP 4 | Local 5 | Local Source 6 | Trsfr/Rtrn /Recycle In 7 | Trsfr/ Out 8 | Groundwater Supply: District 9 | Private 10 | Safe Yield 11 | Recharge 12 | Total Supply 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1993 normal | 150,000 * | 0 | 0 | 371,000 | Mokelumn | 0 | 0 | 0 | 0 | | 0 | 371,000 |
| 1994 dry | 150,000 * | 0 | 0 | 176,000 | Mokelumn | 0 | 0 | 0 | 0 | | 0 | 176,000 |
| 1995 critical | 150,000 * | 0 | 0 | 129,000 | Mokelulmn | 0 | 0 | 0 | 0 | | 0 | 129,000 |
| 2023 normal | 150,000 * | 150,000 | 0 | 364,000 | Mokelumn | 0 | 0 | 0 | 0 | | 0 | 514,000 |
| 2024 dry | 150,000 * | 112,500 | 0 | 100,000 | Mokelumn | 0 | 0 | 0 | 0 | | 0 | 212,500 |
| 2025 critical | 150,000 * | 112,500 | 0 | 80,000 | Mokelumn | 0 | 0 | 0 | 0 | | 0 | 192,500 |

Contractor's Agricultural Water Demands

Maximum ProductiveAcres=

| Timeframe 1 | Crop Water Requirement (acre-feet) 15 | District Irrig. Efficiency (%) 16 | Effective Precip (acre-feet) 17 | Reference Effective Precip (acre-ft) 18 | Calculated Net Crop Water Req (acre-feet) 19 | USBR Net Crop Water Req (acre-feet) 20 | Average Irrigated Acres (acres) 21 | Reference Irrigated Acres (acres) 22 | Calculated FDR (AF/acre) 23 | USBR FDR (AF/acre) 24 | Conveyance Loss (acre-feet) 25 | Total Ag Demand (acre-feet) 26 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1993 | | | | | | | | | | | | |
| 1994 | | | | | | | | | | | | |
| 1995 | | | | | | | | | | | | |
| 2023 | | | | | | | | | | | | |
| 2024 | | | | | | | | | | | | |
| 2025 | | | | | | | | | | | | |

## Contractor's M&I Water Demands

| | Residential Water Demand | | | Nonresidential Water Demand | | | Less | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Timeframe 1 | Population 28 | Per Capita Demand (gpcd) 29 | Total Demand (acre-feet) 30 | Industrial (acre-feet) 31 | Comm/ Instit (acre-feet) 32 | Total Demand (acre-feet) 33 | Unacc /Distr (acre-feet) 34 | Ref Urban Per Capita Dmd (gpcd) 35 | Calc Urban Per Capita Dmd (gpcd) 36 | Total M&I Demand (acre-feet) 37 | Total Ag+ M&I Dmd (acre-feet) 38 | Unmet Demand (acre-feet) 39 |
| 1993 | 1,200,000 | 95.2 | 128,000 | 28,000 | 43,150 | 71,150 | 25,600 | 177.0 | 167.2 | 224,750 | 224,750 | -146,250 |
| 1994 | 1,200,000 | 71.4 | 96,000 | 21,000 | 32,363 | 53,363 | 19,200 | 177.0 | 125.4 | 168,563 | 168,563 | -7,437 |
| 1995 | 1,200,000 | 71.4 | 96,000 | 21,000 | 32,363 | 53,363 | 19,200 | 177.0 | 125.4 | 168,563 | 168,563 | 39,563 |
| 2023 | 1,317,000 | 95.9 | 141,500 | 34,200 | 53,800 | 88,000 | 28,200 | 169.0 | 174.7 | 257,700 | 257,700 | -256,300 |
| 2024 | 1,317,000 | 86.4 | 127,400 | 30,800 | 48,400 | 79,200 | 25,400 | 169.0 | 157.3 | 232,000 | 232,000 | 19,500 |
| 2025 | 1,317,000 | 71.9 | 106,100 | 25,700 | 40,300 | 66,000 | 21,100 | 169.0 | 131.0 | 193,200 | 193,200 | 700 |

**Notes:** 1 in 20 yr demand for 150 TAF when Mokelumne R System off-line for repairs in wet year. Possible future normal yr need for conjunctive use. CVP dry/critical yr supplies reduced by 25%; EBMUD dry/critical yr demands reduced by 10% and 25%, respectively.

