# STUDY REPORT W&AR-02
# PROJECT OPERATIONS/WATER BALANCE MODEL

## ATTACHMENT B

## MODEL DESCRIPTION AND USER'S GUIDE

**TABLEOF CONTENTS**

| Section No. | Description | Page No. |
|---|---|---|

## List of Figures

## List of Tables

# 1.0 INTRODUCTION

The Turlock Irrigation District (TID) and Modesto Irrigation District (MID) (collectively, the Districts) have developed a computerized Project Operations Model (Model) to assist in evaluating the relicensing of the Don Pedro Project (Project) (FERC Project 2299). On November 22, 2011, in accordance with the Integrated Licensing Process schedule for the relicensing of the Don Pedro Project, the Districts filed their Revised Study Plan containing 35 proposed studies with the Federal Energy Regulatory Commission (FERC) and relicensing participants. On December 22, 2011, FERC issued its Study Plan Determination approving, with modifications, the proposed studies, including Study Plan W&AR-2: Project Operations /Water Balance Model Study Plan. Consistent with the FERC-approved study plan, the objective of the Model is to provide a tool to compare current and potential future operations of the Project. Due to the fact that the geographic scope of the Model extends from the City and County of San Francisco's (CCSF) Hetch Hetchy system in the upper part of the watershed to the confluence of the Tuolumne and San Joaquin rivers, the Model is now entitled the Tuolumne River Daily Operations Model.

As fully described in this User's Guide, and consistent with the FERC-approved study plan, the Model includes numerous user-controlled parameters that allow the simulation of alternative Project operations, such as alternative flow regimes for the lower Tuolumne River. The Model performs a simulation of Project operations for a sequential period of years that covers a range of historical hydrologic conditions. The period of hydrologic record selected for the Model is Water Year 1971 through Water Year 2009, which includes extreme years of hydrology (1977 dry and 1983 wet) and multi-year periods of challenging water supply conditions such as 1976-1977, 1987-1992, and 2001-2004. The purpose of this User's Guide is to describe the structure of the Model, the interfaces available for operation of the Model, and methods available for the reviewing Model results. Procedures for development of input files for running alternative future operations are also described and illustrated. The data presented in this document are referenced to a "Test-Case" simulation of operations and are being incorporated for illustrative purposes.

As is the case with any model, the Tuolumne River Daily Operations Model is only a depiction of project operations, and is limited to representing CCSF and District operations to the extent that their operations can be described systematically by various equations and algorithms. Actual project operations may vary from those depicted by the Model due to circumstantial conditions of hydrology and weather, facility operation, and human intervention. The FERC-approved study plan has identified a number of user-controlled variables for running alternatives. The fact that the Model provides these user-controlled inputs is not an indication that either the Districts or CCSF endorse or support any specific alternative developed by manipulating these inputs.

# 2.0 GEOGRAPHICAL RANGE OF MODEL AND UNDERLYING SYSTEM OPERATION

As mentioned above, the geographic scope of the Model extends for CCSF's Hetch Hetchy system to the confluence of the Tuolumne and San Joaquin Rivers, as generally depicted in Figure 2.0-1. The Model comprises two primary subsystems -- the Districts' Don Pedro Project and CCSF's Hetch Hetchy Project, which are independently owned and operated by the respective parties. The Don Pedro Project includes the Don Pedro Reservoir and powerhouse. It provides water storage and flood control benefits. Water that flows into Don Pedro Reservoir is either stored or passed through to the lower Tuolumne River. Included in the model is the projected diversion of water at La Grange to serve irrigation and M&I customers of MID and TID. A model "node" (calculation point) is provided at the Districts' La Grange diversion dam, where the Model simulates flows to the Modesto Canal, the Turlock Canal, and the Tuolumne River below the La Grange diversion dam. The CCSF System is modeled as three physical reservoirs (Hetch Hetchy Reservoir, Lake Lloyd and Lake Eleanor), the San Joaquin Pipeline (SJPL), and an accounting for the Don Pedro Water Bank Account. All releases from the CCSF System, except those diverted to the SJPL enter Don Pedro Reservoir. A node is also provided to represent the location of the existing USGS stream flow gage entitled "Tuolumne River at Modesto" (Modesto). Additional nodes may be established above and/or below the Modesto gage node depending on the results of ongoing lower Tuolumne River accretion flow measurements.

The Model components operate with systematic algorithms that attempt to mimic operational decisions for reservoir and facility operations. For each subsystem, certain operation constraints can be user-controlled consistent with the FERC-approved study plan. Within each subsystem, each reservoir has the same underlying operation protocol. A daily mass balance is performed: change in reservoir storage = inflow, minus outflow (releases), minus reservoir losses. If the calculation results in a reservoir storage that is in excess of preferred/maximum capacity, an additional release is made.

Minimum releases for each modeled reservoir are in accordance with current stream flow requirements and diversion requirements. Each reservoir assumes a common "hold-unless-need-to-release" protocol, except as conditioned by minimum stream release requirements, diversions, preferred/maximum storage, snowmelt management releases, or other specified releases. In essence, each reservoir operates for its own "reservoir conservation" goal and retains storage as much as possible, only drawn down as needed to meet release requirements, diversions, or to achieve reservoir or flow management goals such as flood control or, in some cases hydropower.

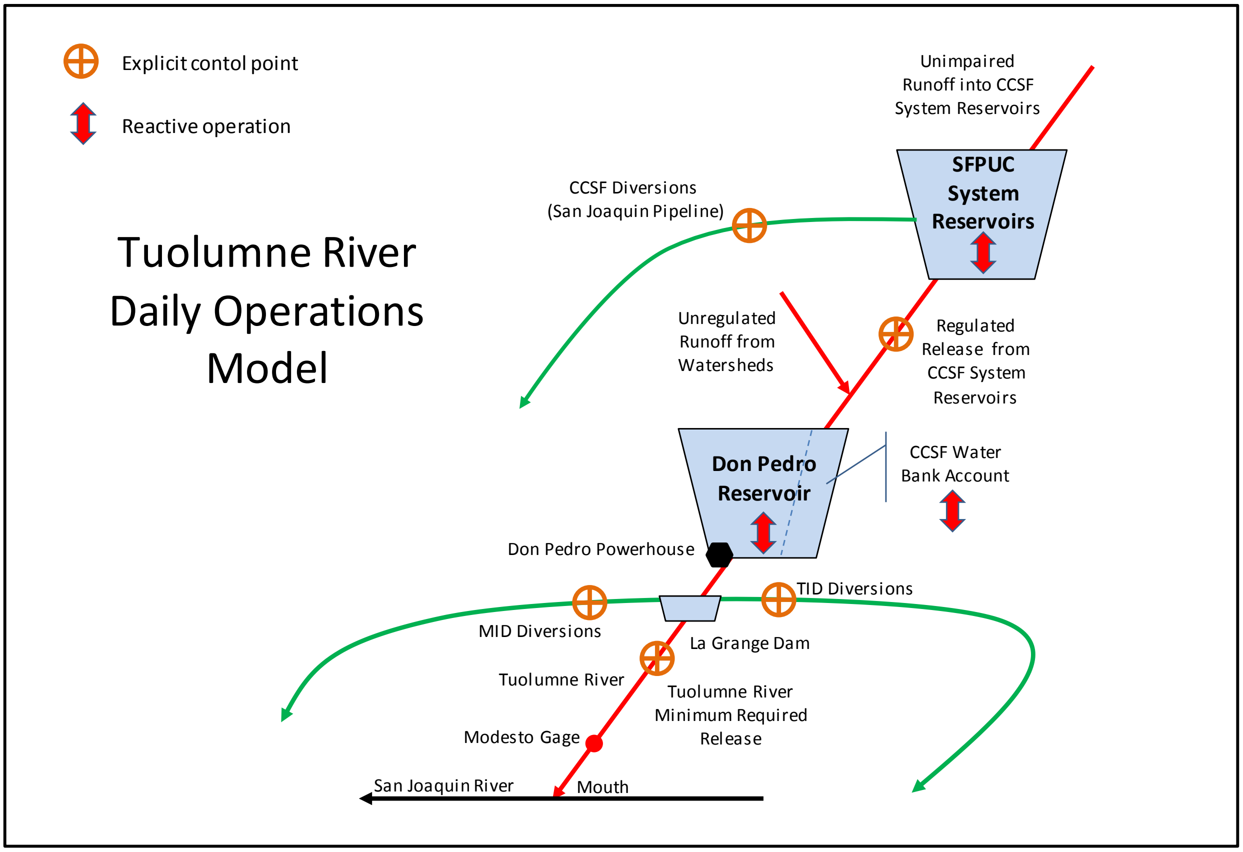



**Figure 2.0-1. Tuolumne River Daily Operations Model.**

## 3.0 DON PEDRO PROJECT AND LA GRANGE DIVERSION DAM

The Don Pedro Project and the La Grange diversion dam operations are modeled to represent current operations for irrigation and municipal water deliveries, fishery and instream flow requirements and flood control. Hydropower production is a function of the releases made for these other purposes. The following elements of hydrology and objectives guide the modeled operation.

### 3.1 Reservoir Inflow

Inflow to Don Pedro Reservoir is modeled as two components: 1) a fluctuating unregulated inflow to Don Pedro Reservoir, and 2) the regulated releases (regulated Don Pedro Reservoir inflow) from the CCSF System. The inflow will reflect a daily fluctuating pattern which is mostly associated with the unregulated component of runoff in the basin, which is approximately 40 percent of the total runoff in the basin. The unregulated component of inflow to Don Pedro Reservoir remains the same among all operation simulations. The regulated inflow to Don Pedro is based on a projected level of development and operation for the CCSF System. This component of Don Pedro Reservoir inflow may change among operation simulations due to changed assumptions for CCSF System demands and level of development, or due to user-controlled parameters.

### 3.2 MID and TID Canal Demand

Figure 3.2-1 is a schematic of the parameters used by modeling to create each District's diversion demand at La Grange diversion dam.

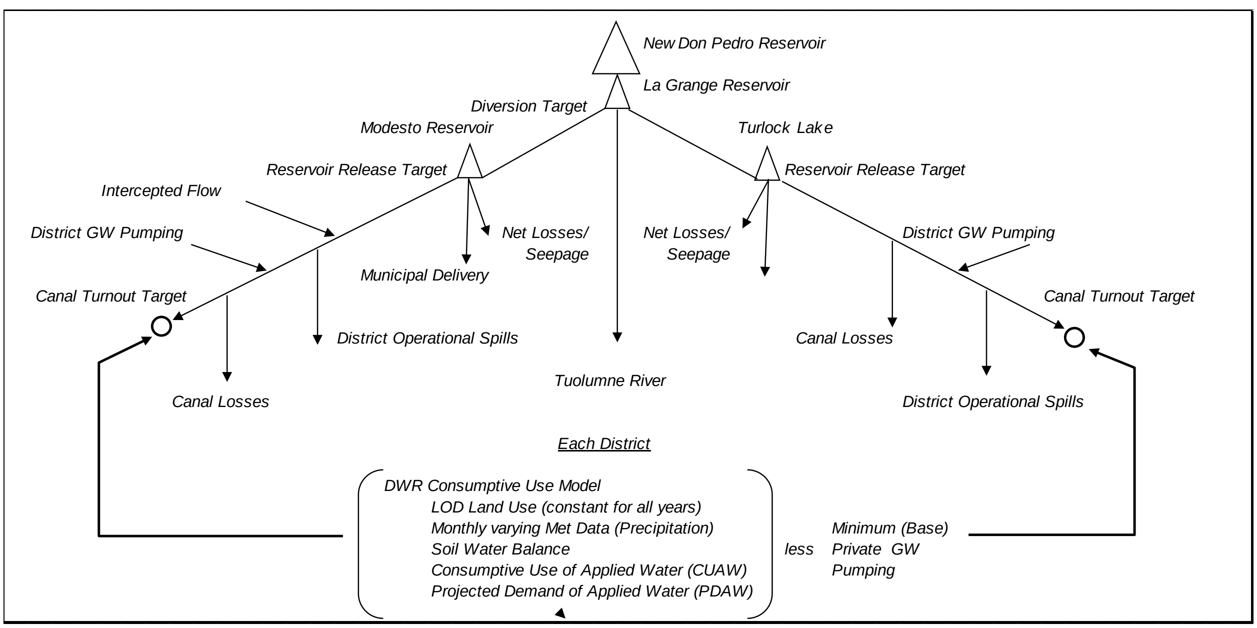



**Figure 3.2-1. District Canal Demand Parameters.**

Due to changing land use and cropping patterns, groundwater use and irrigation and canal management practices throughout history, the historical record of recorded diversions does not provide a consistent definition of water diversion needs. Similar to depicting inflow, the Model uses a projected level of development for establishing irrigation and canal diversion demand.

The canal diversions are assumed to be driven by three components: 1) a fluctuating customer component, the (P)rojected (D)emand of (A)pplied (W)ater (PDAW) that varies year to year and month to month, 2) a relatively constant depiction of District and land owner system losses and efficiencies, and 3) a water supply availability factor based on Don Pedro Reservoir storage and inflow.

The PDAW is developed through use of the California Department of Water Resources (CDWR) consumptive use model, and considers precipitation, ET rates, soil moisture criteria, rooting depth, irrigation indicators, and other factors along with land use to estimate the CUAW on a monthly basis. Monthly water use varies based on input ET rates, which are constant each year. CUAW will only vary each year based on variation in precipitation. The PDAW has been adjusted to reflect other routine irrigation practices not identifiable with strict ET, such as pre-irrigation. The estimate of monthly PDAW is distributed daily based on the historical (2009-2011) distribution of canal diversions within months.

In addition to the PDAW requirement, several canal operation and management components are incorporated into the projected diversion demand. The following tables provide the monthly estimates used for each component, Table 3.2-1 for MID and Table 3.2-2 for TID.

The turnout delivery factor is unique to each District and represents a modeling mechanism to adjust the PDAW for irrigation practices that are not included in the estimation of the CUAW, such as irrigation that provides for groundwater recharge.

**Table 3.2-1. Canal Demand and Operation Components for MID.**

**Modesto Irrigation District**

| | Turnout Delivery Factor | Nominal Private GW Pumping | Canal Operational Spills Critical | Canal Operational Spills Non-crit | System Losses below Modesto Res | Intercepted Flows | Nominal MID GW Pumping | Modesto Res and Upper Canal Losses/Div | Municipal Delivery from Modesto Res | Modesto Res Target Storage |
|---|---|---|---|---|---|---|---|---|---|---|
| Month | % | TAF | TAF | TAF | TAF | TAF | TAF | TAF | TAF | TAF |
| January | 35 | 0.0 | 2.0 | 2.0 | 0.1 | 0.0 | 0.0 | 0.0 | 2.3 | 17.0 |
| February | 35 | 0.0 | 2.0 | 2.0 | 0.1 | 0.0 | 0.0 | 0.0 | 2.3 | 18.0 |
| March | 65 | 1.0 | 1.0 | 3.0 | 0.6 | 0.9 | 1.0 | 2.0 | 2.7 | 18.0 |
| April | 70 | 2.0 | 3.0 | 6.0 | 0.6 | 0.9 | 2.3 | 2.9 | 2.7 | 19.0 |
| May | 85 | 3.0 | 4.0 | 6.5 | 0.6 | 1.2 | 2.3 | 3.9 | 3.0 | 20.0 |
| June | 85 | 4.0 | 3.5 | 6.5 | 0.6 | 1.0 | 2.3 | 4.3 | 3.2 | 20.0 |
| July | 77.5 | 4.0 | 3.5 | 6.5 | 0.6 | 1.0 | 2.6 | 4.9 | 3.3 | 21.0 |
| August | 70 | 4.0 | 4.9 | 7.0 | 0.6 | 1.4 | 2.4 | 4.9 | 3.3 | 22.0 |
| September | 65 | 2.0 | 5.0 | 7.0 | 0.6 | 1.2 | 2.3 | 4.2 | 3.3 | 20.0 |
| October | 40 | 1.0 | 2.8 | 6.9 | 0.6 | 0.9 | 2.1 | 2.0 | 3.2 | 17.0 |
| November | 30 | 0.0 | 2.0 | 2.0 | 0.1 | 0.0 | 0.0 | 2.0 | 2.7 | 15.0 |
| December | 35 | 0.0 | 2.0 | 2.0 | 0.1 | 0.0 | 0.0 | 0.0 | 2.5 | 15.0 |
| Total | | 21.0 | 35.7 | 57.4 | 5.4 | 8.5 | 17.3 | 31.1 | 34.5 | |

**Table 3.2-2. Canal Demand and Operation Components for TID.**

**Turlock Irrigation District**

| | Turnout Delivery Factor | Nominal Private GW Pumping | Canal Operational Spills Critical | Canal Operational Spills Non-crit | System Losses below Turlock Lk | Intercepted Flows | Nominal TID GW Pumping | Turlock Lk and Upper Canal Losses | Other Delivery from Turlock Lk | Turlock Lk Target Storage |
|---|---|---|---|---|---|---|---|---|---|---|
| Month | % | TAF | TAF | TAF | TAF | TAF | TAF | TAF | TAF | TAF |
| January | 30 | 0.0 | 2.0 | 2.0 | 0.8 | 0.0 | 0.0 | 1.0 | 0.0 | 18.0 |
| February | 30 | 0.0 | 2.0 | 2.0 | 0.8 | 0.0 | 0.0 | 1.0 | 0.0 | 25.0 |
| March | 65 | 1.2 | 3.0 | 3.0 | 4.5 | 0.0 | 4.1 | 1.0 | 0.0 | 30.0 |
| April | 57.5 | 2.4 | 5.1 | 6.3 | 4.5 | 0.0 | 8.0 | 6.6 | 0.0 | 30.0 |
| May | 85 | 3.6 | 4.6 | 6.7 | 4.5 | 0.0 | 10.3 | 7.7 | 0.0 | 32.0 |
| June | 92.5 | 5.2 | 4.2 | 6.7 | 4.5 | 0.0 | 12.4 | 8.2 | 0.0 | 32.0 |
| July | 72.5 | 6.4 | 4.2 | 6.7 | 4.5 | 0.0 | 14.6 | 8.7 | 0.0 | 32.0 |
| August | 62.5 | 6.2 | 4.0 | 7.3 | 4.5 | 0.0 | 13.3 | 9.0 | 0.0 | 30.0 |
| September | 67.5 | 3.9 | 3.2 | 7.3 | 4.5 | 0.0 | 9.1 | 5.0 | 0.0 | 27.0 |
| October | 40 | 2.4 | 2.3 | 7.3 | 4.5 | 0.0 | 5.3 | 2.0 | 0.0 | 13.0 |
| November | 30 | 0.0 | 2.0 | 2.0 | 0.8 | 0.0 | 0.0 | 1.0 | 0.0 | 13.0 |
| December | 30 | 0.0 | 2.0 | 2.0 | 0.8 | 0.0 | 0.0 | 1.0 | 0.0 | 13.0 |
| Total | | 31.3 | 38.6 | 59.3 | 39.2 | 0.0 | 77.1 | 52.2 | 0.0 | |

## 3.3 Required FERC flows at La Grange Bridge

The current FERC minimum flow requirements at La Grange Bridge are included in the Model. In the Model the terms “La Grange releases”, “flows at La Grange Bridge” or “releases at La Grange diversion dam” are used interchangeably to mean the minimum flow requirements under the Project’s current FERC license as measured at the USGS gage “Tuolumne River at La Grange, CA”. The annual flow requirement is established for the April-March flow year beginning April based on pre-knowledge of the final San Joaquin River Index (60-20-20) for the year. The annual volume including “interpolation water” is computed using the FERC Settlement Agreement procedures, which includes a revised year type distribution using a 1906-2011 population of historical years. The interpolation water is assumed to be spread among April and May volumes.

The Model assumes each month’s volume of the annual volume is spread evenly across the days of the months, except during April and May where the user can define the distribution of daily flows. The user can define the distribution as: 1) total monthly volume spread evenly across all days of a month, or 2) a user-specified daily distribution of monthly volume during April and May. Figure 3.3-1 illustrates the outcome of the two assumed flow distributions during April and May. The pulsing pattern option shown in Figure 3.3-1 is being used by the Model.

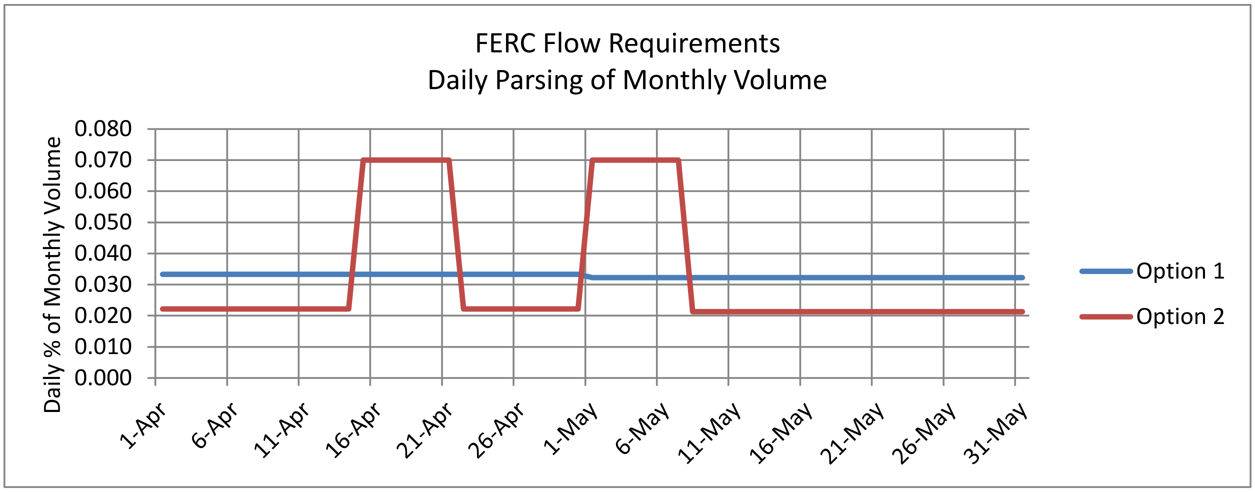



**Figure 3.3-1. User-specified Distribution of April and May FERC Flow Requirements.**

## 3.4 Reservoir and Release Management

Don Pedro Reservoir storage is initially checked against a preferred storage target. The Model allows the user to establish the preferred storage target. The preferred storage target is the Army Corps of Engineers (ACOE) rain flood reservation objective, except after July 1, when there is no required reservation space. The preferred storage target reflects a drawdown to evacuate storage during the summer in late and wet runoff years. The preferred target storage is again equal to the ACOE objective on October 7. Figure 3.4-1 illustrates the reservoir storage target used in the Model.

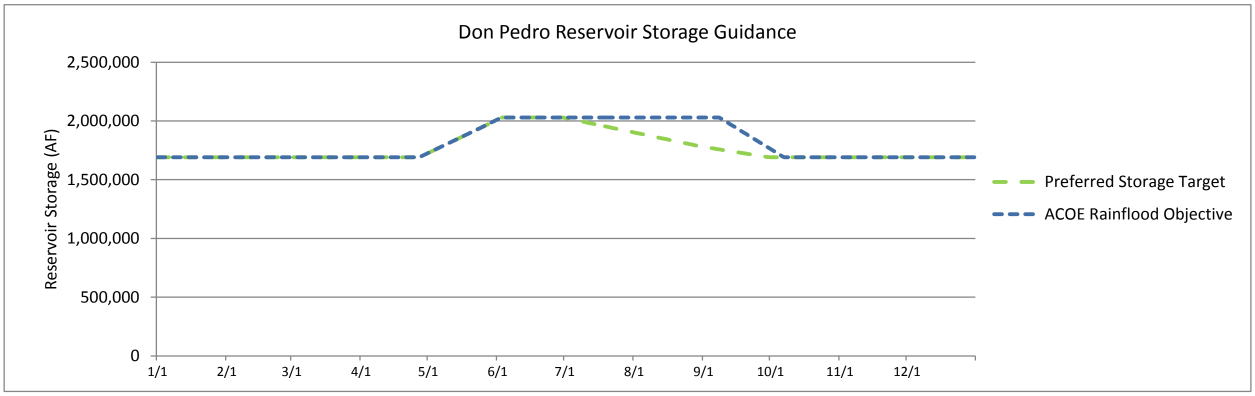



**Figure 3.4-1. Reservoir Storage Guidance.**

For a day of Don Pedro Reservoir operation, the day's inflow is a computed amount from upstream CCSF System operations and unregulated inflow. The stream flow requirements contained in the FERC license at La Grange Bridge and the MID and TID canal diversions are the release from Don Pedro Reservoir. The prior day's reservoir evaporation is included in the calculation. If the computation produces resulting Don Pedro Reservoir storage in excess (encroachment) of the preferred storage target, the encroachment is computed. Every 7th day the model checks for an encroachment, and if it exists a "check" release is computed. It is assumed that a constant supplemental release (in excess of minimum releases) will be initiated at a rate equal to the encroachment divided equally over the next 10 days. This protocol repeats itself every 7th day, reestablishing the level of check release each time. The end result of this procedure will allow encroachment of storage space above the preferred storage target and not require unrealistic “hard” releases of water to exactly conform to the target.

A second check release is made during the April through June period for management of anticipated snowmelt runoff. On the first day of each of these months a forecast is made of anticipated runoff into the reservoir and minimum releases and losses from the reservoir from the date of forecast through the end of June (the assumed target date of reservoir filling). These forecasts determine the volume of water (if any) that will require release in excess of minimum releases and losses and storage gain by the end of June. For April and May, the DWR “90 percent exceedence forecast” is used for anticipated runoff, along with known minimum releases and losses, and upstream impairment. The user defines the percentage of volume (of the total volume) to be additionally released during each month. For April, 30 percent of the 3-month volume is advised for release, and during May 50 percent of the 2-month volume is advised for released. For June, the historically reported unimpaired flow (UF) flow is assumed for the runoff computation. This assumes pre-knowledge of the runoff volume for the month, and 100 percent of the excess is spread across the month. The snowmelt check release is evenly distributed across the days of the month. The release made in a day is the greater of the two check releases or the minimum release. At no time is the maximum capacity of the reservoir (2,030,000 acre-feet) allowed to be exceeded, and if necessary a release, regardless of magnitude, will be made by the Model to not exceed maximum storage capacity.

A Modesto flood control objective is incorporated into the release logic. The objective is to maintain a flow at Modesto no greater than a user specified flow rate (assumed as 9,000 cfs). The logic checks against an “allowable” La Grange release considering the lower Tuolumne River accretions and Dry Creek flow. Model logic compares the La Grange allowable release to the other check releases. The La Grange release is then reduced if necessary to not exceed the Modesto flow target objective, even if it results in an encroachment in Don Pedro Reservoir. The exception is when the reservoir reaches full (2,030,000 AF). Any computed encroachment above a full reservoir is passed and the Modesto flow objective will be exceeded.

Consistent with the original FERC license filings for the new Don Pedro Project, the minimum operating reservoir level is established at elevation 600 feet, corresponding to a storage volume of 308,960 AF. Below this elevation is referred to as the “dead pool” storage.

## 3.5 Water Supply Factor

A constraint to the Districts’ canal diversions is recognized when there is a reduced water supply at Don Pedro Reservoir. The premise of the (W)ater (S)upply (F)actor (WSF) is to reduce the amount of water diverted to the canals during years when lack of carryover storage at Don Pedro Reservoir becomes a concern.

The modeling mechanism used to reduce canal diversions is a factor applied to the PDAW of the canal demand. This mechanism results in a reduction to the amount of water “turned out” to the customers while still recognizing the relatively constant efficiencies of canal operations.

The WSF is established by forecasting upcoming water supply, based on antecedent storage and anticipated inflow to Don Pedro Reservoir. The forecasting procedure begins in February and ends in April. The Factor Table is based on April forecast results. The February and March Forecasts act as adjustments to get to the April 1 state. The forecasts have the following protocol:

*February Forecast (forecasting April 1 state):*
*End of January storage + Feb-Jul UF - Feb-Jul Upstream adjustment - Feb-Mar minimum river*
*March Forecast (forecasting April 1 state):*
*End of February storage + Mar-Jul UF - Mar-Jul Upstream adjustment - Mar minimum river*
*April Forecast: (final)*
*End of March storage + Apr-Jul UF - Apr-Jul Upstream adjustment*

Pre-knowledge of unimpaired runoff for each forecast period is assumed, as well as knowledge of upcoming upstream impairment of the runoff.

The WSF factor / Don Pedro Storage + Inflow relationship is developed through iterations of multi-year system operation simulations. The WSF depicts actions that may be implemented during times of drought, and the projected canal diversions and reservoir storage operation during drought periods. The factors and index triggers were developed reviewing reservoir storage levels that occurred during the 1987-1992 drought.

## 3.6 Power Generation

Equations of Don Pedro powerhouse generation characteristics define capacity (MW) and efficiency (kWh/AF), based on reservoir storage. Capacity potential uses minimum storage of the day, while efficiency uses average storage of the day. The maximum flow through plant is assumed to be 5,400 cfs. Water that does not appear as passing through the generators is computed to be “spilled-bypassed”. The power generation “cutoff” also occurs at the reservoir storage of 308,960 acre-feet or the top of dead pool.

## 3.7 User-Interface Adjustments

The Model allows alternative user-specified data for two components of District operations: 1) user-specified assumptions for the La Grange Bridge minimum flow requirements, and 2) a user-specified diversion for the Districts’ canals. An alternative La Grange Bridge flow requirement can be incorporated by definition of required flows by periods within a year, based on year type. Entered in this protocol the input will result as a daily time series for the Model. Alternatively, a flow requirement can be entered as a daily time series. For an alternative canal diversion, an array has been provided to input a monthly by 39-year matrix of alternative canal diversions. The monthly array of data is parsed by the Model into daily distributions reflecting the current depicted daily distribution of canal diversions.

# 4.0 CITY AND COUNTY OF SAN FRANCISCO SYSTEM

The Model representation of the CCSF System on the Tuolumne River includes the three physical reservoirs (Hetch Hetchy Reservoir, Lake Lloyd and Lake Eleanor), diversions to the Bay Area through the San Joaquin Pipeline, and an accounting for the Don Pedro Water Bank Account. The CCSF System is illustrated in Figure 4.0-1, with detail provided for the components of explicitly modeled hydrologic parameters.

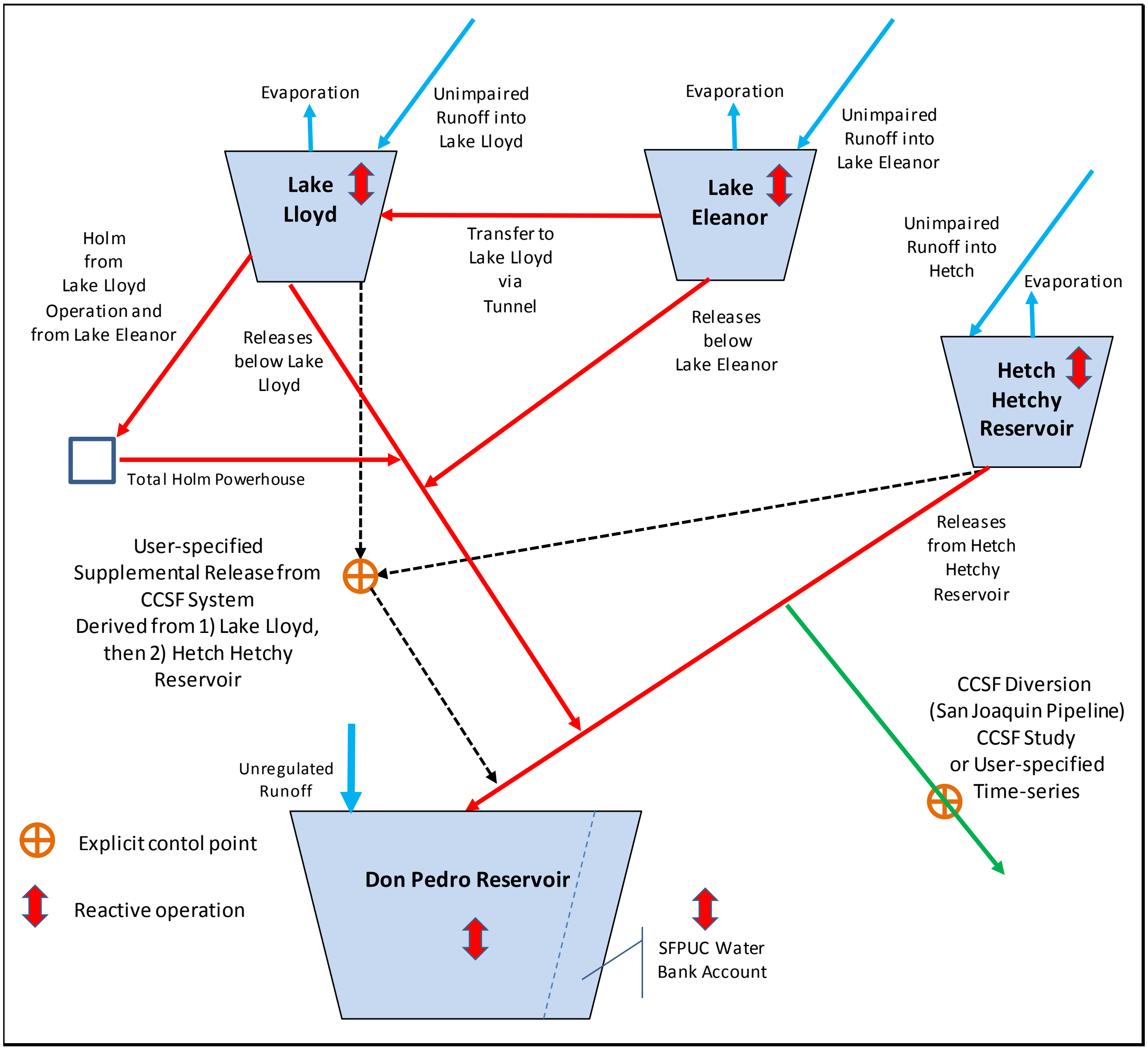



**Figure 4.0-1. City and County of San Francisco System.**

Each CCSF System reservoir has the same underlying operation protocol. A daily mass balance is performed: change in reservoir storage = inflow, minus outflow (releases), minus reservoir losses. If the calculation results in reservoir storage exceeding preferred/maximum capacity, an additional release of water is made.

Minimum releases from each reservoir are in accordance with current requirements for Hetch Hetchy Reservoir, Lake Lloyd and Lake Eleanor.

Each reservoir assumes a common "hold-unless-need-to-release" protocol, except as conditioned by minimum release requirements, diversions, preferred/maximum storage, snowmelt management releases, hydropower, or other flow or management objectives. In essence, each reservoir operates for its own "reservoir conservation" goal of retaining storage unless drawn down by demands or reservoir management objectives. CCSF is required by State law and its Charter to operate its system for "water first".

## 4.1 Hetch Hetchy Reservoir

Hetch Hetchy Reservoir storage is initially checked against a preferred storage target. The day's inflow is a given amount, and the SJPL diversion and minimum stream flow requirements below Hetch Hetchy Reservoir determine the release. The prior day's reservoir evaporation is included in the calculation. If the computation produces storage in excess (encroachment) of the preferred storage target, the encroachment is computed. Every 7th day the model checks for the encroachment, and if it exists a check release is computed. It is assumed that a constant supplemental release (in excess of minimum releases) will be initiated at a rate equal to the encroachment divided equally over the next 7 days. This protocol repeats itself every 7th day, reestablishing the level of check release each time. The end result of this procedure will allow encroachment of storage space above the preferred target storage and not require unrealistic releases of water to exactly conform to the target.

A second check release is made during the February through June period for management of anticipated snowmelt runoff. On the first day of each of these months a forecast is made of anticipated runoff into the reservoir and minimum releases and losses from the reservoir from the date of forecast through the end of June (assumed target of reservoir filling). These forecasts determine the volume of water (if any) that will require release in excess of minimum releases and losses and storage gain by the end of June. Pre-knowledge is used for anticipated runoff, minimum releases and losses. The user defines the percentage of volume (of the total volume for the period) to be additionally released during each month. For February through April, 10 percent of the additional release volume is advised for release, and may be additionally capped. This approach tends to hold Hetch Hetchy Reservoir releases for later release during May. The snowmelt check release is evenly distributed across the days of the month and can be capped in terms of rate (cfs) or minimum volume of the reservoir to which it can be drawn during the month. The particular release made in a day is the greater of the two check releases or the minimum release. At no time is the maximum capacity of the reservoir allowed to be exceeded, and if necessary a release, regardless of magnitude, will be made by the Model to not exceed maximum storage capacity.

For Hetch Hetchy Reservoir these two check releases typically guide the operation of the reservoir during the winter and spring. After reservoir filling, summer-time stream release requirements and the SJPL demand typically draw the reservoir down below the preferred storage targets.

Canyon Tunnel, Kirkwood Powerhouse, Mountain Tunnel and Moccasin Powerhouse are not explicitly modeled. The structure of the Model depicts the component of inflow to Don Pedro Reservoir that originates from the Hetch Hetchy Reservoir watershed. The detail of flow reaches below Hetch Hetchy Reservoir is not needed. Therefore, the simple gradation of flow between flow removed from the stream system by the SJPL and the remaining flow that will eventually reach Don Pedro Reservoir is sufficient for purposes related to the relicensing of the Districts' Don Pedro Project.

## 4.2 Lake Lloyd

The same underlying reservoir operation protocols of Hetch Hetchy Reservoir apply to Lake Lloyd, with a couple of modifications. Instead of the SJPL demand being assumed as an initial release requirement, a minimum Holm Powerhouse release during May through August is assumed from Lake Lloyd.

Both the initial check release for preferred storage encroachment and the snowmelt check release are computed and advised for reservoir operations. If supplemental releases above minimum releases are computed the Model routes the additional release through Holm Powerhouse up to its available capacity. The remainder of the supplemental release is routed to the stream below Lake Lloyd. A comparison is made between "Lloyd-only" use of Holm Powerhouse capacity and maximum capacity for passage to the Lake Eleanor model component.

The operation goal linkage between Lake Lloyd and Lake Eleanor assumes that Lake Eleanor will transfer water from its watershed to Lake Lloyd for the purpose of enhancing power generation at Holm Powerhouse. Thus, any available capacity at Holm Powerhouse after the Lloyd-only operation is assumed available and desired for use of a Lake Eleanor transfer. If water is transferred from Lake Eleanor the Model assumes the water to be directly routed to Holm Powerhouse which then becomes additional release from Lake Lloyd. The inclusion of the Holm Powerhouse logic in the Lloyd/Eleanor watershed logic is only done to facilitate the interaction between the two watersheds.

## 4.3 Lake Eleanor

Both the initial check release for preferred storage encroachment and the snowmelt check release are computed and employed into reservoir operations. In this instance of Lake Eleanor operations, the transfer "desire" for Holm Powerhouse generation is considered a disposition of the Lake Eleanor releases determined to be in excess of minimum stream requirements. To the extent that check (stream) releases are available from Lake Eleanor, they will be transferred. The amount transferred is limited by available Holm Powerhouse capacity and the assumed capacity of the Eleanor-Cherry Diversion Tunnel. The Lake Eleanor operation protocol will transfer water that would otherwise be released in excess of minimum flow requirements (largely dependent upon the preferred storage target and snowmelt releases) but it will not allow water to be "pulled" from Lake Eleanor to Lake Lloyd.

## 4.4 Don Pedro Inflow

The three components of regulated releases from Hetch Hetchy Reservoir (not including the SJPL), Lake Lloyd and Lake Eleanor are combined with the unregulated runoff below CCSF System reservoirs to provide the inflow data set for Don Pedro Reservoir.

## 4.5 Water Bank Account

A Water Bank Account calculation procedure is included in the Model. A running account of the Water Bank Account balance is computed daily, as limited by the Fourth Agreement and implementing agreement. The Model allows the computation of a "negative" balance. The accounting of the balance is incidental to model operations, and there is no auto-default feedback linkage to upstream operations if the balance is negative. To be consistent with current operations in the watershed, the user must employ the user-specified adjustment mechanism for supplemental CCSF System releases to remedy any negative balances.

For purposes of the FERC investigation, the protocols of Fourth Agreement Water Bank Accounting have been amended to incorporate a hypothetical implementation of "shared responsibility" for incremental increases in FERC-required flows for the Tuolumne River.[1] The incremental increase in FERC-required flows is determined by the daily difference between the current FERC requirements and scenario-required minimum flows. Approximately fifty-two percent (51.7121%) of the incremental difference between the flow schedules is assigned as CCSF's responsibility and counted as a debit within Water Bank Accounting.

## 4.6 User Interface Adjustments

The Model allows alternative user-specified data for two components of CCSF operations: 1) user-specified supplemental releases from the CCSF System, and 2) user-specified SJPL diversions.

The user-specified release from the CCSF System is to allow the user to "pull" additional water from the CCSF System as supplemental inflow to Don Pedro Reservoir. A single entry is established that will first pull water from Lake Lloyd so that water supply is preserved in the Hetch Hetchy Reservoir system for diversion to the SJPL. At a point when such supplemental releases strain Lake Lloyd storage, the supplemental releases are directed to Hetch Hetchy Reservoir. When employed, a daily flow release is directed from a reservoir at a point in logic after most of the previously described logic occurs. Thus, this release occurs in addition to what operation is already occurring by default. Such a release can affect the following day's default operation or previous periods' operations, thus results require review to determine if the user's desired result occurs. It is also necessary to determine at the end of each simulation whether the operations depicted are consistent with the keeping of the Water Bank Account Balance from being negative.

[1] The "shared responsibility" assumption is presented for the purpose of evaluating alternative operations. The assumption shall not be used as evidence in any proceeding relating to and shall not act as precedence for any allocation of Tuolumne River water between CCSF and the Districts for any purpose under the Fourth Agreement.

This adjustment capability is used to maintain the Water Bank Account Balance greater than zero. There is no auto-default logic to keep the Water Bank Account Balance from going negative. In a typical scenario of normal CCSF System operations during most years, for this level of modeling, the Water Bank Account would not affect CCSF upstream operations. The exception is during prolonged drought when the default reservoir operation of CCSF System reservoirs attempts to hold stream releases to a minimum. In the modeled WY 1971 to 2009, the period 1987 through 1992, and possibly other periods may drive the Water Bank Account to a negative condition. The release adjustment is used to provide additional releases from the CCSF System to avoid driving the Water Bank Account negative.

The second adjustment to SF System hydrology can be made to the pre-specified time series of monthly SJPL diversion. The user is provided a tool to enter an alternative time series of data. This capability can be used to adjust CCSF System diversions from the Tuolumne River.

## 5.0 MODEL STRUCTURE

The Model was constructed within the platform of a Microsoft Excel 2010 workbook. All Model logic is contained within cells of the workbook with no macros or calls to other forms of programming such as Visual Basic for Applications. Numerous worksheets within the workbook represent logical groupings of either sub-system facilities and operations, or input/output functionality. The worksheets of the Model are briefly described in Table 5.0-1. Some of the worksheets in the Model are fixed to prevent inadvertent changes to certain facility functions and operations. These aspects of the Model are consistent with the FERC-approved study plan.

**Table 5.0-1. Model Worksheets.**

| Purpose | Worksheet Name | Description |
|---|---|---|
| Model Input | UserInput* | Contains user inputs for lower Tuolumne River flow requirements, Districts' canal diversions, CCSF SJPL and CCSF supplemental releases |
| Model Input/Operations | WaterBankRel* | Contains model logic and user input for CCSF supplemental releases (Model component worksheet) (preferred daily entry method) |
| Summarize Results | Review* | Provides summary of results and simulation warnings |
| Model Input | Control | Contains inputs for facility characteristics, system operation and configuration |
| Model Output | Output* | Results of scenario specific simulation in HEC-DSS format |
| Comparison Results | Test_Case | Results of Test Case simulation (HEC-DSS format) |
| Summarize Results | DSSAnyGroup* | Plots any group of parameters for a calendar year from HEC-DSS format |
| | DSSMonthTable* | Plots and tables up to four parameters, summarizing daily data by month from HEC-DSS format |
| | Switches* | Provides an echo of assumptions and values of UserInput and Control worksheets |
| | ModelYearofDaily* | Plots and tables any single parameter for a calendar or water year from Model component worksheets |
| | ModelAnyGroup* | Plots any group of parameters for a calendar year from Model component worksheets |
| | ModelMonthTable* | Plots and tables up to four parameters, summarizing daily data by month from Model component worksheets |
| Model Operations | DonPedro | Contains model logic for Don Pedro Reservoir operation (Model component worksheet) |
| | SFHetchHetchy | Contains model logic for Hetch Hetchy Reservoir operation (Model component worksheet) |
| | SFLloyd | Contains model logic for Lake Lloyd operation (Model component worksheet) |
| | SFEleanor | Contains model logic for Lake Eleanor operation (Model component worksheet) |
| | SFWaterBank | Contains model logic for Water Bank operation (Model component worksheet) (year type plus daily entry method) |

| Purpose | Worksheet Name | Description |
|---|---|---|
| Summarize Results | DPGroup* | Plots simulation of Don Pedro Reservoir operations and River flows (from Model component worksheets) |
| | DPGroup86_94* | Plots simulation of Don Pedro Reservoir operation during 1986-1994 (from Model component worksheets) |
| | HHGroup* | Plots simulation of Hetch Hetchy Reservoir operation (from Model component worksheets) |
| | LloydGroup* | Plots simulation of Lake Lloyd operation (from Model component worksheets) |
| | ELGroup* | Plots simulation of Lake Eleanor operation (from Model component worksheets) |
| | WBGroup* | Plots simulation of Water Bank Balance computation (from Model component worksheets) |
| | SFSysGroup* | Plots simulation of CCSF System reservoirs (from Model component worksheets) |
| | SFGroup86_94* | Plots simulation of CCSF System operation during 1986-1994 (from Model component worksheets) |
| Model Operations | LaGrangeSchedule | Contains model logic for 1995 FERC minimum flow requirements (Model component worksheet) |
| | DailyCanalsCompute | Contains model logic for computation of daily District canal demand (Model component worksheet) |
| | DailyCanals | Contains model logic for computation of user-defined canal demand (Model component worksheet) |
| | DPWSF | Contains model logic for computation of Don Pedro water supply factor (Model component worksheet) |
| | CCSF | Contains model logic for CCSF release and diversion requirements (Model component worksheet) |
| Model Input | Hydrology | Contains input data for hydrology |
| | 602020 | Contains input data for forecasting hydrology |

"*" Identifies worksheets accessible as user interfaces.

## 5.1 UserInput Worksheet

This worksheet (UserInput) provides the interface for entering assumptions for minimum flow schedules for the lower Tuolumne River at La Grange Bridge, canal diversions by the Modesto Irrigation District and Turlock Irrigation District, supplemental releases to Don Pedro Reservoir from the CCSF System, and diversions by CCSF through the San Joaquin Pipeline. The worksheet is described below.

### 5.1.1 Contents Description and Study Name

This section (Figure 5.1-1) provides an index of the contents included in the worksheet, and identifies a named label for the particular study. An alpha numeric entry is entered (UI 1.00) for the study name, which is then incorporated into the DSS output interface tab (see worksheet Output description).

### 5.1.2 Section 1: Minimum Flow Requirements at La Grange Bridge

This section (Figure 5.1-2) provides an entry of the minimum flow schedule for the lower Tuolumne River. Switch UI 1.10 directs the use of the current 1995 FERC schedule (UI 1.10 = 0) or an alternative schedule (UI 1.10 = 1). If an alternative schedule is directed, Switch UI 1.20

directs the use of a user-defined daily times series (UI 1.20 = 0) or the use of a user-specified year type schedule (UI 1.20 = 1).

> Daily Time Series - If the daily time series is directed, a flow value (expressed in average daily flow – cfs) must be entered in Column BM of this worksheet for each day beginning October 1, 1970 through September 30, 2009.
>
> Year Type Schedule - If the year type schedule is directed, values must be entered into the matrix provided at UI 1.30. Values are entered as average daily flow (cfs) for 6 year types, for up to 24 discrete periods during the year. The periods are identified in MM.DD format. For instance, for a flow to be provided for January 1 through January 15 the flow would be identified with a period starting 01.01 (January [01], day 1) and ending with a different flow identified with a starting period of 01.16 (January [01], day 16). The year type has been established by the naming of 6 year types, wet, above normal, normal, below normal, dry and critical. Using the water year runoff for the years 1921 through 2011 (91 years), the years were rank ordered from wettest to driest. The wettest 20 percent of the years (18 years) are designated the wet year type. The next wettest 18 years are designated the above normal year type. And so on for the normal and below normal year types. The driest 20 percent of years are split between the dry and critical year types. After the demarcation occurs for each year the data set is reduced to only the 1971 through 2009 modeling period (39 years). The reduced set of years of the modeling period maintains a year type frequency distribution similar to the larger data set's 20/20/20/20/10/10 percent frequency. Switch UI 1.40 directs the monthly sequence of the flow requirement year. For instance, if the flow schedule is to be established for a year beginning February 1 of the year, UI 1.40 would be set to "Feb". The applicable year type schedule would be applied beginning February 1 of the year and continue through January 31 of the following year. Switch UI 1.40 can be set to any month February (Feb) through June (Jun).

The current 1995 FERC minimum flows to the lower Tuolumne River at La Grange Bridge are illustrated in this section for comparison purposes only, and the values are arranged in the context of the year type designations described above. The values reflect an assumption of two equal periods of flow requirements during each month. If Switch UI 1.10 directs the use of the current schedule, the 1995 FERC schedule as defined by the 1995 FERC Settlement Agreement is implemented including the use of its definition of year types and discrete periods of flow requirements during the year. The 1995 FERC schedule is computed in worksheet LaGrangeSchedule.

**User Defined Input**

Variables Affected by User Entered in Blue Shaded Cells

Contents:



(UI 1.00) Enter Study Reference: Test_Case *For Part 6 of DSS file (minimize length of name)*

**Figure 5.1-1. Contents Description and Study Name.**

**Section 1 - Alternative Flow Requirements La Grange Bridge**

This table is used to enter a user-specified minimum flow schedule at La Grange Bridge. Twenty-four time periods are available to define a flow rate. Six different water year types can be established.
The year types correspond to the Preliminary Relicensing Year Type which is based on Tuolumne River unimpaired flow.

(UI 1.10) Turn alterantive flow requirement on: 0 *(1) on, and use alternative flow requirement, or (0) off, use current FERC flow requirement*

(UI 1.20) Use year type table below, or time series: 0 *(1) for table below, or (0) for time series (Column BM)* N/A

Alternative Flow Requirements

Enter values in CFS

(UI 1.30)

| CYMo Day MM.DD | W 1 | AN 2 | N 3 | BN 4 | D 5 | C 6 |
|---|---|---|---|---|---|---|
| 1.01 | 300 | 300 | 233 | 150 | 157 | 150 |
| 1.16 | 300 | 300 | 233 | 150 | 157 | 150 |
| 2.01 | 1,287 | 994 | 729 | 419 | 409 | 359 |
| 2.15 | 1,287 | 994 | 729 | 419 | 409 | 359 |
| 3.01 | 1,627 | 1,172 | 912 | 931 | 627 | 421 |
| 3.16 | 1,627 | 1,172 | 912 | 931 | 627 | 421 |
| 4.01 | 1,960 | 1,533 | 1,508 | 1,211 | 1,075 | 785 |
| 4.16 | 1,960 | 1,533 | 1,508 | 1,211 | 1,075 | 785 |
| 5.01 | 2,767 | 2,744 | 2,476 | 1,696 | 1,258 | 905 |
| 5.16 | 2,767 | 2,744 | 2,476 | 1,696 | 1,258 | 905 |
| 6.01 | 2,857 | 2,200 | 1,619 | 924 | 566 | 382 |
| 6.16 | 2,857 | 2,200 | 1,619 | 924 | 566 | 382 |
| 7.01 | 250 | 250 | 150 | 61 | 56 | 50 |
| 7.16 | 250 | 250 | 150 | 61 | 56 | 50 |
| 8.01 | 250 | 250 | 150 | 61 | 56 | 50 |
| 8.16 | 250 | 250 | 150 | 61 | 56 | 50 |
| 9.01 | 250 | 250 | 150 | 61 | 56 | 50 |
| 9.16 | 250 | 250 | 150 | 61 | 56 | 50 |
| 10.01 | 397 | 397 | 295 | 143 | 152 | 126 |
| 10.16 | 397 | 397 | 295 | 143 | 152 | 126 |
| 11.01 | 300 | 300 | 233 | 150 | 158 | 150 |
| 11.16 | 300 | 300 | 233 | 150 | 158 | 150 |
| 12.01 | 300 | 300 | 233 | 150 | 157 | 150 |
| 12.16 | 300 | 300 | 233 | 150 | 157 | 150 |

(UI 1.40) Enter beginning month of annual flow requirement schedule: Feb-Jun / Feb / 2

Preliminary Relicensing Year Type is based on a rank-ordering of the water-year runoff for the years 1921-2011. Each water year type W, AN, N, and BN represent 20% of the years of ranking. D and C year types each represent 10% of the years.

CCSF Responsibility* for La Grange Minimum Flows

CCSF responsibility is applied as a daily debit in the computation of CCSF debit or credit in the Water Bank Account.

0 *(0) not responsible, or*

(UI 1.31) *(1) responsible for 51.7121% of difference between 1995 FERC and scenario requirement.*

*If responsibility option is selected, user should go to Section 3 of UserInput and use supplemental CCSF releases to maintain Water Bank Account > zero.*

Existing FERC Flow Requirements at La Grange Bridge

Values in CFS

| CYMo Day MM.DD | W 1 | AN 2 | N 3 | BN 4 | D 5 | C 6 |
|---|---|---|---|---|---|---|
| 1.01 | 300 | 300 | 225 | 150 | 157 | 150 |
| 1.16 | 300 | 300 | 225 | 150 | 157 | 150 |
| 2.01 | 300 | 300 | 225 | 150 | 158 | 150 |
| 2.15 | 300 | 300 | 225 | 150 | 158 | 150 |
| 3.01 | 300 | 300 | 225 | 150 | 157 | 150 |
| 3.16 | 300 | 300 | 225 | 150 | 157 | 150 |
| 4.01 | 300 | 300 | 225 | 150 | 158 | 150 |
| 4.15 | 1,762 | 1,762 | 1,562 | 776 | 655 | 461 |
| 5.01 | 1,762 | 1,762 | 1,562 | 776 | 655 | 461 |
| 5.16 | 300 | 300 | 225 | 150 | 157 | 150 |
| 6.01 | 250 | 250 | 150 | 61 | 56 | 50 |
| 6.16 | 250 | 250 | 150 | 61 | 56 | 50 |
| 7.01 | 250 | 250 | 150 | 61 | 56 | 50 |
| 7.16 | 250 | 250 | 150 | 61 | 56 | 50 |
| 8.01 | 250 | 250 | 150 | 61 | 56 | 50 |
| 8.16 | 250 | 250 | 150 | 61 | 56 | 50 |
| 9.01 | 250 | 250 | 150 | 61 | 56 | 50 |
| 9.16 | 250 | 250 | 150 | 61 | 56 | 50 |
| 10.01 | 397 | 397 | 284 | 143 | 152 | 126 |
| 10.16 | 397 | 397 | 284 | 143 | 152 | 126 |
| 11.01 | 300 | 300 | 225 | 150 | 158 | 150 |
| 11.16 | 300 | 300 | 225 | 150 | 158 | 150 |
| 12.01 | 300 | 300 | 225 | 150 | 157 | 150 |
| 12.16 | 300 | 300 | 225 | 150 | 157 | 150 |

Existing FERC flow requirements averaged within Preliminary Relicensing Year Type designations. Existing annual FERC schedules are assumed to begin April 1. Values shown for comparison purposes.