*** Represents Maximum Contract Amount**

**Water supply and demand information is for a normal hydrologic year. Crop Water Requirement includes leaching req. and cultural water but not irrigation efficiency.**

☐ **Information from contractor's water management plan or data submittal for historical years. USBR reference information for future years**

☐ **Quality control check; information is either calculated by USBR staff, or from reference.**

form updated 11/02/99

## Water Needs Assessment--Calculation of Past Beneficial Use, Current Conditions & Future Demand

### Definitions and equations

Contractor's Water Supply Sources and Quantities

| Ref. No. | Title | Units | Description |
|---|---|---|---|
| 1 | Year | | Time frame for the data analysis |
| 2 | SURFACE WATER - Reference Deliv/Max | [acre-ft] | Contractual water supply from USBR |
| 3 | SURFACE WATER - USBR Total Deliv/Max | [acre-ft] | Water deliveried from USBR supplies |
| 4 | SURFACE WATER - SWP | [acre-ft] | Water deliveried from State Water Project supplies |
| 5 | SURFACE WATER - Local | [acre-ft] | Water deliveried from Local supplies (non-USBR/SWP) |
| 6 | SURFACE WATER - Source | | Water source for Local supplies (non-USBR/SWP) |
| 7 | SURFACE WATER - Trsfr/Retrn/Recycle In | [acre-ft] | Supplies transferred, returned, or recycled into the District |
| 8 | SURFACE WATER - Trsfr/Drainage Out | [acre-ft] | Drainage water or Supplies transferred out the District (include Minor M&I water deliveries) |
| 9 | GROUNDWATER - District | [acre-ft] | Ground Water pumped by or for the District |
| 10 | GROUNDWATER - Private | [acre-ft] | Ground Water pumped by and for private entities in the District |
| 11 | GROUNDWATER - Safe Yield | [acre-ft] | Perennial groundwater yield during a normal water year. |
| 12 | GROUNDWATER - GW Recharge | [acre-ft] | Planned recharge to the GW aquifer for recovery by the District or its water users |
| 13 | TOTAL SUPPLY | [acre-ft] | Net water supply available to the District for delivery to its water users |

Calculations

| Ref. | |
|---|---|
| | No. 3 + No. 4 + No. 5 + No. 7 + No. 9 + No. 10 - No. 8 - No. 12 |
| 13 | = (USBR Total Deliv/Max + SWP + Local + Trsfr/Retrn/Recycle In + District GW + Private GW) - (Trsfr/Drainage Out) - (GW Recharge) |

form updated 11/02/99

## Water Needs Assessment--Calculation of Past Beneficial Use, Current Conditions & Future Demand

### Definitions and equations

Contractor's Agricultural Water Demands

| Ref. No. | Title | Units | Description |
|---|---|---|---|
| 15 | Crop Water Req | [ac-ft] | Crop water use (consumptive use) that includes leaching requirement and cultural water, but not irrigation efficiency. |
| 16 | Distrct Irrig. Efficiency | [%] | Net aggregate water use efficiency on a district wide level |
| 17 | Effective Precipitatn | [acre-ft] | Rainfall is used to meet the crop water requirement. |
| 18 | Reference Effective Precipitatn | [acre-ft] | Effective precipitation calculated from the annual rainfall |
| 19 | Calculated Net Crop Water Req | [acre-ft] | Calculated from District records |
| 20 | USBR Net Crop Water Req | [acre-ft] | Calculated from District cropping patterns using CA DWR references |
| 21 | Average Irrigated Acres | [acre] | Irrigated acres crops were grown including multiple cropped acreage |
| 22 | Reference Irrigated Acres | [acre] | Irrigated acreage from USBR records or District Submittal |
| 23 | Calculated FDR | [AF/acre] | Calculated from District records |
| 24 | USBR FDR | [AF/acre] | Calculated from District cropping patterns using CA DWR references |
| 25 | Conveyance Loss | [acre-ft] | Seepage, evaporation, leaks, operational spills, etc. attributed to the District conveyance system not accounted for elsewhere |
| 26 | TOTAL AG DMND | [acre-ft] | Gross water requirement needed by the District to meet crop water requirements |
| | Maximum Productive Acres | [acre] | Physical irrigated acreage limit where the District can supply water |