*The "shared responsibility" assumption is presented for the purpose of evaluating alternative operations. The assumption shall not be used as evidence in any proceeding relating to and shall not act as precedence for any allocation of Tuolumne River water between CCSF and the Districts for any purpose under the Fourth Agreement.

**Figure 5.1-2. Minimum Flow Requirements at La Grange Bridge.**

Shared responsibility for incremental increases in FERC-required flows for the Tuolumne River is enabled with Switch 1.31.[2] The incremental increase in FERC-required flows is determined by the daily difference between the current FERC requirements and scenario-required minimum flows. Approximately fifty-two percent (51.7121%) of the incremental difference between the flow schedules is assigned as CCSF's responsibility and counted as a debit within Water Bank Accounting. If enabled, shared responsibility will cause an effect in the CCSF Water Bank Account which requires review and possible revision to CCSF supplemental release.

### 5.1.3 Section 2: Canal Diversions of Modesto Irrigation District and Turlock Irrigation District

This section provides an entry of the diversions of the Modesto Irrigation District and Turlock Irrigation District. Switch UI 2.10 directs the use of Test Case diversions (UI 2.10 = 0) or user specified canal diversions (UI 2.10 = 1). If Test Case diversions are directed, a pre-processed daily time series of canal diversions is used. If directed to use user-specified canal diversions, the matrix tables shown at UI 2.30 (Figure 5.1-3) for Modesto Irrigation District) and at UI 2.40 (Figure 5.1-4) for Turlock Irrigation District) require input values for each month of each simulation year, beginning October 1970 (water year 1971) through September 2009. Values are entered as monthly volumes (acre-feet), which will be parsed by the Model into a daily distribution each month represented by the distribution pattern of the Test Case diversions. The Test Case diversions to the Modesto Canal and Turlock Canal are illustrated in this section for comparison purposes.

### 5.1.4 Section 3: Supplemental Releases of City and County of San Francisco

This section (Figure 5.1-5) provides entry of supplemental releases from CCSF upstream facilities. Switch UI 3.10 directs the use of a suggested method for defining daily supplemental releases (UI 3.10 = 1) or the use of a user-specified table of supplemental releases with or without consideration of Test Case supplemental releases (UI 3.10 = 0), other methods. If the suggested daily supplemental releases method is selected (UI 3.10 = 1) the user must go to worksheet WaterBankRel to complete Model input (see worksheet WaterBankRel description). If the "other methods" path is selected (UI 3.10 = 0) the user must provide additional direction. Switch UI 3.20 directs the use of Test Case supplemental releases (UI 3.20 = 0) or the use of a user-specified table of supplemental releases (UI 3.20 = 1). The user must also direct the consideration of Test Case supplemental releases. To only use the user-specified table of supplement releases, Switch UI 3.30 is set to 0. To add Test Case supplemental releases to the user-specified table of supplemental releases, Switch UI 3.30 is set to 1. The format and application of the user-specified table is the same as described for the entry of alternative flow requirements in Section 1. Values must be entered into the matrix provided at UI 3.40. Values are entered as a daily volume (acre-feet) for 6 year types, for up to 24 discrete periods during the year. The periods are identified in MM.DD format. The year type has been established by the naming of 6 year types, wet, above normal, normal, below normal, dry and critical. Switch UI 3.50 directs the monthly sequence of the supplemental release year. For instance, if the schedule

[2] The "shared responsibility" assumption is presented for the purpose of evaluating alternative operations. The assumption shall not be used as evidence in any proceeding relating to and shall not act as precedence for any allocation of Tuolumne River water between CCSF and the Districts for any purpose under the Fourth Agreement.

is to be established for a year beginning February 1 of the year, UI 3.50 would be set to “Feb”. The applicable year type schedule would be applied beginning February 1 of the year and continue through January 31 of the following year. Switch UI 3.50 can be set to any month February (Feb) through June (Jun). The Test Case supplemental release schedule is illustrated in this section for information purposes.

### 5.1.5 Section 4: San Joaquin Pipeline Diversions of City and County of San Francisco

This section (Figure 5.1-6) provides an entry for the diversions of the CCSF System to the San Joaquin Pipeline. Switch UI 4.10 directs the use of Test Case diversions (UI 4.10 = 0), or user-specified diversions (UI 4.10 = 1). If Test Case diversions are directed, a pre-processed time series of diversions is used. If directed to use user-specified diversions, the matrix table shown at UI 4.20 requires input values for each month of each simulation year, beginning October 1970 (water year 1971) through September 2009. Values are entered as monthly volumes (acre-feet), which will be parsed by the Model into an equal daily distribution each month.

**Section 2 - Alternative Modesto and Turlock Canal Diversions**

These tables are used to enter user-specified canal diversions for Modesto ID and Turlock ID. Enter a value for each month of each year.
The monthly volumes of canal diversions are distributed daily within a month based on the daily distribution used for the Base case.

(UI 2.10) Turn alterantive canal diversion on: 0 *(1) on, and use table below, or (0) off, use Test Case canal diversion*

(UI 2.20)

Alternative MID Canal Diversion

Enter values in acre-feet

| Prelim Relicense Yr-Type | WY | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Total WY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N | 1971 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 30,656 | 42,917 | 47,253 | 54,987 | 49,086 | 32,192 | 305,589 |
| BN | 1972 | 20,952 | 5,130 | 2,500 | 4,300 | 5,679 | 24,844 | 46,800 | 46,544 | 46,542 | 54,987 | 49,086 | 30,637 | 338,001 |
| N | 1973 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 23,737 | 45,374 | 47,016 | 54,987 | 49,086 | 32,658 | 301,356 |
| AN | 1974 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 18,115 | 42,917 | 45,239 | 49,733 | 49,086 | 32,658 | 286,246 |
| AN | 1975 | 20,952 | 5,460 | 2,500 | 4,300 | 3,300 | 14,746 | 28,782 | 44,672 | 47,253 | 54,859 | 43,423 | 32,658 | 302,906 |
| C | 1976 | 20,952 | 6,451 | 2,500 | 4,300 | 6,350 | 30,232 | 34,676 | 38,540 | 38,163 | 44,939 | 35,682 | 24,524 | 287,308 |
| C | 1977 | 14,568 | 5,081 | 2,500 | 4,300 | 6,379 | 17,127 | 30,279 | 23,572 | 28,282 | 33,405 | 30,961 | 19,432 | 215,886 |
| W | 1978 | 10,761 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 10,143 | 39,642 | 47,253 | 54,987 | 49,086 | 25,506 | 264,924 |
| N | 1979 | 23,490 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 27,340 | 45,140 | 47,253 | 53,962 | 49,086 | 32,658 | 306,475 |
| W | 1980 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 24,602 | 43,034 | 47,253 | 50,758 | 49,086 | 32,658 | 295,889 |
| D | 1981 | 23,236 | 7,441 | 2,500 | 4,300 | 3,300 | 14,746 | 33,395 | 45,608 | 47,253 | 54,987 | 49,086 | 32,658 | 318,510 |
| W | 1982 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 12,687 | 42,917 | 45,476 | 54,987 | 49,086 | 17,265 | 270,916 |
| W | 1983 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 11,058 | 40,110 | 47,253 | 54,987 | 47,529 | 15,866 | 265,301 |
| AN | 1984 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 37,719 | 46,777 | 47,253 | 54,859 | 49,086 | 32,502 | 316,695 |
| BN | 1985 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 33,106 | 46,193 | 45,950 | 54,987 | 49,086 | 31,881 | 309,700 |
| W | 1986 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 19,701 | 42,215 | 47,253 | 54,987 | 49,086 | 32,192 | 293,932 |
| C | 1987 | 20,952 | 7,441 | 2,500 | 4,300 | 3,300 | 11,348 | 33,450 | 38,540 | 38,264 | 45,048 | 40,977 | 26,903 | 273,023 |
| C | 1988 | 14,568 | 5,081 | 2,500 | 4,300 | 3,300 | 10,522 | 20,959 | 28,485 | 29,064 | 35,631 | 32,822 | 21,807 | 209,039 |
| BN | 1989 | 13,109 | 2,700 | 2,500 | 4,300 | 5,631 | 11,348 | 37,004 | 38,341 | 38,264 | 45,048 | 40,375 | 15,537 | 254,156 |
| D | 1990 | 14,568 | 5,361 | 2,500 | 4,300 | 5,590 | 15,190 | 29,936 | 21,644 | 29,236 | 34,588 | 31,919 | 20,952 | 215,784 |
| BN | 1991 | 11,125 | 6,242 | 2,500 | 4,300 | 5,812 | 10,324 | 26,779 | 32,222 | 30,198 | 37,899 | 33,900 | 23,035 | 224,335 |
| C | 1992 | 12,215 | 6,407 | 2,500 | 4,300 | 3,300 | 9,811 | 16,590 | 29,752 | 29,193 | 35,255 | 32,639 | 21,693 | 203,656 |
| AN | 1993 | 11,399 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 23,160 | 36,951 | 44,528 | 54,987 | 49,086 | 32,658 | 280,315 |
| D | 1994 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 17,718 | 28,427 | 26,707 | 38,264 | 45,048 | 40,977 | 26,639 | 257,531 |
| W | 1995 | 14,568 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 15,953 | 32,974 | 43,936 | 54,987 | 49,086 | 32,658 | 271,707 |
| AN | 1996 | 23,490 | 7,441 | 2,500 | 4,300 | 3,300 | 14,746 | 24,746 | 30,868 | 47,134 | 54,987 | 49,086 | 32,658 | 295,257 |
| W | 1997 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 45,935 | 45,491 | 46,542 | 54,987 | 49,086 | 32,658 | 323,197 |
| W | 1998 | 21,967 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 20,421 | 19,404 | 43,462 | 54,987 | 49,086 | 32,502 | 269,376 |
| AN | 1999 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 31,232 | 43,619 | 47,134 | 54,987 | 49,086 | 32,347 | 306,904 |
| N | 2000 | 23,236 | 6,781 | 2,500 | 4,300 | 3,300 | 14,746 | 19,989 | 29,347 | 38,722 | 54,987 | 49,086 | 32,192 | 279,187 |
| BN | 2001 | 20,952 | 5,790 | 2,500 | 4,300 | 3,300 | 14,746 | 21,863 | 44,204 | 46,898 | 54,987 | 49,086 | 31,414 | 300,040 |
| N | 2002 | 21,713 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 36,133 | 45,959 | 47,253 | 54,987 | 49,086 | 32,658 | 315,335 |
| N | 2003 | 23,490 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 27,196 | 44,087 | 47,253 | 54,987 | 47,670 | 32,658 | 304,888 |
| BN | 2004 | 23,490 | 6,781 | 2,500 | 4,300 | 5,959 | 25,777 | 51,269 | 46,777 | 47,253 | 54,987 | 49,086 | 32,192 | 350,369 |
| W | 2005 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 36,422 | 46,193 | 47,134 | 54,987 | 49,086 | 30,792 | 313,112 |
| W | 2006 | 22,982 | 6,121 | 2,500 | 4,300 | 3,300 | 14,746 | 13,115 | 41,747 | 47,253 | 54,987 | 49,086 | 32,502 | 292,640 |
| D | 2007 | 20,952 | 2,700 | 2,500 | 4,300 | 5,672 | 22,068 | 36,391 | 38,142 | 38,264 | 45,048 | 40,977 | 25,317 | 282,330 |
| BN | 2008 | 14,568 | 5,923 | 2,500 | 4,300 | 3,300 | 11,348 | 31,368 | 38,540 | 38,264 | 45,048 | 40,977 | 26,903 | 263,037 |
| N | 2009 | 14,568 | 5,361 | 2,500 | 4,300 | 3,300 | 14,746 | 47,088 | 44,204 | 46,661 | 54,987 | 49,086 | 31,259 | 318,060 |
| | Ave | 19,262 | 4,197 | 2,500 | 4,300 | 3,830 | 15,412 | 28,160 | 38,984 | 42,875 | 50,662 | 45,333 | 28,663 | 284,177 |

Test Case MID Canal Diversion

Values in acre-feet

| WY | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Total WY | Full Dem Total WY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1971 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 30,656 | 42,917 | 47,253 | 54,987 | 49,086 | 32,192 | 305,589 | 305,589 |
| 1972 | 20,952 | 5,130 | 2,500 | 4,300 | 5,679 | 24,844 | 46,800 | 46,544 | 46,542 | 54,987 | 49,086 | 30,637 | 338,001 | 338,001 |
| 1973 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 23,737 | 45,374 | 47,016 | 54,987 | 49,086 | 32,658 | 301,356 | 301,356 |
| 1974 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 18,115 | 42,917 | 45,239 | 49,733 | 49,086 | 32,658 | 286,246 | 286,246 |
| 1975 | 20,952 | 5,460 | 2,500 | 4,300 | 3,300 | 14,746 | 28,782 | 44,672 | 47,253 | 54,859 | 43,423 | 32,658 | 302,906 | 302,906 |
| 1976 | 20,952 | 6,451 | 2,500 | 4,300 | 6,350 | 30,232 | 34,676 | 38,540 | 38,163 | 44,939 | 35,682 | 24,524 | 287,308 | 324,478 |
| 1977 | 14,568 | 5,081 | 2,500 | 4,300 | 6,379 | 17,127 | 30,279 | 23,572 | 28,282 | 33,405 | 30,961 | 19,432 | 215,886 | 316,195 |
| 1978 | 10,761 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 10,143 | 39,642 | 47,253 | 54,987 | 49,086 | 25,506 | 264,924 | 271,015 |
| 1979 | 23,490 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 27,340 | 45,140 | 47,253 | 53,962 | 49,086 | 32,658 | 306,475 | 306,475 |
| 1980 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 24,602 | 43,034 | 47,253 | 50,758 | 49,086 | 32,658 | 295,889 | 295,889 |
| 1981 | 23,236 | 7,441 | 2,500 | 4,300 | 3,300 | 14,746 | 33,395 | 45,608 | 47,253 | 54,987 | 49,086 | 32,658 | 318,510 | 318,510 |
| 1982 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 12,687 | 42,917 | 45,476 | 54,987 | 49,086 | 17,265 | 270,916 | 270,916 |
| 1983 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 11,058 | 40,110 | 47,253 | 54,987 | 47,529 | 15,866 | 265,301 | 265,301 |
| 1984 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 37,719 | 46,777 | 47,253 | 54,859 | 49,086 | 32,502 | 316,695 | 316,695 |
| 1985 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 33,106 | 46,193 | 45,950 | 54,987 | 49,086 | 31,881 | 309,700 | 309,700 |
| 1986 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 19,701 | 42,215 | 47,253 | 54,987 | 49,086 | 32,192 | 293,932 | 293,932 |
| 1987 | 20,952 | 7,441 | 2,500 | 4,300 | 3,300 | 11,348 | 33,450 | 38,540 | 38,264 | 45,048 | 40,977 | 26,903 | 273,023 | 307,868 |
| 1988 | 14,568 | 5,081 | 2,500 | 4,300 | 3,300 | 10,522 | 20,959 | 28,485 | 29,064 | 35,631 | 32,822 | 21,807 | 209,039 | 288,428 |
| 1989 | 13,109 | 2,700 | 2,500 | 4,300 | 5,631 | 11,348 | 37,004 | 38,341 | 38,264 | 45,048 | 40,375 | 15,537 | 254,156 | 293,803 |
| 1990 | 14,568 | 5,361 | 2,500 | 4,300 | 5,590 | 15,190 | 29,936 | 21,644 | 29,236 | 34,588 | 31,919 | 20,952 | 215,784 | 304,883 |
| 1991 | 11,125 | 6,242 | 2,500 | 4,300 | 5,812 | 10,324 | 26,779 | 32,222 | 30,198 | 37,899 | 33,900 | 23,035 | 224,335 | 299,335 |
| 1992 | 12,215 | 6,407 | 2,500 | 4,300 | 3,300 | 9,811 | 16,590 | 29,752 | 29,193 | 35,255 | 32,639 | 21,693 | 203,656 | 285,286 |
| 1993 | 11,399 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 23,160 | 36,951 | 44,528 | 54,987 | 49,086 | 32,658 | 280,315 | 285,768 |
| 1994 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 17,718 | 28,427 | 26,707 | 38,264 | 45,048 | 40,977 | 26,639 | 257,531 | 287,956 |
| 1995 | 14,568 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 15,953 | 32,974 | 43,936 | 54,987 | 49,086 | 32,658 | 271,707 | 273,991 |
| 1996 | 23,490 | 7,441 | 2,500 | 4,300 | 3,300 | 14,746 | 24,746 | 30,868 | 47,134 | 54,987 | 49,086 | 32,658 | 295,257 | 295,257 |
| 1997 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 45,935 | 45,491 | 46,542 | 54,987 | 49,086 | 32,658 | 323,197 | 323,197 |
| 1998 | 21,967 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 20,421 | 19,404 | 43,462 | 54,987 | 49,086 | 32,502 | 269,376 | 269,376 |
| 1999 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 31,232 | 43,619 | 47,134 | 54,987 | 49,086 | 32,347 | 306,904 | 306,904 |
| 2000 | 23,236 | 6,781 | 2,500 | 4,300 | 3,300 | 14,746 | 19,989 | 29,347 | 38,722 | 54,987 | 49,086 | 32,192 | 279,187 | 279,187 |
| 2001 | 20,952 | 5,790 | 2,500 | 4,300 | 3,300 | 14,746 | 21,863 | 44,204 | 46,898 | 54,987 | 49,086 | 31,414 | 300,040 | 300,040 |
| 2002 | 21,713 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 36,133 | 45,959 | 47,253 | 54,987 | 49,086 | 32,658 | 315,335 | 315,335 |
| 2003 | 23,490 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 27,196 | 44,087 | 47,253 | 54,987 | 47,670 | 32,658 | 304,888 | 304,888 |
| 2004 | 23,490 | 6,781 | 2,500 | 4,300 | 5,959 | 25,777 | 51,269 | 46,777 | 47,253 | 54,987 | 49,086 | 32,192 | 350,369 | 350,369 |
| 2005 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 36,422 | 46,193 | 47,134 | 54,987 | 49,086 | 30,792 | 313,112 | 313,112 |
| 2006 | 22,982 | 6,121 | 2,500 | 4,300 | 3,300 | 14,746 | 13,115 | 41,747 | 47,253 | 54,987 | 49,086 | 32,502 | 292,640 | 292,640 |
| 2007 | 20,952 | 2,700 | 2,500 | 4,300 | 5,672 | 22,068 | 36,391 | 38,142 | 38,264 | 45,048 | 40,977 | 25,317 | 282,330 | 315,945 |
| 2008 | 14,568 | 5,923 | 2,500 | 4,300 | 3,300 | 11,348 | 31,368 | 38,540 | 38,264 | 45,048 | 40,977 | 26,903 | 263,037 | 299,996 |
| 2009 | 14,568 | 5,361 | 2,500 | 4,300 | 3,300 | 14,746 | 47,088 | 44,204 | 46,661 | 54,987 | 49,086 | 31,259 | 318,060 | 320,443 |
| Ave | 19,262 | 4,197 | 2,500 | 4,300 | 3,830 | 15,412 | 28,160 | 38,984 | 42,875 | 50,662 | 45,333 | 28,663 | 284,177 | 300,954 |

**Figure 5.1-3. Canal Diversions of Modesto Irrigation District.**

Alternative TID Canal Diversion

Enter values in acre-feet

| | Prelim Relicense Yr-Type | WY | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Total WY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (UI 2.30) | N | 1971 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 71,385 | 79,506 | 96,454 | 118,397 | 101,372 | 51,350 | 608,171 |
| | BN | 1972 | 31,487 | 4,120 | 1,000 | 6,000 | 12,542 | 70,210 | 104,879 | 92,357 | 95,639 | 118,397 | 101,372 | 50,168 | 688,170 |
| | N | 1973 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 44,833 | 89,056 | 96,105 | 118,397 | 101,372 | 52,681 | 592,149 |
| | AN | 1974 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 39,626 | 82,689 | 92,845 | 106,930 | 101,372 | 52,681 | 565,851 |
| | AN | 1975 | 31,487 | 4,761 | 1,000 | 6,000 | 8,000 | 42,220 | 59,410 | 85,755 | 96,454 | 117,430 | 92,559 | 52,681 | 597,756 |
| | C | 1976 | 31,487 | 6,684 | 1,000 | 6,000 | 13,169 | 81,414 | 79,704 | 77,553 | 79,063 | 97,737 | 72,955 | 32,004 | 578,770 |
| | C | 1977 | 20,773 | 1,000 | 1,000 | 6,000 | 13,371 | 50,509 | 72,025 | 45,645 | 54,416 | 68,098 | 57,243 | 26,675 | 416,755 |
| | W | 1978 | 11,340 | 4,569 | 1,000 | 6,000 | 8,000 | 42,220 | 9,548 | 72,786 | 96,454 | 118,397 | 101,372 | 37,013 | 508,698 |
| | N | 1979 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 53,683 | 87,405 | 96,454 | 115,219 | 101,372 | 52,681 | 596,521 |
| | W | 1980 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 49,345 | 81,864 | 96,454 | 112,318 | 101,372 | 52,681 | 583,741 |
| | D | 1981 | 31,487 | 7,966 | 1,000 | 6,000 | 11,130 | 42,220 | 78,153 | 90,235 | 96,454 | 118,397 | 101,372 | 52,681 | 637,093 |
| | W | 1982 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 18,801 | 79,506 | 93,427 | 118,397 | 101,372 | 26,075 | 527,285 |
| | W | 1983 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 14,289 | 73,376 | 96,454 | 118,397 | 97,046 | 25,780 | 515,047 |
| | AN | 1984 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 89,260 | 92,475 | 95,173 | 118,120 | 101,372 | 51,794 | 637,901 |
| | BN | 1985 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 80,930 | 92,003 | 92,845 | 118,397 | 101,372 | 51,942 | 627,195 |
| | W | 1986 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 36,155 | 80,567 | 96,454 | 118,397 | 101,372 | 50,168 | 572,820 |
| | C | 1987 | 31,487 | 7,645 | 1,000 | 6,000 | 11,080 | 37,117 | 80,884 | 77,453 | 79,756 | 97,972 | 82,761 | 40,798 | 553,954 |
| | C | 1988 | 20,773 | 4,345 | 1,000 | 6,000 | 8,000 | 34,416 | 44,841 | 54,744 | 59,435 | 73,648 | 61,984 | 30,238 | 399,424 |
| | BN | 1989 | 13,087 | 1,000 | 1,000 | 6,000 | 11,360 | 37,117 | 89,292 | 76,551 | 79,756 | 97,972 | 80,991 | 19,063 | 513,190 |
| | D | 1990 | 20,773 | 4,889 | 1,000 | 6,000 | 11,491 | 42,592 | 67,733 | 41,090 | 58,355 | 70,954 | 59,683 | 28,700 | 413,261 |
| | BN | 1991 | 12,239 | 5,799 | 1,000 | 6,000 | 12,548 | 33,362 | 63,975 | 63,689 | 62,376 | 79,506 | 64,759 | 32,781 | 438,033 |
| | C | 1992 | 14,931 | 5,806 | 1,000 | 6,000 | 8,000 | 31,457 | 37,881 | 58,023 | 58,785 | 71,771 | 61,517 | 30,001 | 385,173 |
| | AN | 1993 | 12,915 | 5,034 | 1,000 | 6,000 | 8,000 | 42,220 | 43,271 | 70,428 | 88,770 | 118,397 | 101,372 | 52,681 | 550,087 |
| | D | 1994 | 31,487 | 4,441 | 1,000 | 6,000 | 8,000 | 42,220 | 67,460 | 54,104 | 79,756 | 97,972 | 82,761 | 39,040 | 514,241 |
| | W | 1995 | 20,773 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 25,049 | 58,874 | 87,023 | 118,120 | 101,372 | 52,681 | 522,113 |
| | AN | 1996 | 31,487 | 7,966 | 1,000 | 6,000 | 8,000 | 42,220 | 46,047 | 59,228 | 96,454 | 118,397 | 101,372 | 52,681 | 570,851 |
| | W | 1997 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 107,135 | 91,532 | 95,173 | 118,397 | 101,372 | 52,089 | 655,405 |
| | W | 1998 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 31,470 | 38,950 | 81,784 | 118,397 | 101,372 | 52,681 | 514,360 |
| | AN | 1999 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 75,897 | 88,702 | 96,454 | 118,397 | 101,372 | 52,681 | 623,209 |
| | N | 2000 | 31,487 | 5,723 | 1,000 | 6,000 | 8,000 | 42,220 | 36,503 | 56,634 | 83,065 | 118,397 | 101,372 | 52,681 | 543,081 |
| | BN | 2001 | 31,487 | 4,761 | 1,000 | 6,000 | 8,000 | 42,220 | 49,518 | 83,515 | 96,105 | 118,397 | 101,372 | 50,168 | 592,542 |
| | N | 2002 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 84,748 | 81,510 | 96,454 | 118,397 | 101,372 | 52,681 | 624,868 |
| | N | 2003 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 66,179 | 82,454 | 96,454 | 118,397 | 99,129 | 52,681 | 604,999 |
| | BN | 2004 | 31,487 | 6,363 | 1,000 | 6,000 | 8,000 | 42,220 | 111,474 | 89,763 | 91,215 | 112,042 | 96,725 | 52,681 | 648,970 |
| | W | 2005 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 54,725 | 81,275 | 96,454 | 118,397 | 100,731 | 48,099 | 589,386 |
| | W | 2006 | 31,487 | 6,363 | 1,000 | 6,000 | 8,000 | 42,220 | 29,387 | 71,607 | 96,454 | 118,397 | 101,372 | 52,681 | 564,968 |
| | D | 2007 | 31,487 | 1,000 | 1,000 | 6,000 | 12,448 | 70,365 | 85,162 | 76,852 | 79,756 | 97,972 | 82,761 | 36,904 | 581,706 |
| | BN | 2008 | 20,773 | 5,707 | 1,000 | 6,000 | 8,000 | 37,117 | 76,901 | 76,952 | 79,756 | 97,972 | 82,761 | 40,798 | 533,738 |
| | N | 2009 | 20,773 | 4,617 | 1,000 | 6,000 | 8,000 | 42,220 | 103,144 | 85,047 | 95,522 | 118,397 | 101,372 | 50,611 | 636,704 |
| | | Ave | 27,456 | 3,271 | 1,000 | 6,000 | 8,952 | 43,791 | 61,044 | 74,917 | 87,340 | 108,669 | 92,511 | 44,747 | 559,697 |

Test Case TID Canal Diversion

Values in acre-feet

| WY | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Total WY | Full Dem Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1971 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 71,385 | 79,506 | 96,454 | 118,397 | 101,372 | 51,350 | 608,171 | 608,171 |
| 1972 | 31,487 | 4,120 | 1,000 | 6,000 | 12,542 | 70,210 | 104,879 | 92,357 | 95,639 | 118,397 | 101,372 | 50,168 | 688,170 | 688,170 |
| 1973 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 44,833 | 89,056 | 96,105 | 118,397 | 101,372 | 52,681 | 592,149 | 592,149 |
| 1974 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 39,626 | 82,689 | 92,845 | 106,930 | 101,372 | 52,681 | 565,851 | 565,851 |
| 1975 | 31,487 | 4,761 | 1,000 | 6,000 | 8,000 | 42,220 | 59,410 | 85,755 | 96,454 | 117,430 | 92,559 | 52,681 | 597,756 | 597,756 |
| 1976 | 31,487 | 6,684 | 1,000 | 6,000 | 13,169 | 81,414 | 79,704 | 77,553 | 79,063 | 97,737 | 72,955 | 32,004 | 578,770 | 669,740 |
| 1977 | 20,773 | 1,000 | 1,000 | 6,000 | 13,371 | 50,509 | 72,025 | 45,645 | 54,416 | 68,098 | 57,243 | 26,675 | 416,755 | 669,171 |
| 1978 | 11,340 | 4,569 | 1,000 | 6,000 | 8,000 | 42,220 | 9,548 | 72,786 | 96,454 | 118,397 | 101,372 | 37,013 | 508,698 | 524,472 |
| 1979 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 53,683 | 87,405 | 96,454 | 115,219 | 101,372 | 52,681 | 596,521 | 596,521 |
| 1980 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 49,345 | 81,864 | 96,454 | 112,318 | 101,372 | 52,681 | 583,741 | 583,741 |
| 1981 | 31,487 | 7,966 | 1,000 | 6,000 | 11,130 | 42,220 | 78,153 | 90,235 | 96,454 | 118,397 | 101,372 | 52,681 | 637,093 | 637,093 |
| 1982 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 18,801 | 79,506 | 93,427 | 118,397 | 101,372 | 26,075 | 527,285 | 527,285 |
| 1983 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 14,289 | 73,376 | 96,454 | 118,397 | 97,046 | 25,780 | 515,047 | 515,047 |
| 1984 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 89,260 | 92,475 | 95,173 | 118,120 | 101,372 | 51,794 | 637,901 | 637,901 |
| 1985 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 80,930 | 92,003 | 92,845 | 118,397 | 101,372 | 51,942 | 627,195 | 627,195 |
| 1986 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 36,155 | 80,567 | 96,454 | 118,397 | 101,372 | 50,168 | 572,820 | 572,820 |
| 1987 | 31,487 | 7,645 | 1,000 | 6,000 | 11,080 | 37,117 | 80,884 | 77,453 | 79,756 | 97,972 | 82,761 | 40,798 | 553,954 | 640,376 |
| 1988 | 20,773 | 4,345 | 1,000 | 6,000 | 8,000 | 34,416 | 44,841 | 54,744 | 59,435 | 73,648 | 61,984 | 30,238 | 399,424 | 595,199 |
| 1989 | 13,087 | 1,000 | 1,000 | 6,000 | 11,360 | 37,117 | 89,292 | 76,551 | 79,756 | 97,972 | 80,991 | 19,063 | 513,190 | 610,352 |
| 1990 | 20,773 | 4,889 | 1,000 | 6,000 | 11,491 | 42,592 | 67,733 | 41,090 | 58,355 | 70,954 | 59,683 | 28,700 | 413,261 | 632,968 |
| 1991 | 12,239 | 5,799 | 1,000 | 6,000 | 12,548 | 33,362 | 63,975 | 63,689 | 62,376 | 79,506 | 64,759 | 32,781 | 438,033 | 624,153 |
| 1992 | 14,931 | 5,806 | 1,000 | 6,000 | 8,000 | 31,457 | 37,881 | 58,023 | 58,785 | 71,771 | 61,517 | 30,001 | 385,173 | 586,401 |
| 1993 | 12,915 | 5,034 | 1,000 | 6,000 | 8,000 | 42,220 | 43,271 | 70,428 | 88,770 | 118,397 | 101,372 | 52,681 | 550,087 | 564,462 |
| 1994 | 31,487 | 4,441 | 1,000 | 6,000 | 8,000 | 42,220 | 67,460 | 54,104 | 79,756 | 97,972 | 82,761 | 39,040 | 514,241 | 588,710 |
| 1995 | 20,773 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 25,049 | 58,874 | 87,023 | 118,120 | 101,372 | 52,681 | 522,113 | 527,941 |
| 1996 | 31,487 | 7,966 | 1,000 | 6,000 | 8,000 | 42,220 | 46,047 | 59,228 | 96,454 | 118,397 | 101,372 | 52,681 | 570,851 | 570,851 |
| 1997 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 107,135 | 91,532 | 95,173 | 118,397 | 101,372 | 52,089 | 655,405 | 655,405 |
| 1998 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 31,470 | 38,950 | 81,784 | 118,397 | 101,372 | 52,681 | 514,360 | 514,360 |
| 1999 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 75,897 | 88,702 | 96,454 | 118,397 | 101,372 | 52,681 | 623,209 | 623,209 |
| 2000 | 31,487 | 5,723 | 1,000 | 6,000 | 8,000 | 42,220 | 36,503 | 56,634 | 83,065 | 118,397 | 101,372 | 52,681 | 543,081 | 543,081 |
| 2001 | 31,487 | 4,761 | 1,000 | 6,000 | 8,000 | 42,220 | 49,518 | 83,515 | 96,105 | 118,397 | 101,372 | 50,168 | 592,542 | 592,542 |
| 2002 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 84,748 | 81,510 | 96,454 | 118,397 | 101,372 | 52,681 | 624,868 | 624,868 |
| 2003 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 66,179 | 82,454 | 96,454 | 118,397 | 99,129 | 52,681 | 604,999 | 604,999 |
| 2004 | 31,487 | 6,363 | 1,000 | 6,000 | 8,000 | 42,220 | 111,474 | 89,763 | 91,215 | 112,042 | 96,725 | 52,681 | 648,970 | 648,970 |
| 2005 | 31,487 | 1,000 | 1,000 | 6,000 | 8,000 | 42,220 | 54,725 | 81,275 | 96,454 | 118,397 | 100,731 | 48,099 | 589,386 | 589,386 |
| 2006 | 31,487 | 6,363 | 1,000 | 6,000 | 8,000 | 42,220 | 29,387 | 71,607 | 96,454 | 118,397 | 101,372 | 52,681 | 564,968 | 564,968 |
| 2007 | 31,487 | 1,000 | 1,000 | 6,000 | 12,448 | 70,365 | 85,162 | 76,852 | 79,756 | 97,972 | 82,761 | 36,904 | 581,706 | 662,937 |
| 2008 | 20,773 | 5,707 | 1,000 | 6,000 | 8,000 | 37,117 | 76,901 | 76,952 | 79,756 | 97,972 | 82,761 | 40,798 | 533,738 | 625,483 |
| 2009 | 20,773 | 4,617 | 1,000 | 6,000 | 8,000 | 42,220 | 103,144 | 85,047 | 95,522 | 118,397 | 101,372 | 50,611 | 636,704 | 642,676 |
| Ave | 27,456 | 3,271 | 1,000 | 6,000 | 8,952 | 43,791 | 61,044 | 74,917 | 87,340 | 108,669 | 92,511 | 44,747 | 559,697 | 601,215 |

**Figure 5.1-4. Canal Diversions of Turlock Irrigation District.**

**Section 3 - Supplemental Release from CCSF Upstream Reservoirs**

This table is used to enter a user-specified supplemental release from CCSF upstream reservoirs. Twenty-four time periods are available to define the period and flow rate. Six different water year types can be established.
The year types correspond to the Preliminary Relicensing Year Type which is based on Tuolumne River unimpaired flow.
The supplemental release will be directed to Lake Lloyd until the reservoir storage reaches a defined limit, then the supplemental release is directed to Hetch Hetchy Reservoir.
User specifies whether or not Table supplemental releases are added to Test Case supplemental releases.
Alternatively, user can define a daily supplemental release from CCSF facilities. This option is the same method used to define Test Base supplemental releases to maintain the Water Bank Balance at or above zero. (Suggested method)

(UI 3.10) Use daily supplemental release option: 1 *(1) on, use daily defined option - go to worksheet WaterBankRel, or (0) off, use other supplemental release options*

If using other supplement release options, Switch UI 3.10 = 0, enter choices below.

(UI 3.20) Turn other user-specified supplemental releases on: 0 *(1) on, and use table below, or (0) off, use existing Test Case supplemental releases* N/A

(UI 3.30) If using table below, add to existing supplemental releases: 1 *(1) yes, add table to existing releases, or (0) no use table only*

Alternative Supplemental Releases

Enter values in acre-feet per day

(UI 3.40)

| CYMo Day | W | AN | N | BN | D | C |
|---|---|---|---|---|---|---|
| MM.DD | 1 | 2 | 3 | 4 | 5 | 6 |
| 1.01 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1.16 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2.01 | 0 | 0 | 0 | 0 | 2,000 | 2,000 |
| 2.15 | 0 | 0 | 0 | 0 | 2,000 | 2,000 |
| 3.01 | 0 | 0 | 0 | 0 | 2,000 | 2,000 |
| 3.16 | 0 | 0 | 0 | 0 | 2,000 | 2,000 |
| 4.01 | 0 | 0 | 0 | 0 | 2,000 | 2,000 |
| 4.16 | 0 | 0 | 0 | 0 | 2,000 | 2,000 |
| 5.01 | 0 | 0 | 0 | 0 | 2,000 | 2,000 |
| 5.16 | 0 | 0 | 0 | 0 | 2,000 | 2,000 |
| 6.01 | 0 | 0 | 0 | 0 | 2,000 | 2,000 |
| 6.16 | 0 | 0 | 0 | 0 | 2,000 | 2,000 |
| 7.01 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7.16 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8.01 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8.16 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9.01 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9.16 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10.01 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10.16 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11.01 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11.16 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12.01 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12.16 | 0 | 0 | 0 | 0 | 0 | 0 |

Preliminary Relicensing Year Type is based on a rank-ordering of the water-year runoff for the years 1921-2011. Each water year type W, AN, N, and BN represent 20% of the years of ranking. D and C year types each represent 10% of the years.

(UI 3.50) Enter beginning month of annual supplemental release schedule:

| Feb-Jun |
|---|
| Jun |
| 6 |

Test Case Supplemental Releases (made to retain WB Balance above zero)

| Prelim Relicense Yr-Type | WY | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Monthly Acre-feet | | | | | | | | | | | | | |
| N | 1971 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BN | 1972 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N | 1973 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AN | 1974 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AN | 1975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| C | 1976 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| C | 1977 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| W | 1978 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N | 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| W | 1980 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| D | 1981 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| W | 1982 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| W | 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AN | 1984 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BN | 1985 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| W | 1986 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| C | 1987 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| C | 1988 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BN | 1989 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| D | 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BN | 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| C | 1992 | 0 | 0 | 0 | 0 | 0 | 0 | 59,864 | 70,684 | 19,366 | 21,794 | 0 | 0 | 171,708 |
| AN | 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| D | 1994 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| W | 1995 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AN | 1996 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| W | 1997 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| W | 1998 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AN | 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N | 2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BN | 2001 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N | 2002 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N | 2003 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BN | 2004 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| W | 2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| W | 2006 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| D | 2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BN | 2008 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N | 2009 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Values are associated with Test Case scenario and are equal to daily supplemental releases made from CCSF facilities to maintain the Water Bank Account Balance at or above zero. Values are shown for comparison purposes.

**Figure 5.1-5. Supplemental Releases of City and County of San Francisco.**

**Section 4 - Alternative CCSF San Joaquin Pipeline**

This section specifies the CCSF San Joaquin Pipeline diversion. Use Test Case diversions, or user-specified values by entering a value for each month of each year.
The monthly volumes of pipeline diversions will be distributed daily within a month equally.

(UI 4.10) Turn alterantive pipeline diversion on: 0 *(0) off, use Test Case pipeline diversion, (1) on, use table below*

(UI 4.20)

Alternative SJPL Diversion — Enter values in acre-feet

| Prelim Relicense Yr-Type | WY | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Total WY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N | 1971 | 19,027 | 11,969 | 6,660 | 6,660 | 6,015 | 25,782 | 24,950 | 25,782 | 24,950 | 29,778 | 29,778 | 23,937 | 235,286 |
| BN | 1972 | 21,881 | 16,572 | 12,368 | 17,124 | 15,467 | 25,782 | 25,779 | 25,782 | 24,950 | 29,778 | 29,778 | 24,950 | 270,211 |
| N | 1973 | 21,881 | 14,731 | 12,368 | 6,660 | 6,015 | 6,660 | 16,572 | 25,782 | 24,950 | 29,778 | 29,778 | 23,937 | 219,110 |
| AN | 1974 | 17,124 | 10,127 | 6,660 | 6,660 | 6,015 | 6,660 | 7,365 | 24,735 | 23,937 | 29,778 | 29,778 | 24,950 | 193,789 |
| AN | 1975 | 17,124 | 0 | 0 | 25,782 | 11,171 | 6,660 | 10,127 | 24,735 | 23,937 | 29,778 | 29,778 | 24,950 | 204,042 |
| C | 1976 | 17,124 | 13,810 | 12,368 | 19,027 | 17,186 | 25,782 | 26,699 | 25,782 | 24,950 | 29,778 | 29,778 | 24,950 | 267,234 |
| C | 1977 | 21,881 | 16,572 | 17,124 | 17,124 | 15,467 | 25,782 | 27,620 | 26,638 | 25,779 | 27,589 | 25,782 | 21,175 | 268,535 |
| W | 1978 | 19,027 | 16,572 | 12,368 | 6,660 | 6,015 | 6,660 | 9,023 | 22,833 | 22,096 | 29,778 | 29,778 | 23,937 | 204,745 |
| N | 1979 | 17,124 | 13,810 | 17,124 | 15,222 | 6,015 | 17,124 | 22,096 | 25,782 | 24,950 | 29,778 | 29,778 | 23,937 | 242,741 |
| W | 1980 | 17,124 | 0 | 0 | 14,270 | 6,015 | 6,660 | 19,334 | 25,782 | 24,950 | 29,778 | 29,778 | 23,937 | 197,628 |
| D | 1981 | 17,124 | 13,810 | 12,891 | 12,368 | 11,171 | 22,833 | 23,937 | 25,782 | 24,950 | 29,778 | 29,778 | 23,937 | 248,358 |
| W | 1982 | 17,124 | 11,969 | 9,323 | 6,660 | 6,015 | 6,660 | 6,445 | 19,979 | 19,334 | 29,778 | 29,778 | 26,239 | 189,302 |
| W | 1983 | 19,979 | 11,969 | 6,660 | 6,660 | 6,015 | 6,660 | 7,365 | 12,368 | 11,969 | 29,778 | 29,778 | 28,817 | 178,015 |
| AN | 1984 | 22,833 | 9,023 | 6,660 | 6,660 | 6,015 | 25,782 | 24,950 | 24,735 | 23,937 | 29,778 | 29,778 | 24,950 | 235,099 |
| BN | 1985 | 21,881 | 0 | 0 | 25,782 | 20,623 | 25,782 | 28,817 | 25,782 | 24,950 | 29,778 | 29,778 | 23,937 | 257,109 |
| W | 1986 | 21,881 | 18,413 | 12,368 | 19,027 | 6,015 | 6,660 | 14,731 | 25,782 | 24,950 | 29,778 | 29,778 | 23,937 | 233,319 |
| C | 1987 | 17,124 | 13,810 | 17,124 | 17,124 | 15,467 | 25,782 | 26,239 | 25,782 | 24,950 | 29,778 | 29,778 | 24,950 | 267,909 |
| C | 1988 | 21,881 | 16,572 | 12,368 | 19,027 | 17,186 | 25,782 | 27,620 | 25,782 | 24,950 | 27,589 | 26,638 | 21,175 | 266,571 |
| BN | 1989 | 19,027 | 16,572 | 15,222 | 15,222 | 13,749 | 25,782 | 23,937 | 22,833 | 22,096 | 28,541 | 25,782 | 21,175 | 249,937 |
| D | 1990 | 19,027 | 0 | 0 | 25,782 | 20,623 | 25,782 | 28,817 | 22,833 | 22,096 | 28,541 | 25,782 | 21,175 | 240,458 |
| BN | 1991 | 19,027 | 16,572 | 12,891 | 17,124 | 15,467 | 19,979 | 22,096 | 22,833 | 22,096 | 27,589 | 25,782 | 21,175 | 242,632 |
| C | 1992 | 19,027 | 16,572 | 15,222 | 15,222 | 6,015 | 21,881 | 21,175 | 22,833 | 22,096 | 27,589 | 25,782 | 21,175 | 234,590 |
| AN | 1993 | 19,027 | 16,572 | 12,368 | 6,660 | 6,015 | 6,660 | 16,572 | 21,881 | 21,175 | 29,778 | 29,778 | 24,950 | 211,435 |
| D | 1994 | 17,124 | 13,810 | 17,124 | 17,124 | 13,749 | 24,735 | 24,950 | 25,782 | 24,950 | 29,778 | 29,778 | 24,950 | 263,855 |
| W | 1995 | 19,979 | 0 | 0 | 12,368 | 6,874 | 6,660 | 13,810 | 22,833 | 22,096 | 29,778 | 29,778 | 24,950 | 189,124 |
| AN | 1996 | 17,124 | 13,810 | 12,891 | 6,660 | 6,015 | 6,660 | 18,413 | 24,735 | 23,937 | 29,778 | 29,778 | 24,950 | 214,751 |
| W | 1997 | 17,124 | 7,365 | 6,660 | 6,660 | 6,015 | 19,979 | 23,937 | 25,782 | 24,950 | 29,778 | 29,778 | 23,937 | 221,964 |
| W | 1998 | 21,881 | 11,969 | 12,368 | 6,660 | 6,015 | 6,660 | 6,445 | 19,979 | 19,334 | 29,778 | 29,778 | 24,950 | 195,814 |
| AN | 1999 | 17,124 | 13,810 | 15,222 | 14,270 | 6,015 | 12,368 | 13,810 | 24,735 | 23,937 | 29,778 | 29,778 | 23,937 | 224,785 |
| N | 2000 | 17,124 | 0 | 0 | 25,782 | 11,171 | 6,660 | 23,937 | 25,782 | 24,950 | 29,778 | 29,778 | 23,937 | 218,898 |
| BN | 2001 | 19,027 | 13,810 | 12,368 | 19,027 | 12,889 | 17,124 | 22,096 | 25,782 | 24,950 | 29,778 | 29,778 | 23,937 | 250,566 |
| N | 2002 | 17,124 | 13,810 | 9,323 | 15,222 | 13,749 | 24,735 | 23,937 | 25,782 | 24,950 | 29,778 | 29,778 | 24,950 | 253,138 |
| N | 2003 | 19,979 | 14,731 | 6,660 | 6,660 | 6,015 | 25,782 | 24,950 | 22,833 | 22,096 | 29,778 | 29,778 | 24,950 | 234,209 |
| BN | 2004 | 21,881 | 13,810 | 14,270 | 15,222 | 6,015 | 19,027 | 24,950 | 25,782 | 24,950 | 29,778 | 29,778 | 23,937 | 249,400 |
| W | 2005 | 19,979 | 0 | 0 | 12,368 | 6,874 | 6,660 | 13,810 | 24,735 | 23,937 | 29,778 | 29,778 | 24,950 | 192,868 |
| W | 2006 | 17,124 | 13,810 | 10,465 | 6,660 | 6,015 | 9,323 | 6,445 | 22,833 | 22,096 | 29,778 | 29,778 | 24,950 | 199,276 |
| D | 2007 | 19,027 | 13,810 | 15,222 | 17,124 | 15,467 | 24,735 | 23,937 | 25,782 | 24,950 | 29,778 | 29,778 | 24,950 | 264,561 |
| BN | 2008 | 21,881 | 16,572 | 12,368 | 9,323 | 6,015 | 21,881 | 23,937 | 25,782 | 24,950 | 29,778 | 29,778 | 24,950 | 247,215 |
| N | 2009 | 19,979 | 14,731 | 17,124 | 17,124 | 6,015 | 6,660 | 23,937 | 25,782 | 24,950 | 29,778 | 29,778 | 23,937 | 239,795 |
| | Ave | 19,174 | 11,586 | 10,056 | 13,763 | 9,761 | 16,390 | 19,886 | 24,296 | 23,512 | 29,490 | 29,185 | 24,138 | 231,238 |

Test Case SJPL Diversion — Values in acre-feet

| WY | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Total WY | CCSF Sys Action |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1971 | 19,027 | 11,969 | 6,660 | 6,660 | 6,015 | 25,782 | 24,950 | 25,782 | 24,950 | 29,778 | 29,778 | 23,937 | 235,286 | 0 |
| 1972 | 21,881 | 16,572 | 12,368 | 17,124 | 15,467 | 25,782 | 25,779 | 25,782 | 24,950 | 29,778 | 29,778 | 24,950 | 270,211 | 0 |
| 1973 | 21,881 | 14,731 | 12,368 | 6,660 | 6,015 | 6,660 | 16,572 | 25,782 | 24,950 | 29,778 | 29,778 | 23,937 | 219,110 | 0 |
| 1974 | 17,124 | 10,127 | 6,660 | 6,660 | 6,015 | 6,660 | 7,365 | 24,735 | 23,937 | 29,778 | 29,778 | 24,950 | 193,789 | 0 |
| 1975 | 17,124 | 0 | 0 | 25,782 | 11,171 | 6,660 | 10,127 | 24,735 | 23,937 | 29,778 | 29,778 | 24,950 | 204,042 | 0 |
| 1976 | 17,124 | 13,810 | 12,368 | 19,027 | 17,186 | 25,782 | 26,699 | 25,782 | 24,950 | 29,778 | 29,778 | 24,950 | 267,234 | 0 |
| 1977 | 21,881 | 16,572 | 17,124 | 17,124 | 15,467 | 25,782 | 27,620 | 26,638 | 25,779 | 27,589 | 25,782 | 21,175 | 268,535 | 1 |
| 1978 | 19,027 | 16,572 | 12,368 | 6,660 | 6,015 | 6,660 | 9,023 | 22,833 | 22,096 | 29,778 | 29,778 | 23,937 | 204,745 | 0 |
| 1979 | 17,124 | 13,810 | 17,124 | 15,222 | 6,015 | 17,124 | 22,096 | 25,782 | 24,950 | 29,778 | 29,778 | 23,937 | 242,741 | 0 |
| 1980 | 17,124 | 0 | 0 | 14,270 | 6,015 | 6,660 | 19,334 | 25,782 | 24,950 | 29,778 | 29,778 | 23,937 | 197,628 | 0 |
| 1981 | 17,124 | 13,810 | 12,891 | 12,368 | 11,171 | 22,833 | 23,937 | 25,782 | 24,950 | 29,778 | 29,778 | 23,937 | 248,358 | 0 |
| 1982 | 17,124 | 11,969 | 9,323 | 6,660 | 6,015 | 6,660 | 6,445 | 19,979 | 19,334 | 29,778 | 29,778 | 26,239 | 189,302 | 0 |
| 1983 | 19,979 | 11,969 | 6,660 | 6,660 | 6,015 | 6,660 | 7,365 | 12,368 | 11,969 | 29,778 | 29,778 | 28,817 | 178,015 | 0 |
| 1984 | 22,833 | 9,023 | 6,660 | 6,660 | 6,015 | 25,782 | 24,950 | 24,735 | 23,937 | 29,778 | 29,778 | 24,950 | 235,099 | 0 |
| 1985 | 21,881 | 0 | 0 | 25,782 | 20,623 | 25,782 | 28,817 | 25,782 | 24,950 | 29,778 | 29,778 | 23,937 | 257,109 | 0 |
| 1986 | 21,881 | 18,413 | 12,368 | 19,027 | 6,015 | 6,660 | 14,731 | 25,782 | 24,950 | 29,778 | 29,778 | 23,937 | 233,319 | 0 |
| 1987 | 17,124 | 13,810 | 17,124 | 17,124 | 15,467 | 25,782 | 26,239 | 25,782 | 24,950 | 29,778 | 29,778 | 24,950 | 267,909 | 0 |
| 1988 | 21,881 | 16,572 | 12,368 | 19,027 | 17,186 | 25,782 | 27,620 | 25,782 | 24,950 | 27,589 | 26,638 | 21,175 | 266,571 | 1 |
| 1989 | 19,027 | 16,572 | 15,222 | 15,222 | 13,749 | 25,782 | 23,937 | 22,833 | 22,096 | 28,541 | 25,782 | 21,175 | 249,937 | 1 |
| 1990 | 19,027 | 0 | 0 | 25,782 | 20,623 | 25,782 | 28,817 | 22,833 | 22,096 | 28,541 | 25,782 | 21,175 | 240,458 | 1 |
| 1991 | 19,027 | 16,572 | 12,891 | 17,124 | 15,467 | 19,979 | 22,096 | 22,833 | 22,096 | 27,589 | 25,782 | 21,175 | 242,632 | 1 |
| 1992 | 19,027 | 16,572 | 15,222 | 15,222 | 6,015 | 21,881 | 21,175 | 22,833 | 22,096 | 27,589 | 25,782 | 21,175 | 234,590 | 1 |
| 1993 | 19,027 | 16,572 | 12,368 | 6,660 | 6,015 | 6,660 | 16,572 | 21,881 | 21,175 | 29,778 | 29,778 | 24,950 | 211,435 | 0 |
| 1994 | 17,124 | 13,810 | 17,124 | 17,124 | 13,749 | 24,735 | 24,950 | 25,782 | 24,950 | 29,778 | 29,778 | 24,950 | 263,855 | 0 |
| 1995 | 19,979 | 0 | 0 | 12,368 | 6,874 | 6,660 | 13,810 | 22,833 | 22,096 | 29,778 | 29,778 | 24,950 | 189,124 | 0 |
| 1996 | 17,124 | 13,810 | 12,891 | 6,660 | 6,015 | 6,660 | 18,413 | 24,735 | 23,937 | 29,778 | 29,778 | 24,950 | 214,751 | 0 |
| 1997 | 17,124 | 7,365 | 6,660 | 6,660 | 6,015 | 19,979 | 23,937 | 25,782 | 24,950 | 29,778 | 29,778 | 23,937 | 221,964 | 0 |
| 1998 | 21,881 | 11,969 | 12,368 | 6,660 | 6,015 | 6,660 | 6,445 | 19,979 | 19,334 | 29,778 | 29,778 | 24,950 | 195,814 | 0 |
| 1999 | 17,124 | 13,810 | 15,222 | 14,270 | 6,015 | 12,368 | 13,810 | 24,735 | 23,937 | 29,778 | 29,778 | 23,937 | 224,785 | 0 |
| 2000 | 17,124 | 0 | 0 | 25,782 | 11,171 | 6,660 | 23,937 | 25,782 | 24,950 | 29,778 | 29,778 | 23,937 | 218,898 | 0 |
| 2001 | 19,027 | 13,810 | 12,368 | 19,027 | 12,889 | 17,124 | 22,096 | 25,782 | 24,950 | 29,778 | 29,778 | 23,937 | 250,566 | 0 |
| 2002 | 17,124 | 13,810 | 9,323 | 15,222 | 13,749 | 24,735 | 23,937 | 25,782 | 24,950 | 29,778 | 29,778 | 24,950 | 253,138 | 0 |
| 2003 | 19,979 | 14,731 | 6,660 | 6,660 | 6,015 | 25,782 | 24,950 | 22,833 | 22,096 | 29,778 | 29,778 | 24,950 | 234,209 | 0 |
| 2004 | 21,881 | 13,810 | 14,270 | 15,222 | 6,015 | 19,027 | 24,950 | 25,782 | 24,950 | 29,778 | 29,778 | 23,937 | 249,400 | 0 |
| 2005 | 19,979 | 0 | 0 | 12,368 | 6,874 | 6,660 | 13,810 | 24,735 | 23,937 | 29,778 | 29,778 | 24,950 | 192,868 | 0 |
| 2006 | 17,124 | 13,810 | 10,465 | 6,660 | 6,015 | 9,323 | 6,445 | 22,833 | 22,096 | 29,778 | 29,778 | 24,950 | 199,276 | 0 |
| 2007 | 19,027 | 13,810 | 15,222 | 17,124 | 15,467 | 24,735 | 23,937 | 25,782 | 24,950 | 29,778 | 29,778 | 24,950 | 264,561 | 0 |
| 2008 | 21,881 | 16,572 | 12,368 | 9,323 | 6,015 | 21,881 | 23,937 | 25,782 | 24,950 | 29,778 | 29,778 | 24,950 | 247,215 | 0 |
| 2009 | 19,979 | 14,731 | 17,124 | 17,124 | 6,015 | 6,660 | 23,937 | 25,782 | 24,950 | 29,778 | 29,778 | 23,937 | 239,795 | 0 |
| Ave | 19,174 | 11,586 | 10,056 | 13,763 | 9,761 | 16,390 | 19,886 | 24,296 | 23,512 | 29,490 | 29,185 | 24,138 | 231,238 | |

**Figure 5.1-6. San Joaquin Pipeline Diversions of City and County of San Francisco.**

## 5.2 WaterBankRel Worksheet

This worksheet (WaterBankRel) provides for entry of daily supplemental releases from the CCSF System. Without any other manual intervention the Model will direct releases from the CCSF System under a “hold-unless-need-to-release” protocol. Additional releases greater than provided by the default protocol may be needed. An example of such a need is during periods when CCSF System operations would otherwise deplete the Water Bank Account to a point of a “negative” balance.