Calculations

18 = (Calculated Reference Effective Precipitation using CA DWR references in ac-ft/ac)*(Average Irrigated Acres)

19 = (Crop Water Req - Effective Precipitatn)/(Distrct Irrig. Efficiency)

20 = (USBR FDR)*(Reference Irrigated Acres)

23 = (Calculated Net Crop Water Req)/(Average Irrigated Acres)

26 = (Calculated Net Crop Water Req)+ (Conveyance Loss)

form updated 11/02/99

## Water Needs Assessment--Calculation of Past Beneficial Use, Current Conditions & Future Demand

### Definitions and equations

Contractor's M&I Water Demands

| Ref. No. | Title | Units | Description |
|---|---|---|---|
| 28 | RESIDENTIAL WATER DEMAND; Population | [# Residnts] | Number or people served |
| 29 | RESIDENTIAL WATER DEMAND; Per Capita Dmd | [gpcd] | Average interior & exterior water use per person per day in gallons |
| 30 | RESIDENTIAL WATER DEMAND; Tot Demand | [acre-ft] | Annual water deliveried to residential customers |
| 31 | NONRESIDENTIAL WATER DEMAND; Industrial | [acre-ft] | Annual water delivered to industrial customers |
| 32 | NONRESIDENTIAL WATER DEMAND; Comm/Instit | [acre-ft] | Annual water delivered to commercial and institutional customers |
| 33 | NONRESIDENTIAL WATER DEMAND; Tot Demand | [acre-ft] | Annual water delivered to industrial, commercial and institutional customers |
| 34 | LOSS Unacc/Distr | [acre-ft] | System losses (leaks, evaporation, water theft) and unaccounted for beneficial use (fire fighting, line flushing , construction, testing) |
| 35 | Ref Urban Per Capita Dmd | [gpcd] | CA DWR reference amount |
| 36 | Calculated Per Capita Dmd | [gpcd] | |
| 37 | TOTAL M&I DMND | [acre-ft] | Annual M&I water deliveried to residential and non-residential |
| 38 | TOTAL Ag/M&I Dmd | [acre-ft] | Overall District water demand of Ag and M&I water |
| 39 | UNMET DEMAND (dmnd - sup) | [acre-ft] | Used to determine if the analysis results in an over or shortage supply |
| 40 | Division: | | USBR group name of disticts typically based on the water supply |
| 41 | District: | | Name of the water district |

Calculations (unit conversions may be necessary but not shown)

29 = (RESIDENTIAL WATER DEMAND; Tot Demand) / (RESIDENTIAL WATER DEMAND; Population)
33 = (NONRESIDENTIAL WATER DEMAND; Industrial) + (NONRESIDENTIAL WATER DEMAND; Comm/Instit)
36 = (TOTAL M&I DMND) / (RESIDENTIAL WATER DEMAND; Population)
37 = (RESIDENTIAL WATER DEMAND; Tot Demand) + (NONRESIDENTIAL WATER DEMAND; Tot Demand) + (LOSS Unacc/Distr)
38 = (TOTAL AG DMND) + (TOTAL M&I DMND)
39 = (TOTAL Ag/M&I Dmd) - (TOTAL SUPPLY)

ATTACHMENT 1

# CENTRAL VALLEY PROJECT (CVP) WATER NEEDS ASSESSMENTS: PURPOSE AND METHODOLOGY

**Purpose:**

Water needs assessments have been performed for each CVP water contractor eligible to participate in the CVP long-term contract renewal process. These water needs assessments serve three purposes:

1. Confirm past beneficial use of CVP water;

2. Provide water demand and supply information under current and future conditions for the environmental documents; and

3. Provide an estimate of contractor-specific needs for CVP water by the year 2025 to serve as a starting point for discussions regarding contract quantities in the negotiation process.

**Small Contractors exempt from Detailed Water Needs Assessments:**

In order to minimize the informational burdens on CVP water contractors with small amounts of CVP supply under contract, an exemption from the requirement for detailed water needs assessments has been provided to these contractors. The exemption applies to contractors who provide agricultural water to a service area of 2000 irrigable acres, or less, and/or provide urban water now, or in the future, in the amount of 2000 acre-feet annually, or less. A contractor may be exempt from the water needs assessment requirement for its urban water service, but not for its agricultural water service, or vice-a-versa. These contractors are assumed to demonstrate future need if they have beneficially used their CVP supplies in the past.