The manual adjustment to releases from the CCSF System is provided to allow the user to “pull” additional water from the CCSF System as supplemental inflow to Don Pedro Reservoir. A single entry is established that will first pull water from Lake Lloyd so that water supply is preserved in the Hetch Hetchy Reservoir system for diversion to the SJPL. At a point when such supplemental releases strain Lake Lloyd storage, the supplemental releases are directed to Hetch Hetchy Reservoir. The supplemental release is directed from a reservoir at a point in logic after the default protocol releases occur. Thus, the release occurs in addition to what operation is already occurring by default. Such a release can affect the following day’s default operation or previous periods’ operations, thus results require review to determine if the user’s desired result occurs. This worksheet is employed when Switch UI 3.10 directs the use of this suggested method for defining daily supplemental releases (UI 3.10 = 1).

Shown in Figure 5.2-1 is a snapshot of the worksheet. The worksheet provides the daily accounting of the Water Bank Account Balance for the Model. Information ported from other worksheets of the Model into this worksheet is Don Pedro Reservoir inflow (Column E) and the unimpaired flow at La Grange (Column F). These data and the protocols associated with Fourth Agreement Water Bank Balance accounting (Columns G through Column O) derive the daily credit or debit of CCSF and then the daily balance of the Water Bank Account (Column M).

For purposes of the FERC investigation, the protocols of Fourth Agreement Water Bank Accounting have been amended to incorporate a hypothetical implementation of “shared responsibility” for incremental increases in FERC-required flows for the Tuolumne River. If running the option with shared responsibility has been selected (worksheet UserInput Switch UI 1.31 = 1), the incremental increase in FERC-required flows is determined by the daily difference between the current 1995 FERC Settlement requirements and scenario-required minimum flows. This computation occurs in worksheet LaGrangeSchedule with information regarding the scenario-required flows directed through worksheet UserInput. Approximately fifty-two percent (51.7121%) of the incremental difference between the flow schedules is assigned as CCSF’s responsibility and is ported into the worksheet in Column Q as a “debit”. This debit then enters the current protocols of Fourth Agreement Water Bank Accounting at Column J, and subsequently contributes to the determination of the daily Water Bank Account Balance (Column M).

Water Bank Account Balances which are less than zero (“negative”) are highlighted, and the minimum balance, whether negative or positive, is reported in Cell M14. When a negative balance occurs, the user is to enter into Column T (WB Supplemental Release) a volume of release needed to maintain the Water Bank Account Balance at, or greater than zero. The Model will first direct the supplemental release to Lake Lloyd, and continue releases until storage at Lake Lloyd is drawn to a specified 45,000 acre-feet minimum level (shown in Cell Q10 and entered at worksheet CCSF Switch 3.00). Subsequent supplemental releases will be drawn from Hetch Hetchy Reservoir any time storage is less than the Lake Lloyd minimum. The result of entering the supplemental release will cause a recalculation of the entire Model with results refreshed in the worksheet. Lake Lloyd, Hetch Hetchy Reservoir and Don Pedro Reservoir storage is ported from other worksheets to provide the status of their storage as supplemental releases are entered.

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 1 | | San Francisco Water Bank Account Balance Computation and Supplement Release | | | | | | | | | | | | | | | | | | | |
| 2 | Unit Title | | 2 | | CFS | CFS | CFS | CFS | CFS | AF | | AF | AF | | AF | | AF | | | AF | | | | |
| 3 | Parameter Title | | 3 | | DP Inflow | La Grange | Fourth Ag | Districts' E | SF Credit/ | SF Credit/Debit w/ C | | SF WB Eva | SF Water Bank Balan | | Max Water Bank Cap | | Credit Adj fc | | | SF Supplemental Release | | | | |
| 4 | | | | | | | | | | | | | | | | | Advice | | | | | | | |
| 5 | Acre-foot to CFS conversion | | | | From | From | | | | | | | | | | | | | | | | | | |
| 6 | divide by : | 1.983471 | | | DonPedro | Hydrology | | Warnings | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | (UI 1.31) | | | (UI 3.10) | Yes, this method is being used | | | |
| 10 | | | | | | | | | | | | | | | | | 0 | | | 1 | Min Lloyd Storage | | Min | Min |
| 11 | | | | | | | | | | | | | | | | | (0) N, (1) Y | | | | for WB | | 103,852 | 84,135 |
| 12 | | | | | | | | | | | | | | | | | - Debit | | | | Call (acre-feet) | | Min | Min |
| 13 | | | | | | | | | | | | Max | 740,000 | | | | + Credit | | | | 45,000 | | Non 76-77 | Non 76-77 |
| 14 | | | | | | | | | | | | Min | 0 | | | Sum: | 0 | | Sum: | 171,708 | 171,708 | 0 | 103,852 | 114,720 |
| 15 | | | | | SF Water Bank Account Balance Calculation | | | | | | | | | | | | La Grange | | | Supplemental Release and Storage Check | | | | |
| 16 | | | | | | | Fourth | Daily | SF | SF C/D | SF Gross | SF WB | SF Net | SF Share | SF Max | | Credit Adj | | | WB | 1st Call | 2nd Call | | |
| 17 | Month | | | | DP | La Grange | Agree | Districts' | Credit/ | w/ | WB | Evap | WB | RFlood | WB | WB | in SF | | | Supp | Lloyd | HH | Lloyd | HH |
| 18 | Index | Date | Day | Days | Inflow | UF | Check | Entitle | Debit | Credit Adj | Balance | Losses | Balance | DP | Balance | Neg Flag | WB | Mark | Mark | Release | Release | Release | Storage | Storage |
| 19 | | | | | CFS | CFS | CFS | CFS | CFS | AF | AF | AF | 570,000 | AF | AF | AF | AF | | | AF | AF | AF | AF | AF |
| 20 | 1970.10 | 10/1/1970 | T | 31 | 322 | 159 | 2,416 | 159 | 163 | 324 | 570,324 | 48 | 570,000 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 | 200,091 | 249,349 |
| 21 | 1970.10 | 10/2/1970 | F | 31 | 453 | 55 | 2,416 | 55 | 398 | 790 | 570,790 | 48 | 570,000 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 | 200,080 | 248,379 |
| 22 | 1970.10 | 10/3/1970 | S | 31 | 541 | 265 | 2,416 | 265 | 276 | 548 | 570,548 | 48 | 570,000 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 | 200,090 | 247,622 |
| 23 | 1970.10 | 10/4/1970 | S | 31 | 625 | -166 | 2,416 | -166 | 791 | 1,569 | 571,569 | 48 | 570,000 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 | 199,278 | 247,032 |
| 24 | 1970.10 | 10/5/1970 | M | 31 | 75 | 180 | 2,416 | 180 | -105 | -208 | 569,792 | 48 | 569,744 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 | 199,896 | 246,150 |
| 25 | 1970.10 | 10/6/1970 | T | 31 | 475 | 92 | 2,416 | 92 | 383 | 760 | 570,504 | 48 | 570,000 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 | 199,781 | 245,360 |
| 26 | 1970.10 | 10/7/1970 | W | 31 | 526 | 150 | 2,416 | 150 | 376 | 746 | 570,746 | 48 | 570,000 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 | 199,660 | 244,595 |
| 27 | 1970.10 | 10/8/1970 | T | 31 | 209 | 153 | 2,416 | 153 | 56 | 111 | 570,111 | 48 | 570,000 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 | 199,746 | 243,730 |
| 28 | 1970.10 | 10/9/1970 | F | 31 | 264 | 146 | 2,416 | 146 | 118 | 234 | 570,234 | 48 | 570,000 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 | 199,746 | 242,867 |
| 29 | 1970.10 | 10/10/1970 | S | 31 | 210 | 99 | 2,416 | 99 | 111 | 220 | 570,220 | 48 | 570,000 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 | 199,677 | 242,119 |
| 30 | 1970.10 | 10/11/1970 | S | 31 | 620 | 293 | 2,416 | 293 | 327 | 649 | 570,649 | 49 | 570,000 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 | 199,112 | 241,661 |
| 31 | 1970.10 | 10/12/1970 | M | 31 | 60 | -285 | 2,416 | -285 | 345 | 684 | 570,684 | 49 | 570,000 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 | 199,319 | 240,049 |
| 32 | 1970.10 | 10/13/1970 | T | 31 | 29 | 335 | 2,416 | 335 | -306 | -607 | 569,393 | 48 | 569,345 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 | 199,568 | 239,666 |
| 33 | 1970.10 | 10/14/1970 | W | 31 | 192 | -15 | 2,416 | -15 | 207 | 411 | 569,755 | 48 | 569,707 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 | 199,310 | 239,002 |
| 34 | 1970.10 | 10/15/1970 | T | 31 | 181 | 135 | 2,416 | 135 | 46 | 91 | 569,798 | 48 | 569,749 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 | 199,262 | 238,351 |
| 35 | 1970.10 | 10/16/1970 | F | 31 | 393 | 210 | 2,416 | 210 | 183 | 363 | 570,112 | 49 | 570,000 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 | 199,172 | 237,490 |
| 36 | 1970.10 | 10/17/1970 | S | 31 | 606 | 439 | 2,416 | 439 | 167 | 331 | 570,331 | 49 | 570,000 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 | 199,106 | 236,626 |
| 37 | 1970.10 | 10/18/1970 | S | 31 | 710 | 407 | 2,416 | 407 | 303 | 601 | 570,601 | 49 | 570,000 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 | 198,622 | 236,098 |
| 38 | 1970.10 | 10/19/1970 | M | 31 | -115 | 20 | 2,416 | 20 | -135 | -268 | 569,732 | 49 | 569,684 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 | 199,115 | 235,023 |
| 39 | 1970.10 | 10/20/1970 | T | 31 | 318 | 130 | 2,416 | 130 | 188 | 373 | 570,057 | 49 | 570,000 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 | 199,014 | 234,169 |

**Figure 5.2-1. WaterBankRel Worksheet .**

Warnings and advice are provided in the worksheet when several conditions occur. The snapshots below illustrate the occurrence of these conditions. A warning has been provided (Figure 5.2-2) that a reservoir has likely been depleted by the current operation assumptions. In this particular example, Tuolumne River minimum flows were increased with responsibility shared with CCSF, and a set of supplemental releases were established. In this iteration of results it is discovered in Column X (Hetch Hetchy Reservoir storage) an error (reported as “#N/A”) on August 26, 1992 has occurred in the Model. By review of the previous day’s storage results for Lake Lloyd (Column W), Hetch Hetchy Reservoir (Column X) and Don Pedro Reservoir (Column Y), and the rate of depletion for each of these reservoirs, it is concluded that Hetch Hetchy Reservoir likely drained on August 26 and thus crashed the Model. Although noted, a negative Water Bank Account Balance (Column M) will not cause the Model to crash. To remedy the condition, the user uses worksheet UserInput to revise (lower) SJPL diversions from Hetch Hetchy Reservoir (UI 4.10 and UI 4.20) and retain water in Hetch Hetchy Reservoir for release. If Don Pedro Reservoir storage was the culprit of causing the Model to crash, the user uses worksheet UserInput to revise (lower) MID and TID canal diversions (UI 2.10, UI 2.20 and UI 2.30 to retain water in Don Pedro Reservoir for release. Alternatively, the user could reduce the scenario's designated minimum flow requirement, which would change flow needed from the upstream systems.

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 1 | | San Francisco Water Bank Account Balance Computation and Supplement Release | | | | | | | | | | | | | | | | | | | | |
| 2 | Unit Title | | 2 | | CFS | CFS | CFS | CFS | CFS | AF | | AF | AF | | AF | | AF | | | AF | | | | | |
| 3 | Parameter Title | | 3 | | DP Inflow | La Grange | Fourth Ag | Districts' E | SF Credit/ | SF Credit/Debit w/ C | | SF WB Eva | SF Water Bank Balan | | Max Water Bank Cap | | Credit Adj fc | | | SF Supplemental Release | | | | | |
| 4 | | | | | | | | | | | | | | | | | Advice | | | | | | | | |
| 5 | Acre-foot to CFS conversion | | | | From | From | | | | | | | | | | | #N/A | | | | | | | | |
| 6 | divide by : | 1.983471 | | | DonPedro | Hydrology | | Warnings | | | | | | | | | #N/A | | | | | | | | |
| 7 | | | | | | | | | Warning: Your have likely drained a reservoir, check reservoirs. | | | | | | | | #N/A | | | | | | | | |
| 8 | | | | | | | | | #N/A | #N/A | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | #N/A | | | | | | | (UI 1.31) | | | (UI 3.10) | Yes, this method is being used | | | | |
| 10 | | | | | | | | | #N/A | #N/A | | | | | | | 1 | | | 1 | Min Lloyd Storage | | Min | Min | Min |
| 11 | | | | | | | | | | #N/A | | | | | | | (0) N, (1) Y | | | | WB Call (CCSF 3.00) | | 24,474 | #N/A | #N/A |
| 12 | | | | | | | | | | | | | | | | | - Debit | | | | (acre-feet) | | Min | Min | Min |
| 13 | | | | | | | | | | | | Max | #N/A | | | | + Credit | | | | 45,000 | | Non76-77 | Non76-77 | Non76-77 |
| 14 | | | | | | | | | | | | Min | #N/A | | | Sum: | -5,922,391 | | Sum: | 1,197,522 | 714,938 | 482,584 | 24,474 | #N/A | #N/A |
| 15 | | | | | SF Water Bank Account Balance Calculation | | | | | | | | | | | | La Grange | | | Supplemental Release and Storage Check | | | | | |
| 16 | | | | | | | Fourth | Daily | SF | SF C/D | SF Gross | SF WB | SF Net | SF Share | SF Max | | Credit Adj | | | WB | 1st Call | 2nd Call | | | |
| 17 | Month | | | | DP | La Grange | Agree | Districts' | Credit/ | w/ | WB | Evap | WB | RFlood | WB | WB | in SF | | | Supp | Lloyd | HH | Lloyd | HH | DP |
| 18 | Index | Date | Day | Days | Inflow | UF | Check | Entitle | Debit | Credit Adj | Balance | Losses | Balance | DP | Balance | Neg Flag | WB | Mark | Mark | Release | Release | Release | Storage | Storage | Storage |
| 19 | | | | | CFS | CFS | CFS | CFS | CFS | AF | AF | AF | 570,000 | AF | AF | AF | AF | | | AF | AF | AF | AF | AF | AF |
| 8018 | 1992.08 | 8/24/1992 | M | 31 | 205 | 5 | 2,416 | 5 | 200 | 396 | -122,421 | 0 | -122,421 | 0 | 570,000 | -396 | 0 | | | 0 | 0 | 0 | 30,461 | 1,488 | 528,302 |
| 8019 | 1992.08 | 8/25/1992 | T | 31 | 445 | 28 | 2,416 | 28 | 417 | 827 | -121,594 | 0 | -121,594 | 0 | 570,000 | -827 | 0 | | | 0 | 0 | 0 | 30,065 | 262 | 526,440 |
| 8020 | 1992.08 | 8/26/1992 | W | 31 | #N/A | 201 | 2,416 | 201 | #N/A | #N/A | #N/A | #N/A | #N/A | #N/A | #N/A | #N/A | 0 | | | 0 | 0 | 0 | 29,709 | #N/A | #N/A |
| 8021 | 1992.08 | 8/27/1992 | T | 31 | #N/A | 104 | 2,416 | 104 | #N/A | #N/A | #N/A | #N/A | #N/A | #N/A | #N/A | #N/A | 0 | | | 0 | 0 | 0 | 29,370 | #N/A | #N/A |

**Figure 5.2-2. Example 1: A Reservoir Empties and the Model Crashes.**

A second example of warning is shown in Figure 5.2-3, and advises that the Water Bank Account Balance is negative for one or more days of the scenario. In this instance, all Model reservoirs are operating within a viable operation (the Model did not crash due an emptying reservoir); however, the objective to maintain a positive Water Bank Account Balance has been violated. Upon inspection of the results the user can find the first instance of violation and remedy the violation by entry into Column T an amount of release that maintains at least a zero balance in the Water Bank Account Balance. For the first day of violation the reported negative balance (e.g., -3,253 acre-feet) is needed as a supplemental release. The ensuing days of supplemental release are informed by Column P.

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 1 | | San Francisco Water Bank Account Balance Computation and Supplement Release | | | | | | | | | | | | | | | | | | | | |
| 2 | Unit Title | | 2 | | CFS | CFS | CFS | CFS | CFS | AF | | AF | AF | | AF | | AF | | | AF | | | | | |
| 3 | Parameter Title | | 3 | | DP Inflow | La Grange | Fourth Ag | Districts' E | SF Credit/ | SF Credit/Debit w/ C | | SF WB Eva | SF Water Bank Balan | | Max Water Bank Cap | | Credit Adj fc | | | SF Supplemental Release | | | | | |
| 4 | | | | | | | | | | | | | | | | | Advice | | | | | | | | |
| 5 | Acre-foot to CFS conversion | | | | From | From | | | | | | | | | | | If Water Bank Balance is negative (shown as highlighted value in | | | | | | | | |
| 6 | divide by : | 1.983471 | | | DonPedro | Hydrology | | Warnings | | | | | | | | | Column M) enter volume of supplemental release into Column T to | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | maintin balance at zero or greater. Use Column M and Column P for guidance. | | | | | | | | |
| 8 | | | | | | | | | Warning: SF Water Bank is 'negative'. Add supplemental release | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | (Column T) to maintain balance at least zero. | | | | | | | | (UI 1.31) | | | (UI 3.10) | Yes, this method is being used | | | | |
| 10 | | | | | | | | | | | | | | | | | 0 | | | 1 | Min Lloyd Storage | | Min | Min | Min |
| 11 | | | | | | | | | | | | | | | | | (0) N, (1) Y | | | | WB Call (CCSF 3.00) | | 131,254 | 84,135 | 508,489 |
| 12 | | | | | | | | | | | | | | | | | - Debit | | | | (acre-feet) | | Min | Min | Min |
| 13 | | | | | | | | | | | | Max | 740,000 | | | | + Credit | | | | 45,000 | | Non76-77 | Non76-77 | Non76-77 |
| 14 | | | | | | | | | | | | Min | -150,778 | | | Sum: | 0 | | Sum: | 0 | 0 | 0 | 131,254 | 114,720 | 740,875 |
| 15 | | | | | SF Water Bank Account Balance Calculation | | | | | | | | | | | | La Grange | | | Supplemental Release and Storage Check | | | | | |
| 16 | | | | | | | Fourth | Daily | SF | SF C/D | SF Gross | SF WB | SF Net | SF Share | SF Max | | Credit Adj | | | WB | 1st Call | 2nd Call | | | |
| 17 | Month | | | | DP | La Grange | Agree | Districts' | Credit/ | w/ | WB | Evap | WB | RFlood | WB | WB | in SF | | | Supp | Lloyd | HH | Lloyd | HH | DP |
| 18 | Index | Date | Day | Days | Inflow | UF | Check | Entitle | Debit | Credit Adj | Balance | Losses | Balance | DP | Balance | Neg Flag | WB | Mark | Mark | Release | Release | Release | Storage | Storage | Storage |
| 19 | | | | | CFS | CFS | CFS | CFS | CFS | AF | AF | AF | 570,000 | AF | AF | AF | AF | | | AF | AF | AF | AF | AF | AF |
| 7887 | 1992.04 | 4/15/1992 | W | 30 | 2138 | 4,322 | 4,066 | 4,066 | -1,928 | -3,824 | 4,011 | 0 | 4,011 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 | 256,353 | 262,227 | 969,641 |
| 7888 | 1992.04 | 4/16/1992 | T | 30 | 1628 | 3,150 | 4,066 | 3,150 | -1,521 | -3,017 | 994 | 0 | 994 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 | 257,148 | 263,740 | 969,822 |
| 7889 | 1992.04 | 4/17/1992 | F | 30 | 1925 | 4,267 | 4,066 | 4,066 | -2,141 | -4,247 | -3,253 | 0 | -3,253 | 0 | 570,000 | 4,247 | 0 | | | 0 | 0 | 0 | 259,037 | 265,786 | 970,196 |
| 7890 | 1992.04 | 4/18/1992 | S | 30 | 1980 | 5,507 | 4,066 | 4,066 | -2,086 | -4,137 | -7,390 | 0 | -7,390 | 0 | 570,000 | 4,137 | 0 | | | 0 | 0 | 0 | 260,795 | 270,314 | 970,897 |

**Figure 5.2-3. Example 2: Water Bank Balance is Negative.**

It is possible that within the remedy of Example 2 the error exemplified by Example 1 may occur as Hetch Hetchy Reservoir may be drained through the efforts of maintaining a positive Water Bank Account Balance. At that point, the procedures of Example 1 will be required and the values already derived for supplemental releases may need to be revisited and possibly changed.

## 5.3 Control Worksheet

This worksheet (Control) provides an interface for entering assumptions for reservoir operations and several facility characteristics of District and CCSF facilities. The worksheet is described below.

### 5.3.1 Contents Description

This section (Figure 5.3-1) provides an index to the contents of this worksheet (Control).

### 5.3.2 Section 1: Don Pedro Reservoir and District Facilities -Reservoir Management, Preferred Storage Target and Drawdown, Modesto Flood Control Objective, Snowmelt Runoff, and Storage Constraints

This section (Figure 5.3-2) describes the parameters that provide guidance to the management of Don Pedro Reservoir storage and provides entry of several parameters that advise reservoir operations. ACOE and preferred reservoir storage guidance is described. User specified values for specific storage targets are input in Section 4 of this worksheet. The maximum targeted flood flow in the Tuolumne River at Modesto (below Dry Creek) is entered at C 1.00. Releases to the Tuolumne River will be constrained to not exceed this flow level when reservoir space is available in Don Pedro Reservoir to defer releases. Guidance is also provided for the release of anticipated runoff during the snowmelt runoff season. Values entered at C 1.10, C 1.11 and C 1.12 advise the amount of projected excess runoff (from the date of forecast through June) to be released during April, May and June. For instance, the value entered at C 1.10 (30 percent) advises the Model to release 30 percent of the excess runoff volume forecasted to occur during April through June during April. The Model estimates the total excess runoff volume as being the projected inflow to Don Pedro Reservoir less projected canal diversions, reservoir evaporation and minimum Tuolumne River flow requirements, with an objective to fill Don Pedro Reservoir at the end of June. An entry at C 1.20 directs the Model to cease the simulation of power generation at Don Pedro Powerhouse when reservoir storage is below the value. A warning occurs when Don Pedro Reservoir storage is less than the value. The warning informs the study that the reservoir is being simulated below dead pool. The study should be revised through inputs in worksheet UserInput to remedy reservoir storage that is less than dead pool. The entry at C 1.21 informs the Model of the maximum flow through the Don Pedro powerhouse. Releases from Don Pedro Dam in excess of this value is labeled spill or bypassed at the dam.

### 5.3.3 FERC Minimum Flows

This section (Figure 5.3-3) defines the 1995 FERC minimum flow requirements. Values are entered (C 1.30) for each defined flow period by year type, consistent with the FERC order issued July 31, 1996. Seven year types are defined based on the San Joaquin Basin 60-20-20 water supply index. The sequence year of the flow schedule begins in April and continues through the following March. The water supply index of each year of the simulation period is found in worksheet 602020, and the projection method of the index is defined at C 1.50. For the Test Case condition, the historical actual 60-20-20 index is used. The volume of water interpolated between annual schedules is distributed among April and May in proportion to the values provided at C 1.40 (April) and C 1.41 (May). The total volume of water designated for April and May is distributed daily during April and May is directed by C 1.60. If directed to use an equal distribution of the volume of flow during April and May, C 1.60 is set as 1. If C 1.60 is set as 2, two 7-day pulse flows will occur with the remaining volume evenly spread over the remaining days of the months. The pattern of these schedules can be modified in worksheet LaGrangeSchedule.

### 5.3.4 Test Case District Canal Demands

This section of parameters (Figure 5.3-4) contributes to the computation of District canal demands. The values entered at C 1.70 for Modesto Irrigation District and at C 1.80 for Turlock Irrigation District are utilized by worksheet DailyCanalsCompute in the projection of daily canal demands for the simulation period. These parameters represent various components of water supplies and disposition that result in the need for canal diversion. These components are combined with the projected demand for applied water associated with lands within the Districts. The projected demand for applied water is provided to the model in worksheet DailyCanalsCompute, and is adjusted by the turnout delivery factor entered in C 1.70 and C 1.80, which adjusts for applied water not associated with immediate consumptive use such as pre-irrigation and groundwater recharge. The computation of daily canal demand is processed by parsing the monthly values of C 1.70 and C 1.80 evenly across the days of a month and combining them with the monthly value of applied water that has been parsed daily in a pattern reflective of recent historical daily diversions for the canals.