**Approach to Confirm Past Beneficial Use and Depict Current Conditions:**

Originally, Reclamation requested water demand and supply information for the 1979 through 1997 timeframe. Reclamation believes that evaluations of beneficial use, current and future CVP needs based on information for a 19-year period of record, including both wet and dry periods, is a scientifically defendable way of conducting water needs assessments. However, the concerns of the CVP water contractors with respect to the magnitude of the information request persuaded Reclamation to perform the assessments using a representative snapshot year approach, instead. Although less scientifically rigorous, the snapshot year approach appears adequate for cursory evaluations of water needs.

The year 1989 is the snapshot year chosen to confirm past beneficial use of CVP water for the American, Delta, Contra Costa, Sacramento, and San Felipe regions (refer to the definitions below). This year was chosen because the majority of CVP water contractors received full delivery of their requested water supplies and the total annual precipitation for most CVP regions was in the normal range. Since 1989 was a drought year in the Friant region, 1996 is the snapshot year selected to calculate past beneficial use for this region. Water Need Assessments for the Stanislaus Region have been deferred pending the resolution of operational issues in the Stanislaus River basin. Some contractors have elected to deviate from the selected snapshot year because of the unavailability of information for that year. Following is a description of the regions:

| | |
|---|---|
| **American:** | American River Division |
| **Delta:** | Delta Division combined with West San Joaquin Division, but not the Contra Costa Unit |
| **Contra Costa:** | Contra Costa Unit |
| **Stanislaus:** | East Side Division |
| **Friant:** | Friant Division combined with Hidden Unit, Buchanan Unit, and Cross Valley Canal |
| **Sacramento:** | Sacramento River Division combined with Trinity River and Shasta Divisions |
| **San Felipe:** | San Felipe Division |

Following is a description of the process to evaluate past beneficial use of CVP water supplies:

For contractors who supply water to meet agricultural demands, Reclamation estimated the district irrigation efficiency associated with the crop water information provided for the snapshot year. Both the district irrigation efficiency and the amount of intra-district conveyance losses are evaluated for reasonableness. Past beneficial use of CVP supplies is confirmed if the district irrigation efficiency is close to the current statewide average of 75 percent, or if a trend towards increasing district irrigation efficiencies over time is apparent; **and** if intra-district conveyance losses total 10 percent, or less, of the district's total water supply. In situations where some, or all, of these conveyance losses contribute to groundwater recharge for later use by the contractor, these "conveyance losses" are shown as groundwater recharge rather than conveyance losses.

For contractors who supply municipal and industrial water, the primary test of past beneficial use of CVP supplies is whether the calculated per capita demand in column 36 is reasonably close to the reference per capita demand value in column 35. Acceptable explanations for calculated per capita demands that significantly exceed the reference number might include a large industrial water demand, or a significant percentage of residences on larger than average-size city lot parcels.

The environmental documentation associated with the CVP long-term contract renewals specifies 1995 as the base year. Therefore, water supply and demand information is indicated on the water needs assessments for the 1995 level of development, if available. In many cases, the information provided to demonstrate past beneficial use is also reasonably representative of 1995 level water supplies and demands.

**Definition of Need for CVP Water Supplies:**

An important function of these assessments is the estimation of year 2025 CVP water needs. The assessments compare all demands and all supplies (including CVP supplies) estimated for the 2025 level of development for a normal hydrologic year. The results are displayed in Column 39 as Unmet Demand. If the number in this column is positive or only slightly negative [1] then the CVP water contractor is deemed to have full future need of the maximum annual CVP supply currently under contract for all year types.

Demands include agricultural, urban and, on occasion, environmental water demands. CVP supplies in the assessments are set at the maximum annual contractual amount for each water contractor, except in the Friant Division. The Friant Division's Class II contract amounts are based on a wet hydrologic year. To reflect a normal hydrologic year, CVP supplies for the Friant Division are set at the maximum annual Class I contract amount plus 40% of the maximum annual Class II contract amount.

Dry year and critically dry year analyses were only performed for urban contractors who did not demonstrate full future need of their CVP contract supply in a normal hydrologic year.

The methodology used to estimate agricultural and urban water demands as well as to estimate the availability of non-CVP supplies is described in the following sections.