### 5.3.5 Don Pedro Water Supply Factor

The Don Pedro Water Supply Factor directs the reduction of District canal diversions during periods of anticipated limited water supply. The values at C 1.90 (Figure 5.3-5) provide the model with a relationship between water availability at Don Pedro Reservoir and advised canal diversions. The parameters of the relationship is an index of water availability which is computed as the storage in Don Pedro Reservoir at the end of March plus the projected inflow into Don Pedro Reservoir for April through July, and the water supply factor which is applied to projected demand for applied water described above. A water supply factor of 1.00 will provide a diversion equal to projected canal demand (full demand). A water supply factor less than 1.00 will reduce the canal diversion to less than full canal demand.

**Operation Control Parameters and Facility Characteristics**
Variables Affecting Case and Facility Operation

Contents:



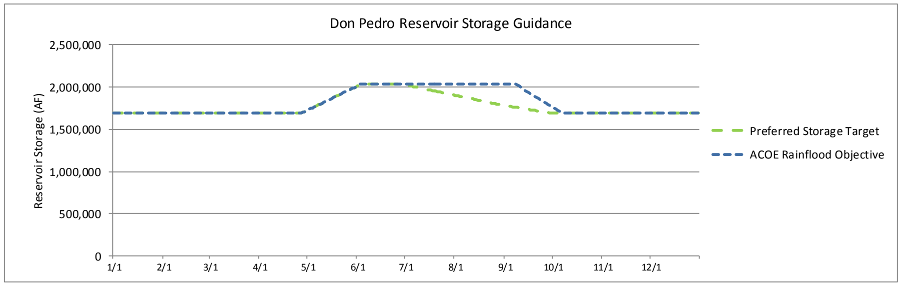
**Figure 5.3-1. Contents Description.**

**Section 1 - Don Pedro Reservoir and District Facilities**

Reservoir Management

Rainflood reservoir reservation space according to ACOE manual.

*"Flood control reservoir increases uniformly at a rate of 11,700 acre-feet per day from zero requirement on September 8 to the maximum reservation of 340,000 acre-feet by October 7. The reservation is maintained at 340,000 acre-feet through April 27 after which, unless additional reservation is indicated by the snowmelt parameters, it will decrease uniformaly at a rate of 9,200 acre-feet per day to zero requirement by June 3."*




Preferred Storage Targets

*ACOE through June 30. Target 1,906,000 acre-feet for July 31, 1,782,000 acre-feet August 31, and 1,692,000 acre-feet for September 30. UCOE thereafter.*

Modesto flood control objective

(C 1.00) 9,000 *cfs. Target flow not to exceed in Tuolumne River below Modesto.*

Snowmelt release forecast parameters

*90% exceedence DWR forecast of watershed runoff for April 1 and May 1*
*Historical watershed runoff for June 1*

*Release of forecasted excess runoff*

| | | |
|---|---|---|
| (C 1.10) | 30 | *percent of April - June excess runoff during April* |
| (C 1.11) | 50 | *percent of May - June excess runoff during May* |
| (C 1.12) | 100 | *percent of June excess runoff during June* |

Reservoir Storage Constraints/Objectives

| | | |
|---|---|---|
| | 2,030,000 | *acre-feet Maximum reservoir storage* |
| (C 1.20) | 308,960 | *acre-feet dead pool, cutoff of generation capability/no release** |
| (C 1.21) | 5,400 | *cfs maximum Don Pedro Powerhouse discharge* |

** The Model will not crash upon simulating an operation below dead pool. However, to conform with operational limitations the user is to modify input assumptions to maintain reservoir storage at or above dead pool.*

**Figure 5.3-2. Section 1: Don Pedro Reservoir and District Facilities -Reservoir Management, Preferred Storage Target and Drawdown, Modesto Flood Control Objective, Snowmelt Runoff, and Storage Constraints.**

FERC Minimum Flow Requirements

*FERC Flow Schedules*

(C 1.30)

| Year Type | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Oct 1-15 (CFS) | 100 | 100 | 150 | 150 | 180 | 200 | 300 |
| Oct 16-31 (CFS) | 150 | 150 | 150 | 150 | 180 | 175 | 300 |
| Total Base (AF) | 7,736 | 7,736 | 9,223 | 9,223 | 11,068 | 11,504 | 18,447 |
| Attraction (AF) | 0 | 0 | 0 | 0 | 1,676 | 1,736 | 5,950 |
| Total Oct (AF) | 7,736 | 7,736 | 9,223 | 9,223 | 12,744 | 13,240 | 24,397 |
| Nov (CFS) | 150 | 150 | 150 | 150 | 180 | 175 | 300 |
| AF | 8,926 | 8,926 | 8,926 | 8,926 | 10,711 | 10,413 | 17,852 |
| Dec (CFS) | 150 | 150 | 150 | 150 | 180 | 175 | 300 |
| AF | 9,223 | 9,223 | 9,223 | 9,223 | 11,068 | 10,760 | 18,447 |
| Jan (CFS) | 150 | 150 | 150 | 150 | 180 | 175 | 300 |
| AF | 9,223 | 9,223 | 9,223 | 9,223 | 11,068 | 10,760 | 18,447 |
| Feb (CFS) | 150 | 150 | 150 | 150 | 180 | 175 | 300 |
| AF | 8,331 | 8,331 | 8,331 | 8,331 | 9,997 | 9,719 | 16,661 |
| Mar (CFS) | 150 | 150 | 150 | 150 | 180 | 175 | 300 |
| AF | 9,223 | 9,223 | 9,223 | 9,223 | 11,068 | 10,760 | 18,447 |
| Apr (CFS) | 150 | 150 | 150 | 150 | 180 | 175 | 300 |
| AF | 8,926 | 8,926 | 8,926 | 8,926 | 10,711 | 10,413 | 17,852 |
| May (CFS) | 150 | 150 | 150 | 150 | 180 | 175 | 300 |
| AF | 9,223 | 9,223 | 9,223 | 9,223 | 11,068 | 10,760 | 18,447 |
| Migration Flow | | | | | | | |
| AF | 11,091 | 20,091 | 32,619 | 37,060 | 35,920 | 60,027 | 89,882 |
| Jun (CFS) | 50 | 50 | 50 | 75 | 75 | 75 | 250 |
| AF | 2,975 | 2,975 | 2,975 | 4,463 | 4,463 | 4,463 | 14,876 |
| Jul (CFS) | 50 | 50 | 50 | 75 | 75 | 75 | 250 |
| AF | 3,074 | 3,074 | 3,074 | 4,612 | 4,612 | 4,612 | 15,372 |
| Aug (CFS) | 50 | 50 | 50 | 75 | 75 | 75 | 250 |
| AF | 3,074 | 3,074 | 3,074 | 4,612 | 4,612 | 4,612 | 15,372 |
| Sep (CFS) | 50 | 50 | 50 | 75 | 75 | 75 | 250 |
| AF | 2,975 | 2,975 | 2,975 | 4,463 | 4,463 | 4,463 | 14,876 |
| Total Annual | 94,001 | 103,001 | 117,017 | 127,508 | 142,503 | 165,004 | 300,926 |

*April - May distribution of spring migration volume*

(C 1.40) 16 *parts (days) during April*

(C 1.41) 15 *parts (days) during May*

31 *parts total during April and May*

*Forecast of San Joaquin River Index*

(C 1.50) 1

| | |
|---|---|
| 1 | Actual |
| 2 | 90% Exc. |
| 3 | 75% Exc. |
| 4 | Med. |
| 5 | 10% Exc. |

*April - May daily parsing of monthly volume of flow*

(C 1.60) 2

| | |
|---|---|
| 1 | Even |
| 2 | 2-Pulse |

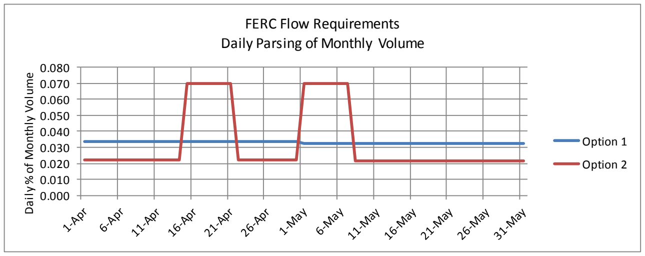



**Figure 5.3-3. FERC Minimum Flows.**

Test Case Canal Demands

*Modesto Irrigation District*

| | | Turnout Delivery Factor | Nominal Private GW Pumping | Canal Operation Spills Critical | Canal Operation Spills Non-crit | Canal Losses blw Modesto Reservoir | Intercptd Flows | Nominal MID GW Pumping | Mod Res & Upper Canal Losses | Modesto Reservoir Municipal Delivery | Modesto Reservoir Target Storage | Modesto Reservoir Target Storage Change |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Month | % | TAF | TAF | TAF | TAF | TAF | TAF | TAF | TAF | TAF | TAF |
| (C 1.70) | Jan | 35.0 | 0.0 | 2.0 | 2.0 | 0.1 | 0.0 | 0.0 | 0.0 | 2.3 | 17.0 | 2.0 |
| | Feb | 35.0 | 0.0 | 2.0 | 2.0 | 0.1 | 0.0 | 0.0 | 0.0 | 2.3 | 18.0 | 1.0 |
| | Mar | 65.0 | 1.0 | 1.0 | 3.0 | 0.6 | 0.9 | 1.0 | 2.0 | 2.7 | 18.0 | 0.0 |
| | Apr | 70.0 | 2.0 | 3.0 | 6.0 | 0.6 | 0.9 | 2.3 | 2.9 | 2.7 | 19.0 | 1.0 |
| | May | 85.0 | 3.0 | 4.0 | 6.5 | 0.6 | 1.2 | 2.3 | 3.9 | 3.0 | 20.0 | 1.0 |
| | Jun | 85.0 | 4.0 | 3.5 | 6.5 | 0.6 | 1.0 | 2.3 | 4.3 | 3.2 | 20.0 | 0.0 |
| | Jul | 77.5 | 4.0 | 3.5 | 6.5 | 0.6 | 1.0 | 2.6 | 4.9 | 3.3 | 21.0 | 1.0 |
| | Aug | 70.0 | 4.0 | 4.9 | 7.0 | 0.6 | 1.4 | 2.4 | 4.9 | 3.3 | 22.0 | 1.0 |
| | Sep | 65.0 | 2.0 | 5.0 | 7.0 | 0.6 | 1.2 | 2.3 | 4.2 | 3.3 | 20.0 | -2.0 |
| | Oct | 40.0 | 1.0 | 2.8 | 6.9 | 0.6 | 0.9 | 2.1 | 2.0 | 3.2 | 17.0 | -3.0 |
| | Nov | 30.0 | 0.0 | 2.0 | 2.0 | 0.1 | 0.0 | 0.0 | 2.0 | 2.7 | 15.0 | -2.0 |
| | Dec | 35.0 | 0.0 | 2.0 | 2.0 | 0.1 | 0.0 | 0.0 | 0.0 | 2.5 | 15.0 | 0.0 |
| | Total | | 21.0 | 35.7 | 57.4 | 5.4 | 8.5 | 17.3 | 31.1 | 34.5 | | |

*March TO Factor*

| TO Del Fac Break Point | Factor % |
|---|---|
| 0 | 65 |
| 9.9 | 65 |
| 13.2 | 65 |
| 20 | 65 |
| 9999 | 65 |

*Turlock Irrigation District*

| | | Turnout Delivery Factor | Nominal Private GW Pumping | Canal Operation Spills Critical | Canal Operation Spills Non-crit | Canal Losses blw Turlock Lake | Intercptd Flows | Nominal TID GW Pumping | Turlock Lk & Upper Canal Losses | Turlock Lake Delivery | Turlock Lake Target Storage | Turlock Lake Target Storage Change |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Month | % | TAF | TAF | TAF | TAF | TAF | TAF | TAF | TAF | TAF | TAF |
| (C 1.80) | Jan | 30 | 0.0 | 2.0 | 2.0 | 0.8 | 0.0 | 0.0 | 1.0 | 0.0 | 18.0 | 5.0 |
| | Feb | 30 | 0.0 | 2.0 | 2.0 | 0.8 | 0.0 | 0.0 | 1.0 | 0.0 | 25.0 | 7.0 |
| | Mar | 65 | 1.2 | 3.0 | 3.0 | 4.5 | 0.0 | 4.1 | 1.0 | 0.0 | 30.0 | 5.0 |
| | Apr | 57.5 | 2.4 | 5.1 | 6.3 | 4.5 | 0.0 | 8.0 | 6.6 | 0.0 | 30.0 | 0.0 |
| | May | 85 | 3.6 | 4.6 | 6.7 | 4.5 | 0.0 | 10.3 | 7.7 | 0.0 | 32.0 | 2.0 |
| | Jun | 92.5 | 5.2 | 4.2 | 6.7 | 4.5 | 0.0 | 12.4 | 8.2 | 0.0 | 32.0 | 0.0 |
| | Jul | 72.5 | 6.4 | 4.2 | 6.7 | 4.5 | 0.0 | 14.6 | 8.7 | 0.0 | 32.0 | 0.0 |
| | Aug | 62.5 | 6.2 | 4.0 | 7.3 | 4.5 | 0.0 | 13.3 | 9.0 | 0.0 | 30.0 | -2.0 |
| | Sep | 67.5 | 3.9 | 3.2 | 7.3 | 4.5 | 0.0 | 9.1 | 5.0 | 0.0 | 27.0 | -3.0 |
| | Oct | 40 | 2.4 | 2.3 | 7.3 | 4.5 | 0.0 | 5.3 | 2.0 | 0.0 | 13.0 | -14.0 |
| | Nov | 30 | 0.0 | 2.0 | 2.0 | 0.8 | 0.0 | 0.0 | 1.0 | 0.0 | 13.0 | 0.0 |
| | Dec | 30 | 0.0 | 2.0 | 2.0 | 0.8 | 0.0 | 0.0 | 1.0 | 0.0 | 13.0 | 0.0 |
| | Total | | 31.3 | 38.6 | 59.3 | 39.2 | 0.0 | 77.1 | 52.2 | 0.0 | | |

*March TO Factor*

| TO Del Fac Break Point | Factor % |
|---|---|
| 0 | 65 |
| 19.8 | 65 |
| 27.5 | 65 |
| 40 | 65 |
| 9999 | 65 |

**Figure 5.3-4. Test Case District Canal Demands.**

Don Pedro Water Supply Factor

| | Don Pedro Stor + Infl Index | M/TID WS Factor |
|---|---|---|
| | TAF | % |
| (C 1.90) | 0 | 0.60 |
| | 1,350 | 0.60 |
| | 1,600 | 0.85 |
| | 2,000 | 0.85 |
| | 2,001 | 1.00 |
| | 2,300 | 1.00 |
| | 9,999 | 1.00 |

*The reservoir index method adds the end-of-March Don Pedro Reservoir storage to the projected April through July inflow to assess water availability for diversion.*

**Figure 5.3-5. Don Pedro Water Supply Factor.**

### 5.3.6 Section 2: City and County of San Francisco Facilities - Hetch Hetchy Reservoir

This section (Figure 5.3-6) provides parameters that direct or advise the operation of Hetch Hetchy Reservoir. Minimum flow releases below Hetch Hetchy Reservoir are directed by C 2.00, C 2.01 and C 2.02. These parameters and schedules are consistent with the stipulations for the Canyon Power Project and the modifications thereof for Kirkwood Powerhouse Unit No. 3. The application of these flow schedules and the addition of 64 cfs to the minimum flow schedule below Hetch Hetchy Reservoir are embedded in model logic in worksheet CCSF.

Values entered at C 2.10 advise the management of reservoir storage throughout a year. The hard limit entered into C 2.10 directs the maximum allowed storage in Hetch Hetchy Reservoir at the end of each month. Model logic will not allow exceedence of these values and will release addition water from the facility if needed to not exceed the values. The soft target, also representing a value at the end of each month, when exceeded advises the Model to make additional releases in order to not exceed that reservoir storage. Model logic computes the storage exceedence, if any, every seventh day and advises a release in addition to minimum releases. The rate of this additional release is equal to the exceedence volume spread over seven days. For transitional months when the soft target value at the end of a month differs from a previous month, the transition in storage target is parsed equally within the days of the month.

Entries at C 2.20 through C 2.24 advise the amount of projected excess runoff (from the date of forecast through June) to be released during February, March, April, May and June. For instance, the value entered at C 2.20 (10 percent) advises the Model to release 10 percent of the excess runoff volume forecasted to occur during the February through June during February. The Model estimates the total excess runoff volume as being the projected inflow to Hetch Hetchy Reservoir less projected San Joaquin Pipeline diversions, deliveries to Groveland and Moccasin Fish Hatchery, reservoir evaporation and minimum flow requirements below Hetch Hetchy Reservoir, with an objective to fill Hetch Hetchy Reservoir at the end of June.

Entries at C 2.25 through C 2.29 work in concert with the advised snowmelt runoff releases, and limit the rate at which those releases will be made. The functionality of the limit provides an ability to manage releases in recognition of downstream facility protection, the efficiency of releases through power generation facilities and reservoir storage goals. The example of C 2.25 being set as 1,200 cfs for February results in the advised snowmelt release being limited to no more than that value regardless of the rate of release advised by the projection of excess runoff. These releases are in addition to the already established minimum releases described previously. C 2.30 and C 2.31 also affect the advisement of snowmelt runoff releases. C 2.30 limits the drawdown of Hetch Hetchy Reservoir for snowmelt runoff, and its value will limit the release to not lower Hetch Hetchy reservoir storage below such value. C 2.31 directs the storage goal for Hetch Hetchy Reservoir at the assumed fill date of the end of June.

### 5.3.7 Lake Lloyd

The section of parameters that direct or advise the operation of Lake Lloyd (Figure 5.3-7) is very similar in content and structure as the section just described for Hetch Hetchy Reservoir.

Minimum flow releases below Lake Lloyd are directed by C 2.40 and C 2.41. A single schedule of flow requirements is provided for Lake Lloyd and is consistent with the stipulations for the Cherry River Project. The application of the flow schedule is embedded in Model logic in worksheet CCSF. Entry of a value at C 2.41 provides a release from Lake Lloyd through Holm Powerhouse during the months of May through August, established as 950 cfs for four hours per day. The entry at C 2.41 also advises the maximum flow rate through Holm Powerhouse.

Values entered at C 2.50 advise the management of reservoir storage throughout a year. The hard limit entered into C 2.50 directs the maximum allowed storage in Lake Lloyd at the end of each month. Model logic will not allow exceedence of these values and will release addition water from the facility if needed to not exceed the values. The soft target, also representing a value at the end of each month, when exceeded advises the Model to make additional releases in order to not exceed that reservoir storage. Model logic computes the storage exceedence, if any, every seventh day and advises a release in addition to minimum releases. The rate of this additional release is equal to the exceedence volume spread over seven days. For transitional months when the soft target value at the end of a month differs from a previous month, the transition in storage target is parsed equally within the days of the month.

Entries at C 2.60 through C 2.64 advise the amount of projected excess runoff (from the date of forecast through June) to be released during February, March, April, May and June. The model estimates the total excess runoff volume as being the projected inflow to Lake Lloyd less reservoir evaporation, minimum flow requirements below Lake Lloyd and releases to Holm Powerhouse, with an objective to fill Lake Lloyd at the end of June.

Entries at C 2.65 through C 2.69 work in concert with the advised snowmelt runoff releases, and limit the rate at which those releases will be made. C 2.70 and C 2.71 also affect the advisement of snowmelt runoff releases. These releases are in addition to the already established minimum releases described previously. C 2.70 limits the drawdown of Lake Lloyd for snowmelt runoff, and its value will limit the release to not lower Lake Lloyd storage below such value. C 2.71 directs the storage goal for Lake Lloyd at the assumed fill date of the end of June.

### 5.3.8 Lake Eleanor

This section (Figure 5.3-8) provides parameters that direct or advise the operation of Lake Eleanor. Minimum flow releases below Lake Eleanor are directed by C 2.80. These flow schedules are consistent with the stipulations for the Cherry-Eleanor Pumping Station. The application of these flow schedules are embedded in Model logic in worksheet CCSF, and always assume the schedule associated with pumping. An entry at C 2.81 directs the maximum flow rate through the Eleanor-Cherry Diversion Tunnel. This value may limit the rate at which water can be transferred from Lake Eleanor to Lake Lloyd.

Values entered at C 2.90 advise the management of reservoir storage throughout a year. The hard limit entered into C 2.90 directs the maximum allowed storage in Lake Eleanor at the end of each month. Model logic will not allow exceedence of these values and will release addition water from the facility if needed to not exceed the values. The soft target, also representing a value at the end of each month, when exceeded advises the Model to make additional releases in order to not exceed that reservoir storage. Model logic computes the storage exceedence, if any, every seventh day and advises a release in addition to minimum releases. The rate of this additional release is equal to the exceedence volume spread over seven days. For transitional months when the soft target value at the end of a month differs from a previous month, the transition in storage target is parsed equally within the days of the month.

Entries at C 2a.10 through C 2a.14 advise the amount of projected excess runoff (from the date of forecast through June) to be released during February, March, April, May and June. The model estimates the total excess runoff volume as being the projected inflow to Lake Eleanor less reservoir evaporation and minimum flow requirements below Lake Eleanor, with an objective to fill Lake Eleanor at the end of June.

Entries at C 2a.15 through C 2a.19 work in concert with the advised snowmelt runoff releases, and limit the rate at which those releases will be made. These releases are in addition to the already established minimum releases described previously. C 2a.20 and C 2a.21 also affect the advisement of snowmelt runoff releases. C 2a.20 limits the drawdown of Lake Eleanor for snowmelt runoff, and its value will limit the release to not lower Lake Eleanor storage below such value. C 2a.21 directs the storage goal for Lake Eleanor at the assumed fill date of the end of June.

### 5.3.9 CCSF Water Supply Parameters

The matrix describing the San Francisco water supply parameters (Figure 5.3-9) provides the model information to report the state of Test Case condition water supply action levels and the potential changes in the occurrence of action level due to alternative operations.

Entries at C 2a.30 represent the relationship between CCSF total system storage (at the end of June each year) and the advisement of water supply actions. Total system storage includes CCSF’s local watershed reservoirs, its Hetch Hetchy Project reservoirs, and also the Don Pedro Water Bank Account Balance. Local watershed storage is provided from CCSF’s system operation model (HHLSM) as pre-processed values for the simulation period. These values are combined with the Model’s depiction of CCSF reservoir storage for the Tuolumne River system to depict total system storage. A water supply action level for each year of each study is determined by the matrix, relating total system storage thresholds to advised action levels. For instance, if total system storage at the end of June of a year is greater than 700,000 acre-feet and less than 1,100,000 acre-feet, an action level of 10 percent rationing is advised. The CCSF Test Case condition SJPL diversions include the effect of occasional water delivery shortages due to these water supply parameters.

**Section 2 - CCSF Facilities**

Hetch Hetchy Reservoir Control

*Minimum releases below reservoir*

(C 2.00)

| *Schedule Index - Accum Inches or Storage* | | | |
|---|---|---|---|
| *CY Month* | *A (1)* | *B (2)* | *C (3)* |
| 1 | 8.80 | 6.10 | |
| 2 | 14.00 | 9.50 | |
| 3 | 18.60 | 14.20 | |
| 4 | 23.00 | 18.00 | |
| 5 | 26.60 | 19.50 | |
| 6 | 28.45 | 21.25 | |
| 7 | 575,000 | 390,000 | |
| 8 | 640,000 | 400,000 | |

(C 2.01)

| *Below Dam Flow Requirement - CFS* | | | |
|---|---|---|---|
| *CY Month* | *A (1)* | *B (2)* | *C (3)* |
| 1 | 50 | 40 | 35 |
| 2 | 60 | 50 | 35 |
| 3 | 60 | 50 | 35 |
| 4 | 75 | 65 | 35 |
| 5 | 100 | 80 | 50 |
| 6 | 125 | 110 | 75 |
| 7 | 125 | 110 | 75 |
| 8 | 125 | 72.5 | 75 |
| 9 | 90 | 65 | 62.5 |
| 10 | 60 | 50 | 35 |
| 11 | 60 | 50 | 35 |
| 12 | 50 | 40 | 35 |

(C 2.02)

| *Discretionary Schedule - Acre-feet* | 15,000 | 6,500 | 4,400 |
|---|---|---|---|
| *CY Month* | *A (1)* | *B (2)* | *C (3)* |
| 1 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 |
| 4 | 0 | 0 | 0 |
| 5 | 0 | 0 | 0 |
| 6 | 0 | 0 | 0 |
| 7 | 0 | 0 | 0 |
| 8 | 0 | 0 | 0 |
| 9 | 0 | 0 | 0 |
| 10 | 0 | 0 | 0 |
| 11 | 0 | 0 | 0 |
| 12 | 0 | 0 | 0 |

*Reservoir Management*

(C 2.10)

| *Target Storage - Acre-feet* | | |
|---|---|---|
| *CY Month* | *Soft Trgt EOM* | *Hard Limit EOM* |
| 1 | 320,000 | 360,360 |
| 2 | 320,000 | 360,360 |
| 3 | 320,000 | 360,360 |
| 4 | 320,000 | 360,360 |
| 5 | 360,360 | 360,360 |
| 6 | 360,360 | 360,360 |
| 7 | 360,360 | 360,360 |
| 8 | 360,360 | 360,360 |
| 9 | 360,360 | 360,360 |
| 10 | 330,000 | 360,360 |
| 11 | 320,000 | 360,360 |
| 12 | 320,000 | 360,360 |

*Snowmelt release forecast parameters*

*Historical watershed runoff used for all forecasts of inflow (perfect foresight)*

*Release of forecasted excess runoff*

| | | |
|---|---|---|
| (C 2.20) | 10 | *percent of Februay - June excess runoff during February* |
| (C 2.21) | 10 | *percent of March - June excess runoff during March* |
| (C 2.22) | 10 | *percent of April - June excess runoff during April* |
| (C 2.23) | 100 | *percent of May - June excess runoff during June* |
| (C 2.24) | 100 | *percent of June excess runoff during June* |

*Maximum advised release for snowmelt*

| | | |
|---|---|---|
| (C 2.25) | 1,200 | *cfs - February* |
| (C 2.26) | 1,150 | *cfs - March* |
| (C 2.27) | 1,200 | *cfs - April* |
| (C 2.28) | 100,000 | *cfs - May* |
| (C 2.29) | 100,000 | *cfs - June* |

*Minimum storage of draw down for snowmelt release*

(C 2.30) 100,000 *acre-feet*

*Target storage for filling at end of June*

(C 2.31) 360,360 *acre-feet*

**Figure 5.3-6. Hetch Hetchy Reservoir.**

Lake Lloyd Control

*Minimum releases below reservoir*

(C 2.40)

| *Blw Lake Lloyd - CFS* | |
|---|---|
| *CY Month* | *Flow Req* |
| 1 | 5 |
| 2 | 5 |
| 3 | 5 |
| 4 | 5 |
| 5 | 5 |
| 6 | 5 |
| 7 | 15.5 |
| 8 | 15.5 |
| 9 | 15.5 |
| 10 | 5 |
| 11 | 5 |
| 12 | 5 |

| *Holm Target Releases* | | |
|---|---|---|
| *May (Memorial Day) thru* | (C 2.41) | |
| *August (Labor Day)* | | |
| *Holm Capacity* | 950 | *cfs* |
| *Day* | 1,884 | *acre-feet* |
| *4-hours per day* | 314 | *acre-feet* |