**Agricultural Water Demand:**

Agricultural water demand is defined as the sum of the district's irrigation water demand and the intra-district conveyance losses, where irrigation water demand is the product of the irrigated acreage in a district and the average farm delivery requirement. The farm delivery requirement is defined as the unit amount of water necessary to supply crop water needs in excess of effective precipitation and varies based on crop type, climate, irrigation water quality, soil salinity and irrigation method. The district's irrigation water demand is not necessarily the sum of all the on-farm irrigation water demands because such measures as recycling of intra-district return flows are effective in reducing the overall district irrigation water demand. The assumption for this analysis is that the continued implementation of water use efficiency measures between now and the year 2025 will further reduce the unit amount of water needed to grow crops in the future. Often, it is also assumed that district conveyance losses will decrease in the future. Specifically, district irrigation efficiencies are assumed to increase from an average of 75 percent currently to 85 percent by the year 2025, where district irrigation efficiency is defined as follows:

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[1] If the negative amount is within 10% for contracts in excess of 15,000 acre-feet, or within 25% for contracts equal to, or less than, 15,000 acre-feet; the test of full future need of CVP supplies under contract is deemed to be met.

District Irrigation Efficiency = $\frac{\text{Supply - Non Recoverable Losses to the District}}{\text{Supply}}$ 2

Or, approximately =

$$\frac{\text{Sum of On-farm Crop Water Requirements of Applied Water (ETAW) + Intra-District Reuse}}{\text{District's Irrigation Water Demand}}$$

Certain districts, such as those with large elevation differences within their boundaries, have target district irrigation efficiencies of 80 percent based on the unavailability of certain water management options to increase overall district irrigation efficiency.

Estimating Crop Water Requirements

Generally, the CVP water contractors' Water Management Plans provide historical information on crop water requirements. This information was used in the snapshot year analyses to confirm past beneficial use of CVP supplies and to reflect the base condition in the environmental documents.

Reclamation estimated crop water requirements for the year 2025 level of development based on the CVP water contractors' estimates of future crops and acreage planted multiplied by estimates of the farm delivery requirements for each crop. Reclamation staff initially estimated crop water requirements for all regions using evapotranspiration (ET) and effective precipitation (EP) data from several sources: 1) California Department of Water Resources (DWR) Bulletin 160-98, 2) DWR Bulletin 113-3, and 3) Reclamation knowledge and experience. The ET and EP information was tabulated on a Detailed Analysis Unit (DAU) basis and then proportioned to each district based on the district's area in a DAU. The data was then used in combination with other traditional methodologies for determining crop water requirements to estimate each district's total irrigation water demand in the year 2025.

In February 2000, representatives of the Friant and Delta Region CVP water contractors expressed the following concerns with using this methodology:

- The crop water requirements estimated are too low;
- The effective precipitation component to meeting crop water requirements is too high for some areas.

In order to address these concerns a number of evaluations were performed.

One analysis compared the agricultural water demand calculations performed by a

2 The general equation for district efficiency includes conveyances losses; however, for these assessments intra-district conveyance losses are not included in the district efficiency equation because these are treated as a separate parameter for the purposes of evaluating beneficial use of CVP supplies.

private consultant to CVP contractors and those performed by Reclamation staff for the water districts in the Delta Region. This analysis indicated that Reclamation's and the consultant's estimation of these water demands on a regional basis is close (within 8%). However, the results of the agricultural water demand determinations diverge as the regional area is broken into sub-regions and especially when the comparison is made at the district level.

A comparison of calculations of ET and EP for alfalfa in the Friant Region using the methodologies of Bulletin 160-98, Reclamation and the Natural Resources Conservation Service (NRCS) indicates that Bulletin 160-98 consistently estimates EP higher than the other two methods at the district level. One reason for this difference appears to be that the Bulletin 160-98 methodology estimates the contribution of rainfall to the soil moisture profile in the non-irrigation season in a different way than the other two methodologies. Similarly, a comparison of ET values shows that the Bulletin 160-98 values are consistently lower than the NRCS values at the district level. This difference is most likely the result of Bulletin 160-98's use of "actual" ET values. "Actual" ET is potential ET modified to reflect regional agricultural practices by farmers. The NRCS method uses potential ET values without modification.

Based on discussions with DWR, the affected CVP water contractors and their consultants; Reclamation concluded that the regional agricultural practices taken into account by Bulletin 160-98 may not be reflective of current and/or future practices by the CVP water contractors. For this reason, Reclamation determined that it was more prudent to use potential ET values than the "actual" ET values from Bulletin 160-98 in evaluating 2025 crop water requirements for water districts located in the Friant and Delta Regions.

In addition, Reclamation and representatives of the Friant and Delta Region water contractors agreed on a different methodology to estimate EP than the one used in Bulletin 160-98 because of the lack of dependable rainfall. The bulletin assumes rainfall is effective if it can be stored in the soil moisture profile, or directly meet crop water needs during any month. However, in actual practice to effectively manage farm operations, a farmer may need to pre-irrigate one or more fields earlier in the month only to have a major precipitation event occur later in the month, thus reducing the effectiveness of the rainfall during that month.

**Revised Agricultural Water Demand Methodology for the Friant and Delta Regions:**

Following is a description of the revised methodology for estimating ET and EP:

- EP is estimated to be 50 percent of long-term average annual rainfall with the exception of citrus EP. For citrus groves, it is estimated that one inch of the initial rainfall is stored before the soil seals over and the runoff begins; then about 10% of the additional rainfall for the season is estimated to be effective.

- ET is determined using California Irrigation Management Information System (CIMIS) potential ET data and crop coefficients supplied by the University of California Cooperative Extension.

No change was made to the ET and EP determinations for the CVP water contractors in the other regions because these regions are located in areas of higher precipitation not as sensitive to the issues raised in the comparative analyses.

**Urban Water Demand:**

Urban water demand is defined as the sum of residential, nonresidential and distribution system demands. The components of residential demand include indoor and outdoor demand. Originally, information on residential and a portion of nonresidential demand was requested in terms of these two components; however, most CVP water contractors were unable to provide the information in that format. Therefore, the information request was revised to a combined figure for indoor and outdoor use. Nonresidential demand includes commercial, institutional and industrial demands. Distribution system demands consist of unaccounted beneficial use and distribution system losses where:

- Unaccounted beneficial use includes water for such uses as fire fighting, mainline flushing, storm drain flushing, sewer and street cleaning, construction site use, water quality testing and other testing.

- Distribution system losses accounts for water lost because of leaks in storage and distribution systems, evaporation, illegal connections, and water theft.

Projected M&I water demand will be influenced over time by many factors, including future land use changes, population shifts, and improvements in residential and distribution system efficiencies over time. As is the case for agricultural water demands, the methodology assumes that the implementation of water conservation measures in the next 25 years will increase the efficiency of urban water use and reduce unit M&I water demands. Specifically, the reference average per capita usage upon which the urban beneficial use evaluation is based decreases from 5% to 14% by the year 2025, depending on the location in the state.

**Non-CVP Water Supplies:**

Non-CVP water supplies can include groundwater including the conjunctive use of surface and groundwater, State Water Project (SWP) supplies, local surface water supplies, recycled water, inter-district return flows and water transfers. The methodology considers water transfers a beneficial use of water. Water transfers are, therefore, included in the 2025 level assessments if there is evidence of a commitment by both parties to engage in the transfer in this timeframe.

Average values for SWP and local surface supplies are used in the 2025 level assessments unless the analysis is for dry or critically dry year conditions. Often the source of information is the 10-year average surface water supply from the contractor's Water Management Plan. If there is an indication that surface water supplies will decrease in the future because of increased upstream diversions or increased environmental requirements, the surface water supply is reduced to reflect these considerations in the 2025 level assessment.

Where available, groundwater safe yields are used to estimate future groundwater pumping. Safe yield is defined as the amount of groundwater a district can pump on a long-term average and not cause the long-term decline of groundwater levels leading to excessive depths for pumping or leading to degradation of groundwater quality. A safe yield value is the result of a complex interaction between many factors; a change in any one of the factors can have an impact on the value obtained from safe yield computations. The main factors involved in safe yield computations can include, but are not limited to, water supply, consumptive use, losses to the system, and water quality. Adding to the complexity of the analysis is that many, if not most, of the factors involved in a safe yield computation are time dependent, and have both short-term and long-term trends--which may be quite different. If a safe yield analysis is not available for the contractors' groundwater resources, groundwater pumping and recharge, if applicable, is estimated from historical information for the 2025 level assessments.