*Reservoir Management*

(C 2.50)

| *Target Storage - Acre-feet* | | |
|---|---|---|
| | *Soft Trgt* | *Hard Limit* |
| *CY Month* | *EOM* | *EOM* |
| 1 | 238,000 | 273,300 |
| 2 | 238,000 | 273,300 |
| 3 | 238,000 | 273,300 |
| 4 | 273,300 | 273,300 |
| 5 | 273,300 | 273,300 |
| 6 | 273,300 | 273,300 |
| 7 | 268,000 | 273,300 |
| 8 | 258,000 | 273,300 |
| 9 | 248,000 | 273,300 |
| 10 | 248,000 | 273,300 |
| 11 | 238,000 | 273,300 |
| 12 | 238,000 | 273,300 |

*Snowmelt release forecast parameters*

*Historical watershed runoff used for all forecasts of inflow (perfect foresight)*

*Release of forecasted excess runoff*

| | | |
|---|---|---|
| (C 2.60) | 20 | *percent of Februay - June excess runoff during February* |
| (C 2.61) | 25 | *percent of March - June excess runoff during March* |
| (C 2.62) | 33 | *percent of April - June excess runoff during April* |
| (C 2.63) | 50 | *percent of May - June excess runoff during June* |
| (C 2.64) | 100 | *percent of June excess runoff during June* |

*Minimum storage of draw down for snowmelt release*

(C 2.70) 100,000 *acre-feet*

*Maximum advised release for snowmelt*

| | | |
|---|---|---|
| (C 2.65) | 1,000 | *cfs - February* |
| (C 2.66) | 1,000 | *cfs - March* |
| (C 2.67) | 1,000 | *cfs - April* |
| (C 2.68) | 1,000 | *cfs - May* |
| (C 2.69) | 1,000 | *cfs - June* |

*Target storage for filling at end of June*

(C 2.71) 273,300 *acre-feet*

**Figure 5.3-7. Lake Lloyd.**

Lake Eleanor Control

Minimum releases below reservoir

| | Blw Lake Eleanor - CFS | | |
|---|---|---|---|
| | CY Month | w/Pump Flow Req | w/o Flow Req |
| (C 2.80) | 1 | 5 | 5 |
| | 2 | 5 | 5 |
| | 3 | 10 | 5 |
| | 4 | 15 | 5 |
| | 5 | 20 | 5 |
| | 6 | 20 | 5 |
| | 7 | 20 | 16 |
| | 8 | 20 | 16 |
| | 9 | 15 | 16 |
| | 10 | 10 | 5 |
| | 11 | 5 | 5 |
| | 12 | 5 | 5 |

Always uses w/Pump flow requirement

Eleanor to Lloyd tunnel capacity
(C 2.81) 400 cfs

Reservoir Management

| | Target Storage - Acre-feet | | |
|---|---|---|---|
| | CY Month | Soft Trgt EOM | Hard Limit EOM |
| (C 2.90) | 1 | 21,495 | 27,100 |
| | 2 | 21,495 | 27,100 |
| | 3 | 21,495 | 27,100 |
| | 4 | 27,100 | 27,100 |
| | 5 | 27,100 | 27,100 |
| | 6 | 27,100 | 27,100 |
| | 7 | 27,100 | 27,100 |
| | 8 | 27,100 | 27,100 |
| | 9 | 15,000 | 27,100 |
| | 10 | 15,000 | 27,100 |
| | 11 | 15,000 | 27,100 |
| | 12 | 18,250 | 27,100 |

Snowmelt release forecast parameters

Historical watershed runoff used for all forecasts of inflow (perfect foresight)

Release of forecasted excess runoff

| | | |
|---|---|---|
| (C 2a.10) | 20 | percent of Februay - June excess runoff during February |
| (C 2a.11) | 25 | percent of March - June excess runoff during March |
| (C 2a.12) | 33 | percent of April - June excess runoff during April |
| (C 2a.13) | 70 | percent of May - June excess runoff during June |
| (C 2a.14) | 100 | percent of June excess runoff during June |

Minimum storage of draw down for snowmelt release

(C 2a.20) 1,000 acre-feet

Maximum advised release for snowmelt

| | | |
|---|---|---|
| (C 2a.15) | 2,000 | cfs - February |
| (C 2a.16) | 2,000 | cfs - March |
| (C 2a.17) | 2,000 | cfs - April |
| (C 2a.18) | 2,000 | cfs - May |
| (C 2a.19) | 2,000 | cfs - June |

Target storage for filling at end of June

(C 2a.21) 27,100 acre-feet

**Figure 5.3-8. Lake Eleanor.**

CCSF Water Supply Parameters

| | Actions | | |
|---|---|---|---|
| | Level | Trigger Tot Sys Stor | Action % Del Reduc |
| (C 2a.30) | 0 | | 0 |
| | 1 | 1,100,000 | 10 |
| | 2 | 1,100,000 | 10 |
| | 3 | 700,000 | 20 |

**Figure 5.3-9. CCSF Water Supply Parameters.**

### 5.3.10 Section 3: Don Pedro Reservoir and CCSF Elevation/Storage/Area and Evaporation Factors

The section (Figure 5.3-10) provides entry of the physical elevation/storage/area relationship for Don Pedro Reservoir and CCSF reservoirs. The values entered at C 3.00 for Hetch Hetchy Reservoir, Lake Lloyd, Lake Eleanor and Don Pedro Reservoir are currently being used by the Model. The Model employs a table lookup function to determine the area of a reservoir based on storage. The area is multiplied by a reservoir's evaporation factor for the estimation of reservoir evaporation. The monthly evaporation factor for CCSF reservoirs is entered at C 3.10 and Don Pedro Reservoir's evaporation factors are entered at C 3.20. These reservoir rating tables and evaporation factors are consistent with the daily accounting of Tuolumne River flows between the Districts and CCSF.

### 5.3.11 Section 4: Don Pedro Reservoir Flood Control Reservation and Discretionary Target

This section (Figure 5.3-11) provides for the entry of the preferred storage target for Don Pedro Reservoir. Values entered at C 4.00 and C 4.01 advises the management of reservoir storage throughout a year. A hard limit of 2,030,000 acre-feet directs the maximum allowed storage in Don Pedro Reservoir at the end of each month. Model logic will not allow exceedence of these values and will release addition water from the facility if needed to not exceed the values. The soft target ("Final Target Storage" at C 4.00), also representing a value at the end of each day, when exceeded advises the model to make additional releases in order to not exceed that reservoir storage. Model logic computes the storage exceedence, if any, every seventh day and advises a release in addition to minimum releases. The rate of this additional release is equal to the exceedence volume spread over ten days. For transitional months when the soft target value at the end of a month differs from a previous month, the transition in storage target is parsed equally within the days of the month.

The guidance provided by this parameter manages Don Pedro Reservoir storage throughout the year for both ACOE objectives during the season of rain flood reservation space and additional discretionary reservoir storage space or targets to manage reservoir storage from one year to another.

**Section 3 - Don Pedro Reservoir and CCSF Reservoir Elevation/Storage/Area and Evaporation Factors**

(C 3.00)

| Hetch Hetchy Reservoir | | | Lake Lloyd | | | Lake Eleanor | | | Don Pedro Reservoir | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Elev - FT | Stor - AF | Area- Ac | Elev - FT | Stor - AF | Area- Ac | Elev - FT | Stor - AF | Area- Ac | Elev - FT | Stor - AF | Area- Ac |
| 3520.0 | 410 | 124.0 | 4440.0 | 0.0 | 5.0 | 4605.0 | 0.0 | 0.0 | | 0 | 0 |
| 3520.1 | 439 | 127.9 | 4440.1 | 1.0 | 5.1 | 4605.1 | 0.0 | 2.5 | | 0 | 0 |
| 3520.2 | 468 | 131.8 | 4440.2 | 2.0 | 5.1 | 4605.2 | 0.0 | 5.0 | | 0 | 0 |
| 3520.3 | 497 | 135.7 | 4440.3 | 2.0 | 5.2 | 4605.3 | 1.0 | 7.6 | | 1 | 1 |
| 3520.4 | 526 | 139.6 | 4440.4 | 3.0 | 5.2 | 4605.4 | 1.0 | 10.1 | | 1 | 1 |
| 3520.5 | 555 | 143.5 | 4440.5 | 4.0 | 5.3 | 4605.5 | 1.0 | 12.6 | | 3 | 2 |
| 3520.6 | 583 | 147.4 | 4440.6 | 5.0 | 5.3 | 4605.6 | 2.0 | 15.1 | | 5 | 3 |
| 3520.7 | 612 | 151.3 | 4440.7 | 5.0 | 5.4 | 4605.7 | 2.0 | 17.6 | | 8 | 3 |
| 3520.8 | 641 | 155.2 | 4440.8 | 6.0 | 5.4 | 4605.8 | 2.0 | 20.2 | | 12 | 4 |
| 3520.9 | 670 | 159.1 | 4440.9 | 7.0 | 5.5 | 4605.9 | 2.0 | 22.7 | | 17 | 6 |
| 3521.0 | 699 | 163.0 | 4441.0 | 8.0 | 5.5 | 4606.0 | 2.0 | 25.2 | 300.0 | 35 | 7 |
| 3521.1 | 728 | 166.9 | 4441.1 | 8.0 | 5.6 | 4606.1 | 3.0 | 27.7 | | 42 | 7 |
| 3521.2 | 757 | 170.8 | 4441.2 | 9.0 | 5.6 | 4606.2 | 3.0 | 30.2 | | 50 | 8 |
| 3521.3 | 786 | 174.7 | 4441.3 | 10.0 | 5.7 | 4606.3 | 3.0 | 32.7 | | 57 | 8 |
| 3521.4 | 815 | 178.6 | 4441.4 | 11.0 | 5.7 | 4606.4 | 3.0 | 35.3 | | 65 | 8 |
| 3521.5 | 843 | 182.5 | 4441.5 | 11.0 | 5.8 | 4606.5 | 4.0 | 37.8 | | 74 | 8 |
| 3521.6 | 872 | 186.4 | 4441.6 | 12.0 | 5.8 | 4606.6 | 4.0 | 40.3 | | 82 | 9 |
| 3521.7 | 901 | 190.3 | 4441.7 | 13.0 | 5.9 | 4606.7 | 4.0 | 42.8 | | 91 | 9 |
| 3521.8 | 930 | 194.2 | 4441.8 | 14.0 | 5.9 | 4606.8 | 4.0 | 45.3 | | 100 | 9 |
| 3521.9 | 959 | 198.1 | 4441.9 | 14.0 | 6.0 | 4606.9 | 5.0 | 47.9 | | 110 | 10 |
| 3522.0 | 988 | 202.0 | 4442.0 | 15.0 | 6.0 | 4607.0 | 5.0 | 50.4 | 310.0 | 120 | 10 |
| 3522.1 | 1017 | 205.9 | 4442.1 | 16.0 | 6.1 | 4607.1 | 5.0 | 52.9 | | 130 | 10 |
| 3522.2 | 1046 | 209.8 | 4442.2 | 17.0 | 6.1 | 4607.2 | 5.0 | 55.4 | | 140 | 10 |
| 3522.3 | 1075 | 213.7 | 4442.3 | 17.0 | 6.2 | 4607.3 | 6.0 | 57.9 | | 150 | 11 |
| 3522.4 | 1104 | 217.6 | 4442.4 | 18.0 | 6.2 | 4607.4 | 6.0 | 60.4 | | 161 | 11 |
| 3522.5 | 1133 | 221.5 | 4442.5 | 19.0 | 6.3 | 4607.5 | 6.0 | 63.0 | | 172 | 11 |
| 3522.6 | 1161 | 225.4 | 4442.6 | 20.0 | 6.3 | 4607.6 | 6.0 | 65.5 | | 183 | 11 |
| 3522.7 | 1190 | 229.3 | 4442.7 | 20.0 | 6.4 | 4607.7 | 7.0 | 68.0 | | 194 | 11 |
| 3522.8 | 1219 | 233.2 | 4442.8 | 21.0 | 6.4 | 4607.8 | 7.0 | 70.5 | | 206 | 12 |
| 3522.9 | 1248 | 237.1 | 4442.9 | 22.0 | 6.5 | 4607.9 | 7.0 | 73.0 | | 218 | 12 |
| 3523.0 | 1277 | 241.0 | 4443.0 | 23.0 | 6.5 | 4608.0 | 7.0 | 75.6 | 320.0 | 229 | 12 |
| 3523.1 | 1306 | 244.9 | 4443.1 | 23.0 | 6.6 | 4608.1 | 8.0 | 78.1 | | 242 | 13 |
| 3523.2 | 1335 | 248.8 | 4443.2 | 24.0 | 6.6 | 4608.2 | 8.0 | 80.6 | | 255 | 13 |
| 3523.3 | 1364 | 252.7 | 4443.3 | 25.0 | 6.7 | 4608.3 | 8.0 | 83.1 | | 268 | 14 |
| 3523.4 | 1393 | 256.6 | 4443.4 | 26.0 | 6.7 | 4608.4 | 8.0 | 85.6 | | 283 | 15 |
| 3523.5 | 1422 | 260.5 | 4443.5 | 26.0 | 6.8 | 4608.5 | 9.0 | 88.2 | | 297 | 15 |

Evaporation Factors

| CCSF Reservoirs | | (C 3.10) |
|---|---|---|
| | | CFS/Ac/Day |
| Jan | 1 = | -0.00325 |
| Feb | 2 = | -0.0036 |
| Mar | 3 = | 0 |
| Apr | 4 = | 0 |
| May | 5 = | 0.003253 |
| Jun | 6 = | 0.006722 |
| Jul | 7 = | 0.009758 |
| Aug | 8 = | 0.009758 |
| Sep | 9 = | 0.006722 |
| Oct | 10 = | 0.003253 |
| Nov | 11 = | 0 |
| Dec | 12 = | 0 |

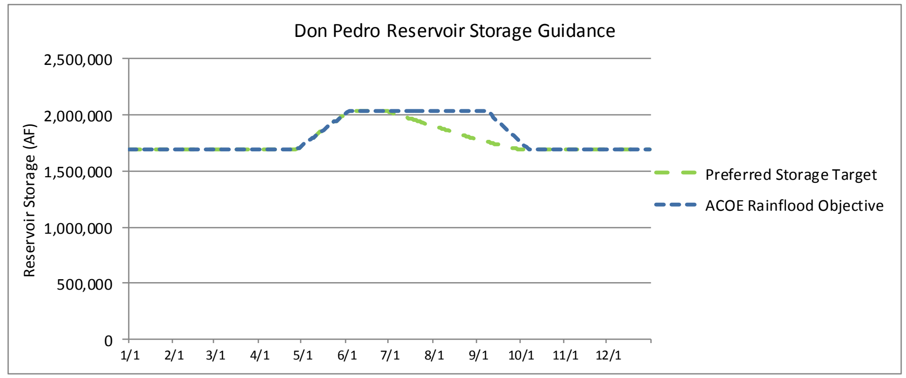
Evaporation Factors

| Don Pedro Reservoir | | (C 3.20) |
|---|---|---|
| | | CFS/Ac/Day |
| Jan | 1 = | -0.00088 |
| Feb | 2 = | -0.00026 |
| Mar | 3 = | 0.001135 |
| Apr | 4 = | 0.003081 |
| May | 5 = | 0.007968 |
| Jun | 6 = | 0.010947 |
| Jul | 7 = | 0.013976 |
| Aug | 8 = | 0.014109 |
| Sep | 9 = | 0.01072 |
| Oct | 10 = | 0.006395 |
| Nov | 11 = | 0.001781 |
| Dec | 12 = | -0.00013 |

**Figure 5.3-10. Don Pedro Reservoir and CCSF Reservoir Characteristics.**

**Section 4 - Don Pedro Reservoir Flood Control Reservation Space and Preferred Storage Target**

| | |
|---|---|
| *Full Res* | *ACOE thru* |
| *(2,030,000)* | *June* |
| *Less* | *1,906,000* |
| *ACOE* | *Jul 31* |
| *RF Space* | *1,782,000* |
| | *Aug 31* |
| | *1,692,000* |
| | *Sep 30* |
| | *UCOE* |
| | *therefter* |




(C 4.00)

| Don Pedro Reservoir FC/Discretionary/Drawdown Space | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mo/Day | Mo/Day Index | | ACOE RF Space AF | DP RF Storage AF | Add Descr Storage AF | Add Descr Modifier AF | Final Target Storage AF |
| 1/1 | 1.01 | | 340,000 | 1,690,000 | | | 1,690,000 |
| 1/2 | 1.02 | | 340,000 | 1,690,000 | | | 1,690,000 |
| 1/3 | 1.03 | | 340,000 | 1,690,000 | | | 1,690,000 |
| 1/4 | 1.04 | | 340,000 | 1,690,000 | | | 1,690,000 |
| 1/5 | 1.05 | | 340,000 | 1,690,000 | | | 1,690,000 |
| 1/6 | 1.06 | | 340,000 | 1,690,000 | | | 1,690,000 |
| 1/7 | 1.07 | | 340,000 | 1,690,000 | | | 1,690,000 |
| 1/8 | 1.08 | | 340,000 | 1,690,000 | | | 1,690,000 |
| 1/9 | 1.09 | | 340,000 | 1,690,000 | | | 1,690,000 |
| 1/10 | 1.10 | | 340,000 | 1,690,000 | | | 1,690,000 |
| 1/11 | 1.11 | | 340,000 | 1,690,000 | | | 1,690,000 |
| 1/12 | 1.12 | | 340,000 | 1,690,000 | | | 1,690,000 |
| 1/13 | 1.13 | | 340,000 | 1,690,000 | | | 1,690,000 |
| 1/14 | 1.14 | | 340,000 | 1,690,000 | | | 1,690,000 |
| 1/15 | 1.15 | | 340,000 | 1,690,000 | | | 1,690,000 |
| 1/16 | 1.16 | | 340,000 | 1,690,000 | | | 1,690,000 |
| 1/17 | 1.17 | | 340,000 | 1,690,000 | | | 1,690,000 |

ACOE Rainflood (AF) End-of-month

| | | | |
|---|---|---|---|
| Jan | 1,690,000 | Jul | 2,030,000 |
| Feb | 1,690,000 | Aug | 2,030,000 |
| Mar | 1,690,000 | Sep | 1,772,600 |
| Apr | 1,717,600 | Oct | 1,690,000 |
| May | 2,002,800 | Nov | 1,690,000 |
| Jun | 2,030,000 | Dec | 1,690,000 |

| | (C 4.01) Discretionar Guide AF |
|---|---|
| 1 Jan | 0 |
| 2 Feb | 0 |
| 3 Mar | 0 |
| 4 Apr | 0 |
| 5 May | 0 |
| 6 Jun | 0 |
| 7 Jul | 0 |
| 8 Aug | 0 |
| 9 Sep | 0 |
| 10 Oct | 0 |
| 11 Nov | 0 |
| 12 Dec | 0 |

**Figure 5.3-11. Don Pedro Reservoir Flood Control and Discretionary Target.**

## 5.4 Output Worksheet

This worksheet (Output) provides an interface between Model computations and summary and analysis tools. It also provides a formatted set of information usable for exchange into an HEC-DSS database file, such as used to provide information to the temperature models used for this FERC investigation. Information concerning HEC-DSS can be found on the HEC web site at: http://www.hec.usace.army.mil/software/hec-dss/hecdss-dss.html

The structure and contents of worksheet Output accommodates the use of the HEC-DSS Excel Data Exchange Add-in which is an application for retrieving and storing interval time series data, in this circumstance the daily results of the Model.

Results provided in worksheet Output are directly linked to the computational and input worksheets of the Model. For instance, the daily inflow to Don Pedro Reservoir listed in worksheet Output is the value provided to worksheet DonPedro for its computations, which is dependent upon several other computation worksheets. As such, any change to model assumptions or data which causes a recalculation by the model will automatically update the values in worksheet Output. To preserve or store the results of a particular model study a copy of the worksheet should be created with a unique tab name and its contents converted to values. The HEC-DSS Add-in could also be used to create a unique database file for later use. Alternatively, but storage consuming, the entire Model could be saved as a unique study. However, this approach is not recommended as the worksheet Output will continue to be dynamically linked to the model's computational worksheets and any subsequent change to model assumptions will overwrite the results previously provided in the worksheet. More than 110 parameters are reported in the worksheet, representing salient information concerning the simulated operations and hydrology of the Tuolumne River and the Districts' and CCSF's facilities. Shown in Figure 5.4-1 is a snapshot of the content and format of the worksheet. Table 5.4-1 provides a listing of the parameters including their HEC-DSS name parts.

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | TUOLUMNE | TUOLUMNE | TUOLUMNE | TUOLUMNE | TUOLUMNE | TUOLUMNE | TUOLUMNE | TUOLUMNE | TUOLUMNE | TUOLUMNE | TUOLUMNE | TUOLUMNE | TUOLUMNE |
| 2 | 2 | TUOLUMNEI | TUOLUMNEI | TUOLUMNEI | TUOLUMNEI | TUOLUMNEI | DONPEDRO | DONPEDRO | DONPEDRO | DONPEDRO | DONPEDRO | DONPEDRO | DONPEDRO | DONPEDRO |
| 3 | 3 | FLOW-LAGRANGE UNIMP | FLOW-HHUNIMP | FLOW-LLOYDUNI MP | FLOW-ELEANORU NIMP | FLOW-UNREGUNI MP | FLOW-TOTINFLO W | FLOW-SUP1INFLO WLL | FLOW-SUP2INFLO WHH | FLOW-INFLOWHH | FLOW-INFLOWLL | FLOW-INFLOWEL | STORAGE | EVAP |
| 4 | 4 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 5 | 5 | 1DAY | 1DAY | 1DAY | 1DAY | 1DAY | 1DAY | 1DAY | 1DAY | 1DAY | 1DAY | 1DAY | 1DAY | 1DAY |
| 6 | 6 | Test_Base | Test_Base | Test_Base | Test_Base | Test_Base | Test_Base | Test_Base | Test_Base | Test_Base | Test_Base | Test_Base | Test_Base | Test_Base |
| 7 | 7 | 1-Oct-70 | 1-Oct-70 | 1-Oct-70 | 1-Oct-70 | 1-Oct-70 | 1-Oct-70 | 1-Oct-70 | 1-Oct-70 | 1-Oct-70 | 1-Oct-70 | 1-Oct-70 | 1-Oct-70 | 1-Oct-70 |
| 8 | 8 | 2400 | 2400 | 2400 | 2400 | 2400 | 2400 | 2400 | 2400 | 2400 | 2400 | 2400 | 2400 | 2400 |
| 9 | 9 | 30-Sep-09 | 30-Sep-09 | 30-Sep-09 | 30-Sep-09 | 30-Sep-09 | 30-Sep-09 | 30-Sep-09 | 30-Sep-09 | 30-Sep-09 | 30-Sep-09 | 30-Sep-09 | 30-Sep-09 | 30-Sep-09 |
| 10 | 10 | 2400 | 2400 | 2400 | 2400 | 2400 | 2400 | 2400 | 2400 | 2400 | 2400 | 2400 | 2400 | 2400 |
| 11 | 11 | CFS | CFS | CFS | CFS | CFS | CFS | AF | AF | CFS | CFS | CFS | AF | AF |
| 12 | | PER_AVER | PER_AVER | PER_AVER | PER_AVER | PER_AVER | PER_AVER | PER_AVER | PER_AVER | PER_AVER | PER_AVER | PER_AVER | PER_AVER | PER_AVER |
| 13 | 10/1/1970 | 159 | 79 | 56 | 25 | -1 | 322 | 0 | 0 | 90 | 223 | 10 | 1,666,767 | 143 |
| 14 | 10/2/1970 | 55 | -82 | 5 | 2 | 130 | 453 | 0 | 0 | 90 | 223 | 10 | 1,664,567 | 141 |
| 15 | 10/3/1970 | 265 | 25 | 15 | 7 | 218 | 541 | 0 | 0 | 90 | 223 | 10 | 1,662,719 | 141 |
| 16 | 10/4/1970 | -166 | 110 | -399 | -179 | 302 | 625 | 0 | 0 | 90 | 223 | 10 | 1,659,892 | 141 |
| 17 | 10/5/1970 | 180 | -38 | 322 | 144 | -248 | 75 | 0 | 0 | 90 | 223 | 10 | 1,656,745 | 141 |
| 18 | 10/6/1970 | 92 | 9 | -48 | -21 | 152 | 475 | 0 | 0 | 90 | 223 | 10 | 1,654,119 | 141 |
| 19 | 10/7/1970 | 150 | 21 | -51 | -23 | 203 | 526 | 0 | 0 | 90 | 223 | 10 | 1,652,009 | 140 |
| 20 | 10/8/1970 | 153 | -29 | 54 | 24 | 104 | 209 | 0 | 0 | 90 | 5 | 10 | 1,650,525 | 140 |
| 21 | 10/9/1970 | 146 | -28 | 10 | 5 | 159 | 264 | 0 | 0 | 90 | 5 | 10 | 1,648,926 | 140 |
| 22 | 10/10/1970 | 99 | 30 | -25 | -11 | 105 | 210 | 0 | 0 | 90 | 5 | 10 | 1,647,059 | 140 |
| 23 | 10/11/1970 | 293 | 176 | -275 | -123 | 515 | 620 | 0 | 0 | 90 | 5 | 10 | 1,645,737 | 140 |