Originally, groundwater pumping for the Friant Region was estimated based on historical estimates of groundwater pumping for 1996 from the water contractors' Water Management Plans. During the February 2000 discussions with representatives of the Friant Region water contractors, the issue of groundwater was raised. Specifically, Reclamation was requested to evaluate the possibility of using the original safe yields estimated by Reclamation as the supply available from groundwater in the 2025 level assessments. Reclamation agreed to investigate the use of these original safe yields because the original safe yields were developed for ultimate build-out and included CVP groundwater recharge. Following is a summary of the analysis performed to estimate groundwater pumping for the Friant Region in the 2025 level assessments:

**Analysis of Groundwater Pumping in the Friant Region:**

Groundwater technical studies were conducted by Reclamation in the 1940's and 1950's to characterize the geohydrology, groundwater occurrence and groundwater conditions in each district, and to determine each district's safe yield. Prior to the delivery of CVP water supplies, farmers irrigated mainly with groundwater, although some local surface water sources were also used. Because recharge of groundwater could not keep pace with the use of water primarily for agricultural purposes, groundwater levels had declined in many areas, and groundwater overdraft was common throughout the region.

A review of Reclamation's original safe yields for the Friant Region shows that these safe yield estimates are generally less than the estimated amounts of groundwater pumping for 1996. Reclamation's original safe yield estimates are also generally less than the updated safe yield estimates performed by Reclamation for some of the districts in the early 1990's. However, the 1990's safe yield estimates are considered preliminary numbers and were never adopted by Reclamation nor accepted by the Friant water contractors. Historical estimates of groundwater pumping indicate that these water contractors are pumping groundwater in excess of the original safe yields.

The groundwater pumping in excess of safe yield has resulted in the continued decline in the groundwater tables underlying most of the districts. A review of hundreds of individual well hydrographs shows that this increase in pumping has not been supported by the aquifer. Most districts are still experiencing declining groundwater levels since the inception of CVP deliveries. With the exception of five districts (Delano Earlimart, Exeter, Lindmore, Lindsay-Strathmore and Orange Cove), cumulative groundwater storage has decreased in the remaining 19 Friant districts since the CVP began importing water into those districts. The five districts that show overall rises in groundwater storage change have unique geohydrologic conditions and were evaluated individually to determine appropriate levels of groundwater pumping for the 2025 level assessments.

From the analysis performed, it can be concluded that CVP deliveries since 1986, as evidenced by a continuous decline in storage from 1986 to 1992, have not been sufficient to maintain reasonably stable groundwater levels, nor have CVP deliveries supported an increase in groundwater levels in wet years under the conjunctive use operations practiced by most districts. Safe yield pumping in combination with surface water supplies should have sustained or raised groundwater levels to some stable level. However, historical groundwater pumping has been higher than the safe yield values. In addition, unforeseen factors in the original safe yield analysis such as the magnitude of groundwater use by non-district entities primarily for urban needs within the boundaries of the district, the magnitude of groundwater and surface water use by adjacent districts, changes in the type of crops, droughts and reductions in CVP water deliveries may render even the original safe yield values as too high. However, the unavailability of critical information and the lack of time to perform an analysis make the determination of new safe yields for the Friant Region infeasible at this time. Therefore, Reclamation concurs that the original safe yields are appropriate to depict groundwater pumping for 19 contractors in the Friant Region for the 2025 level assessments.

**Sources of Information**

The Water Management Plans that most water districts have prepared in response to the mandates of the Central Valley Project Improvement Act and the Reclamation Reform Act provide information on agricultural, urban and environmental water demands as well as on water supplies available to meet these demands. In most cases, these plans depict information for a representative year, although some plans provide a number of years of historical information as well as projections for the future. Fortunately, the representative year for many of these plans is either 1989, or 1996. The water contractors were asked to verify that information contained in these plans may be used to calculate past beneficial use and/or to depict current conditions for the purposes of the environmental documentation. In addition, the agricultural water contractors were requested to provide projections of types of crops planted, irrigated acres and amounts and types of non-CVP water supplies for the year 2025. Similarly, the urban water contractors were asked to provide population projections, projections of nonresidential water demand and amounts and types of non-CVP water supplies for the year 2025.

Other sources of information included DWR Bulletin 160-98, DWR Bulletin 113-3, CIMIS information, crop coefficients from various sources, Reclamation's annual crop reports, the January 2000 Water Forum Agreements for the American River, Reclamation's groundwater safe yield studies and miscellaneous planning and environmental documents.