**Figure 5.4-1. Sample Parameters Listed in Output Worksheet.**

**Table 5.4-1. Columnar Description for Parameters Listed in Output Worksheet.**

| Column | Col No | DSS - Part B | DSS - Part C | Units | Description |
|---|---|---|---|---|---|
| B | 2 | TUOLUMNERIVER | FLOW-LAGRANGEUNIMP | CFS | Unimpaired flow of Tuolumne River as computed at "La Grange" |
| C | 3 | TUOLUMNERIVER | FLOW-HHUNIMP | CFS | Unimpaired flow at Hetch Hetchy Reservoir (inflow) |
| D | 4 | TUOLUMNERIVER | FLOW-LLOYDUNIMP | CFS | Unimpaired flow at Lake Lloyd (inflow) |
| E | 5 | TUOLUMNERIVER | FLOW-ELEANORUNIMP | CFS | Unimpaired flow at Lake Eleanor (inflow) |
| F | 6 | TUOLUMNERIVER | FLOW-UNREGUNIMP | CFS | Unregulated inflow into Don Pedro Reservoir |
| G | 7 | DONPEDRO | FLOW-TOTINFLOW | CFS | Total inflow into Don Pedro Reservoir |
| H | 8 | DONPEDRO | FLOW-SUP1INFLOWLL | AF | Supplemental release from Lake Lloyd |
| I | 9 | DONPEDRO | FLOW-SUP2INFLOWHH | AF | Supplemental release from Hetch Hetchy Reservoir |
| J | 10 | DONPEDRO | FLOW-INFLOWHH | CFS | Total inflow into Don Pedro Reservoir from Hetch Hetchy Reservoir |
| K | 11 | DONPEDRO | FLOW-INFLOWLL | CFS | Total inflow into Don Pedro Reservoir from Lake Lloyd |
| L | 12 | DONPEDRO | FLOW-INFLOWEL | CFS | Total inflow into Don Pedro Reservoir from Lake Eleanor |
| M | 13 | DONPEDRO | STORAGE | AF | Don Pedro Reservoir storage |
| N | 14 | DONPEDRO | EVAP | AF | Don Pedro Reservoir evaporation |
| O | 15 | DONPEDRO | STORAGE-RFTRG | AF | Don Pedro Reservoir storage target assuming USCOE rainflood reservation space |
| P | 16 | DONPEDRO | STORAGE-SOFTTRG | AF | Don Pedro Reservoir storage target assuming USCOE rainflood reservation space and other guidance |
| Q | 17 | DONPEDRO | RELEASE-7DAYENCRADVISE | CFS | Don Pedro Reservoir advised release for target storage enchroachment |
| R | 18 | DONPEDRO | RELEASE-SNOWADVISE | CFS | Don Pedro Reservoir advised release for spring-time snowmelt release |
| S | 19 | DONPEDRO | RELEASE-TOTAL | CFS | Don Pedro Reservoir total release |
| T | 20 | DONPEDRO | POWR-MW | MW | Don Pedro Powerplant Capability |
| U | 21 | DONPEDRO | POWR-EFF | kWh/AF | Don Pedro Powerplant efficiency |
| V | 22 | DONPEDRO | POWR-MWh | MWh | Don Pedro Powerplant energy production |
| W | 23 | DONPEDRO | RELEASE-PH | AF | Don Pedro Powerplant release |
| X | 24 | DONPEDRO | RELEASE-BYPASS | AF | Don Pedro Powerplant bypass release |
| Y | 25 | DONPEDRO | FLOW-TOTCANALS | AF | Don Pedro Reservoir release for combined MID/TID canals |
| Z | 26 | LAGRANGE | RELEASE-MINQ | CFS | Minimum Tuolumne River release requirement (at La Grange) |
| AA | 27 | LAGRANGE | RELEASE-TOTAL | CFS | Total Tuolumne River Release below La Grange Dam |
| AB | 28 | LAGRANGE | RELEASE-MCANAL | CFS | Diversion to Modesto Canal |
| AC | 29 | LAGRANGE | RELEASE-TCANAL | CFS | Diversion to Turlock Canal |
| AD | 30 | LAGRANGE | FULLCANALREQ | AF | Full canal demand of combined MID/TID canals |
| AE | 31 | RIVER | FLOW-LTRACC1 | CFS | Lower Tuolumne River accretion 1 (placeholder) |
| AF | 32 | RIVER | FLOW-LTRACC2 | CFS | Lower Tuolumne River accretion 2 (placeholder) |
| AG | 33 | RIVER | FLOW-LTRACC3 | CFS | Lower Tuolumne River accretion 3 (placeholder) |
| AH | 34 | RIVER | FLOW-LTRACC4 | CFS | Lower Tuolumne River accretion 4 (currently contains synthetic record of accretion blw La Grange) |
| AI | 35 | RIVER | FLOW-DRYCK | CFS | Tuolumne River inflow from Dry Creek |
| AJ | 36 | RIVER | FLOW-LTRACC5 | CFS | Lower Tuolumne River accretion 5 (placeholder) |
| AK | 37 | RIVER | FLOW-TR1 | CFS | Lower Tuolume River flow at end of accretion reach 1 (placeholder) |
| AL | 38 | RIVER | FLOW-TR2 | CFS | Lower Tuolume River flow at end of accretion reach 2 (placeholder) |
| AM | 39 | RIVER | FLOW-TR3 | CFS | Lower Tuolume River flow at end of accretion reach 3 (placeholder) |
| AN | 40 | RIVER | FLOW-TR4 | CFS | Lower Tuolume River flow at end of accretion reach 4 (placeholder) |
| AO | 41 | RIVER | FLOW-MODMAX | CFS | Target flow for Tuolumne River below Modesto |
| AP | 42 | RIVER | FLOW-MODMAXLG | CFS | Maximum target release from La Grange to not exceed target flow below Modesto |
| AQ | 43 | RIVER | FLOW-MODESTO | CFS | Flow of Tuolumne River below Modesto |
| AR | 44 | RIVER | FLOW-TR5 | CFS | Lower Tuolume River flow at end of accretion reach 5 (placeholder) |
| AS | 45 | MIDCANAL | MIDAGPDAW | AF | Projected demand for applied water in MID |
| AT | 46 | MIDCANAL | MIDMI | AF | Projected demand for municipal and industrial uses from MID |
| AU | 47 | MIDCANAL | MIDFACT | PERCENT | Adjustment factor between MID PDAW and canal turnouts |
| AV | 48 | MIDCANAL | MIDNOMGWPRVT | AF | Nominal private groundwater pumping in MID |
| AW | 49 | MIDCANAL | MIDOPSPLS | AF | MID Canal operation spills |
| AX | 50 | MIDCANAL | MIDLOSS | AF | MID Canal losses |
| AY | 51 | MIDCANAL | MIDINTCP | AF | MID Canal intercepted other flows |
| AZ | 52 | MIDCANAL | MIDNOMGWDIST | AF | MID nominal district groundwater pumping |
| BA | 53 | MIDCANAL | MIDUPSYSLOSSDIV | AF | MID Canal upper system losses including seepage from Modesto Lake |
| BB | 54 | MIDCANAL | MIDLKDIV | AF | Modesto Lake diversions (water treatment plant) |
| BC | 55 | MIDCANAL | MIDLKSTORCHNG | AF | Modesto Lake change in storage |
| BD | 56 | MIDCANAL | MIDFULLREQ | AF | Full canal demand of MID |

| Column | Col No | DSS - Part B | DSS - Part C | Units | Description |
|---|---|---|---|---|---|
| BE | 57 | TIDCANAL | TIDAGPDAW | AF | Projected demand for applied water in TID |
| BF | 58 | TIDCANAL | TIDMI | AF | Projected demand for municipal and industrial uses from TID (placeholder) |
| BG | 59 | TIDCANAL | TIDFACT | PERCENT | Adjustment factor between TID PDAW and canal turnouts |
| BH | 60 | TIDCANAL | TIDNOMGWPRVT | AF | Nominal private groundwater pumping in TID |
| BI | 61 | TIDCANAL | TIDOPSPLS | AF | TID Canal operation spills |
| BJ | 62 | TIDCANAL | TIDLOSS | AF | TID Canal losses |
| BK | 63 | TIDCANAL | TIDINTCP | AF | TID Canal intercepted other flows |
| BL | 64 | TIDCANAL | TIDNOMGWDIST | AF | TID nominal district groundwater pumping |
| BM | 65 | TIDCANAL | TIDUPSYSLOSSDIV | AF | TID Canal upper system losses including seepage from Modesto Lake |
| BN | 66 | TIDCANAL | TIDLKDIV | AF | Turlock Lake diversions (placeholder) |
| BO | 67 | TIDCANAL | TIDLKSTORCHNG | AF | Turlock Lake change in storage |
| BP | 68 | TIDCANAL | TIDFULLREQ | AF | Full canal demand of TID |
| BQ | 69 | DONPEDRO | DPFACT | UNIT | Don Pedro water supply factor |
| BR | 70 | SANFRAN | SFSJPLBASE | AF | CCSF San Joaquin Pipeline diversion - Comparison base |
| BS | 71 | SANFRAN | SFLOCALSTOR | AF | CCSF Local Bay Area System reservoir storage |
| BT | 72 | SANFRAN | SFSJPL | AF | CCSF San Joaquin Pipeline diversion - scenario |
| BU | 73 | SANFRAN | SFTOTSYSSTOR | AF | CCSF total system reservoir storage |
| BV | 74 | SANFRAN | SFTOTTRSYSSTOR | AF | CCSF total Tuolumne River system reservoir storage |
| BW | 75 | SANFRAN | SFSUPPREL | UNIT | CCSF total supplemental release |
| BX | 76 | SANFRAN | SFSUPPTAB | UNIT | CCSF supplemental release directed by year type table |
| BY | 77 | SANFRAN | TRIGGER | UNIT | CCSF water supply action level |
| BZ | 78 | SANFRAN | WBBAL | UNIT | CCSF Water Bank Account balance |
| CA | 79 | HETCH | HATCH-GRVLND | CFS | Moccasin Hatchery and Groveland flow requirements |
| CB | 80 | HETCH | HATCH-RTRN | CFS | Return flow to Tuolumne River from Mocassin Hatchery |
| CC | 81 | HETCH | RELEASE-MINQ1 | CFS | Hetch Hetchy Reservoir flow requirement (below dam) prior to Canyon Tunnel stipulation |
| CD | 82 | HETCH | RELEASE-TOTMINQ | CFS | Hetch Hetchy Reservoir flow requirement (below dam) after consideration of Canyon Tunnel flow |
| CE | 83 | HETCH | RELEASE-7DAYENCRADVISE | CFS | Hetch Hetchy Reservoir advised release for target storage enchroachment |
| CF | 84 | HETCH | RELEASE-SNOWADVISE | CFS | Hetch Hetchy Reservoir advised release for spring-time snowmelt release |
| CG | 85 | HETCH | RELEASE-TOTAL | CFS | Hetch Hetchy Reservoir total release |
| CH | 86 | HETCH | STORAGE | AF | Hetch Hetchy Reservoir storage |
| CI | 87 | HETCH | EVAP | AF | Hetch Hetchy Reservoir evaporation |
| CJ | 88 | HETCH | STORAGE-SOFTTRG | AF | Hetch Hetchy Reservoir storage target |
| CK | 89 | LLOYD | RELEASE-MINSTRMQ | CFS | Lake Lloyd flow requirement (below dam) |
| CL | 90 | LLOYD | RELEASE-MINHOLM | CFS | Minimum Lake Lloyd release to Holm Powerplant |
| CM | 91 | LLOYD | RELEASE-7DAYENCRADVISE | CFS | Lake Lloyd advised release for target storage enchroachment |
| CN | 92 | LLOYD | RELEASE-SNOWADVISE | CFS | Lake Lloyd advised release for snowmelt release |
| CO | 93 | LLOYD | RELEASE-LLOYDONLYHOLM | CFS | Lake Lloyd release to Holm Powerplant (Lake Lloyd operation) |
| CP | 94 | LLOYD | HOLMAVAILEL | CFS | Available capacity at Holm Powerplant for Eleanor transfer |
| CQ | 95 | LLOYD | RELEASE-TOTHOLM | CFS | Total Holm Powerplant flow |
| CR | 96 | LLOYD | RELEASE-TOTLLOYD | CFS | Lake Lloyd total release |
| CS | 97 | LLOYD | STORAGE | AF | Lake Lloyd storage |
| CT | 98 | LLOYD | EVAP | AF | Lake Lloyd evaporation |
| CU | 99 | LLOYD | STORAGE-SOFTTRG | AF | Lake Lloyd storage target |
| CV | 100 | ELEANOR | RELEASE-MINSTRMQ | CFS | Lake Eleanor flow requirement (below dam) |
| CW | 101 | ELEANOR | RELEASE-7DAYENCRADVISE | CFS | Lake Eleanor advised release for target storage enchroachment |
| CX | 102 | ELEANOR | RELEASE-SNOWADVISE | CFS | Lake Eleanor advised release for snowmelt release |
| CY | 103 | ELEANOR | TUNTRNSFCAP | CFS | Eleanor - Lloyd tunnel capacity |
| CZ | 104 | ELEANOR | FLOW-TUNNEL | CFS | Eleanor - Lloyd tunnel flow |
| DA | 105 | ELEANOR | RELEASE-STREAM | CFS | Lake Eleanor release to stream |
| DB | 106 | ELEANOR | RELEASE-TOTELEANOR | CFS | Lake Eleanor total release |
| DC | 107 | ELEANOR | STORAGE | AF | Lake Eleanor storage |
| DD | 108 | ELEANOR | EVAP | AF | Lake Eleanor evaporation |
| DE | 109 | ELEANOR | STORAGE-SOFTTRG | AF | Lake Eleanor storage target |
| DF | 110 | TUOLUMNERIVER | YEARMON | UNIT | Calendar year and month (YYYY.MM) |
| DG | 111 | LAGRANGE | CCSFLAGRANGERESP | AF | CCSF La Grange release responsibility |
| DH | 112 | TUOLUMNERIVER | SWITCHES | UNIT | Echo values of input from UserInput and Control worksheets |

## 5.5 DSSAnyGroup Worksheet

This worksheet (DSSAnyGroup) provides plotting of up to ten parameters provided in worksheet Output or another equally formatted worksheet of results. One calendar year (the same year or different years) of data for a parameter can be plotted. The parameter(s) to be plotted are identified by reference worksheet name and column. Figure 5.5-1 is a snapshot of the identification parameters and result values.

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **DSSAnyGroup** | | | | | | | | | | | | | |
| 2 | This sheet illustrates a CY of daily results from Model sheets in graphic format. | | | | | | | | | | | | | |
| 3 | Axis Reference | 1 | | 1 | | 2 | | 2 | | 2 | | 2 | | 1 |
| 4 | Enter CY Graph Year: | 1984 | | 1984 | | 1984 | | 1984 | | 1984 | | 1984 | | 1984 |
| 5 | Enter Sheet Name: | OUTPUT1 | | OUTPUT2 | | OUTPUT2 | | OUTPUT1 | | OUTPUT | | OUTPUT2 | | OUTPUT |
| 6 | Column: | #N/A | | 13 | | 27 | | #N/A | | 26 | | 26 | | #N/A |
| 7 | Enter Column: | | | M | | AA | | | | Z | | Z | | |
| 8 | Data Reference: | #REF! | Date | DONPEDRO STORAGE - AF (OUTPUT2) | Date | LAGRANGE RELEASE- TOTAL - CFS (OUTPUT2) | Date | #REF! | Date | LAGRANGE RELEASE- MINQ - CFS (OUTPUT) | Date | LAGRANGE RELEASE- MINQ - CFS (OUTPUT2) | Date | #REF! |
| 9 | Enter Scaler: | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 |
| 10 | 1-Jan-84 | #REF! | 1-Jan-84 | 1,765,400 | 1-Jan-84 | 8,681 | 1-Jan-84 | #REF! | 1-Jan-84 | 300 | 1-Jan-84 | 300 | 1-Jan-84 | #REF! |
| 11 | 2-Jan-84 | #REF! | 2-Jan-84 | 1,762,808 | 2-Jan-84 | 8,732 | 2-Jan-84 | #REF! | 2-Jan-84 | 300 | 2-Jan-84 | 300 | 2-Jan-84 | #REF! |
| 12 | 3-Jan-84 | #REF! | 3-Jan-84 | 1,759,443 | 3-Jan-84 | 8,758 | 3-Jan-84 | #REF! | 3-Jan-84 | 300 | 3-Jan-84 | 300 | 3-Jan-84 | #REF! |
| 13 | 4-Jan-84 | #REF! | 4-Jan-84 | 1,757,150 | 4-Jan-84 | 8,773 | 4-Jan-84 | #REF! | 4-Jan-84 | 300 | 4-Jan-84 | 300 | 4-Jan-84 | #REF! |
| 14 | 5-Jan-84 | #REF! | 5-Jan-84 | 1,749,651 | 5-Jan-84 | 8,683 | 5-Jan-84 | #REF! | 5-Jan-84 | 300 | 5-Jan-84 | 300 | 5-Jan-84 | #REF! |
| 15 | 6-Jan-84 | #REF! | 6-Jan-84 | 1,741,186 | 6-Jan-84 | 8,683 | 6-Jan-84 | #REF! | 6-Jan-84 | 300 | 6-Jan-84 | 300 | 6-Jan-84 | #REF! |
| 16 | 7-Jan-84 | #REF! | 7-Jan-84 | 1,735,636 | 7-Jan-84 | 8,683 | 7-Jan-84 | #REF! | 7-Jan-84 | 300 | 7-Jan-84 | 300 | 7-Jan-84 | #REF! |
| 17 | 8-Jan-84 | #REF! | 8-Jan-84 | 1,726,314 | 8-Jan-84 | 8,683 | 8-Jan-84 | #REF! | 8-Jan-84 | 300 | 8-Jan-84 | 300 | 8-Jan-84 | #REF! |
| 18 | 9-Jan-84 | #REF! | 9-Jan-84 | 1,718,101 | 9-Jan-84 | 8,683 | 9-Jan-84 | #REF! | 9-Jan-84 | 300 | 9-Jan-84 | 300 | 9-Jan-84 | #REF! |
| 19 | 10-Jan-84 | #REF! | 10-Jan-84 | 1,708,161 | 10-Jan-84 | 8,683 | 10-Jan-84 | #REF! | 10-Jan-84 | 300 | 10-Jan-84 | 300 | 10-Jan-84 | #REF! |
| 20 | 11-Jan-84 | #REF! | 11-Jan-84 | 1,696,327 | 11-Jan-84 | 8,683 | 11-Jan-84 | #REF! | 11-Jan-84 | 300 | 11-Jan-84 | 300 | 11-Jan-84 | #REF! |
| 21 | 12-Jan-84 | #REF! | 12-Jan-84 | 1,691,421 | 12-Jan-84 | 5,421 | 12-Jan-84 | #REF! | 12-Jan-84 | 300 | 12-Jan-84 | 300 | 12-Jan-84 | #REF! |
| 22 | 13-Jan-84 | #REF! | 13-Jan-84 | 1,686,396 | 13-Jan-84 | 5,421 | 13-Jan-84 | #REF! | 13-Jan-84 | 300 | 13-Jan-84 | 300 | 13-Jan-84 | #REF! |
| 23 | 14-Jan-84 | #REF! | 14-Jan-84 | 1,680,358 | 14-Jan-84 | 5,421 | 14-Jan-84 | #REF! | 14-Jan-84 | 300 | 14-Jan-84 | 300 | 14-Jan-84 | #REF! |
| 24 | 15-Jan-84 | #REF! | 15-Jan-84 | 1,674,328 | 15-Jan-84 | 5,421 | 15-Jan-84 | #REF! | 15-Jan-84 | 300 | 15-Jan-84 | 300 | 15-Jan-84 | #REF! |
| 25 | 16-Jan-84 | #REF! | 16-Jan-84 | 1,669,263 | 16-Jan-84 | 5,421 | 16-Jan-84 | #REF! | 16-Jan-84 | 300 | 16-Jan-84 | 300 | 16-Jan-84 | #REF! |

**Figure 5.5-1. DSSAnyGroup Worksheet Input Interface.**

Values are plotted to either the primary y-axis or secondary y-axis. The “axis reference” indicates to which axis the value will be plotted by default. The designation of y-axis assignment is not modified by this field, and the user must edit the series data within the plot to change the y-axis assignment, graph type or line or shape characteristics. The “enter graph year” is a user entry. The same year or different year of a parameter or multiple parameters can be plotted. “Sheet name” is a user entry, and identifies from which Output-formatted worksheet the parameter is to be acquired. The “enter column” entry identifies from which column the parameter occurs. Refer to Table 5.4-1 of the description for worksheet Output for the identification of the column associated with each parameter. Upon proper entry of a parameter a return of the parameter’s label and source worksheet will occur in the “data reference” field. Values for the specified calendar year will also be returned in the data field. If a plotting position is not used, a “#VALUE!” or “#REF!” will be returned. The “scaler” field is provided to allow the conversion or scaling of the data returned from the result worksheet. For instance, if the daily data occurs in the result worksheet in units of daily average flow (cfs) it could be plotted in units of daily volume (acre-feet) by entering the conversion factor of 1.983471. The entry in the field acts as a multiplier to the value occurring in the result worksheet. This field can also be used to scale two different “order of magnitude” parameters to use the same y-axis.

The results of up to ten parameters will be plotted. An example of the several plotted parameters from two different studies is shown in Figure 5.5-2.

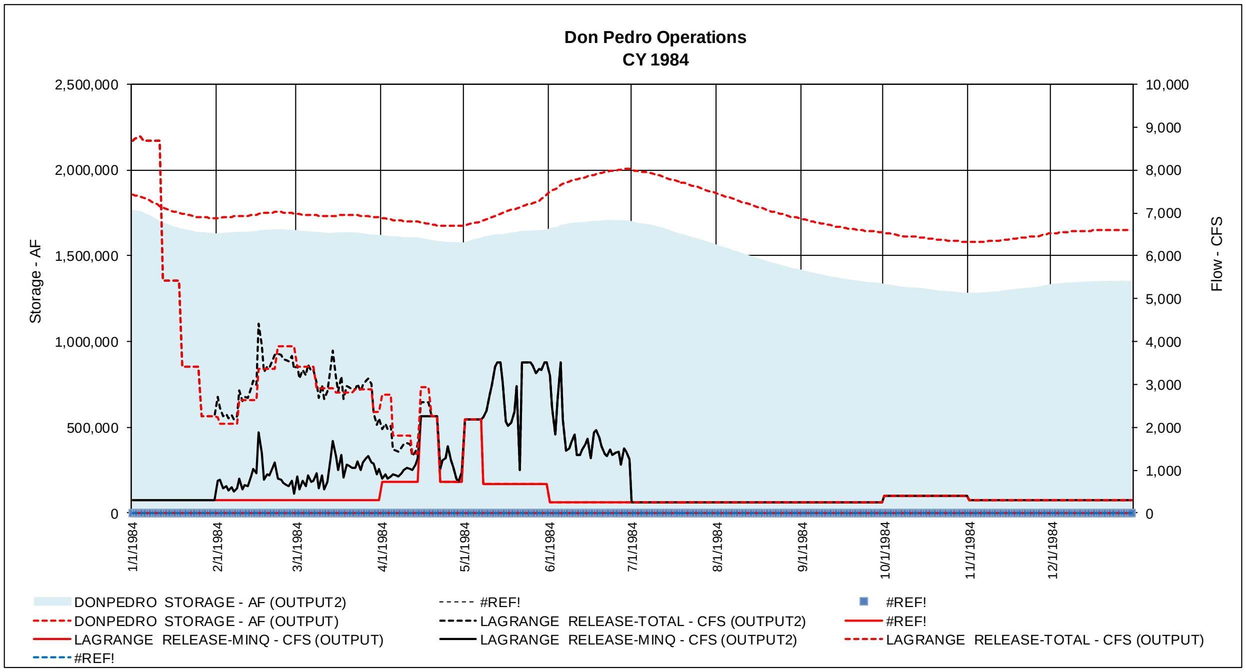



**Figure 5.5-2. DSSAnyGroup Worksheet Plotting.**

Unused plotting positions will appear with values plotted at "zero" and will have legends of "#VALUE!" or "#REF!". To create graphs without unused positions a copy of the plot can be made and positioned elsewhere in the worksheet. The unwanted positions can then be deleted from the plot.

## 5.6 DSSMonthTable Worksheet

This worksheet (DSSMonthTable) provides summation or averaging, and plotting of up to four parameters provided in worksheet Output or another equally formatted worksheet of results. The function of this worksheet is to provide a synthesis of the daily result data into monthly results thus reducing the handling and display of over 14,000 values for each parameter (39 years of days) to 468 values (39 years of months).

The parameter(s) to be plotted or tabled are identified by reference worksheet name and column, very similarly to the method identified for worksheet DSSAnyGroup. Figure 5.6-1 is a snapshot of the identification parameters and result values.

Each parameter is tabled and plotted separately for the entire 39-year simulation period. "Sheet name" is a user entry, and identifies from which Output-formatted worksheet the parameter is to be acquired. The "enter column letter" entry identifies from which column the parameter occurs. Refer to Table 5.4-2 of the description for worksheet Output for the identification of the column associated with each parameter. Upon proper entry of a parameter a return of the parameter's label, source worksheet and the native unit of the parameter will occur. Depending on need, the "conversion" entry is provided. This entry, a keyed value of 0 to 5, directs the worksheet on the handling of the daily data. An entry of 1 will direct the worksheet to sum the daily data into monthly increments in the parameter's native units (e.g., daily acre-feet into monthly volumes).

An entry of 1 will convert the daily data from a native unit of flow (cfs) into monthly volumes of acre-feet. An entry of 2 will convert the daily data from a native unit of volume (acre-feet) into a monthly sum of daily flow in units of cfs. An entry of 3 will act as an entry of 1 except convert the result into monthly volumes with units of 1,000 acre-feet. An entry of 4 will table and plot the daily value associated with the last day of each month in its native unit, and is primarily intended to analyze reservoir storage. An entry of 5 will report the average of daily values within a month. Depending on the entry in the conversion field, the converted unit will be returned to "converted unit" field. Values for the each month of the simulation period will also be returned in the data field. If a plotting position is not used, a "#VALUE!" or "#REF!" will be returned.

A "scaler" field is also provided for each parameter (in the row above the data fields) to allow the conversion or scaling of the data returned from the result worksheet. The results of up to four parameters will be tabled and plotted. Examples of the formats of reports are shown below.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5 | | | | Conversion Key: | | | |
| 6 | | | | 0 | 1 >> 1 | Native | 1 |
| 7 | | | | 1 | CFS >> AF | AF | 1.9834700 |
| 8 | | | | 2 | AF >> CFS | CFS | 0.5041669 |
| 9 | | | | 3 | CFS >> TAF | TAF | 0.0019835 |
| 10 | | | | 4 | EOM Stor | AF | 1 |
| 11 | | | | 5 | Ave Day | Native | 1 |
| 12 | | | Enter Conversion (0-5): | 4 | 4 | 4 | 4 |
| 13 | | | Enter Sheet Name: | Output | Output1 | Output3c | Output2b |
| 14 | | | Enter Column Letter: | M | M | M | M |
| 15 | | | Column No: | 13 | 13 | 13 | 13 |
| 16 | | | Label: | O STORAG | D STORAGE | STORAGE | ) STORAGE |
| 17 | | | Native Unit: | AF | AF | AF | AF |
| 18 | | | Convert Unit: | AF | AF | AF | AF |
| 19 | Index | Date | Day | 1 | 1 | 1 | 1 |
| 20 | 1970.10 | 10/1/1970 | T | 1,666,767 | 1,666,767 | 1,666,767 | 1,666,969 |
| 21 | 1970.10 | 10/2/1970 | F | 1,664,567 | 1,664,567 | 1,664,567 | 1,664,971 |
| 22 | 1970.10 | 10/3/1970 | S | 1,662,719 | 1,662,719 | 1,662,719 | 1,663,323 |
| 23 | 1970.10 | 10/4/1970 | S | 1,659,892 | 1,659,892 | 1,659,892 | 1,660,699 |
| 24 | 1970.10 | 10/5/1970 | M | 1,656,745 | 1,656,745 | 1,656,745 | 1,657,753 |
| 25 | 1970.10 | 10/6/1970 | T | 1,654,119 | 1,654,119 | 1,654,119 | 1,655,329 |

**Figure 5.6-1. DSSMonthTable Worksheet Input Interface.**

## 5.6.1 Standardized Tables

An example of a standardized table for the illustration of results is shown in Table 5.6-1. (Table 1 Form). In this example the current minimum daily flow requirement at La Grange Bridge has been synthesized into monthly volumes for the simulation period, and water year totals and for the annual period February through January.

| | |
|---|---|
| Conversion (0-5): | 1 |
| Sheet Name: | Output1 |
| Column Letter: | Z |
| Column No: | 26 |
| Label: | ELEASE-MI |
| Native Unit: | CFS |
| Convert Unit: | AF |

**Table 5.6-1. Table 1 Form (units of volume).**

Table 1
LAGRANGE RELEASE-MINQ (Output1)
AF

| WY | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Total | Feb-Jan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1971 | 24,397 | 17,851 | 18,447 | 18,447 | 16,661 | 18,447 | 66,685 | 63,515 | 4,463 | 4,612 | 4,612 | 4,463 | 262,598 | 228,631 |
| 1972 | 13,240 | 10,413 | 10,760 | 10,760 | 9,719 | 10,760 | 30,288 | 29,251 | 2,975 | 3,074 | 3,074 | 2,975 | 137,292 | 128,713 |
| 1973 | 9,223 | 8,926 | 9,223 | 9,223 | 8,331 | 9,223 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 240,823 | 283,369 |
| 1974 | 24,397 | 17,851 | 18,447 | 18,447 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 300,923 | 300,923 |
| 1975 | 24,397 | 17,851 | 18,447 | 18,447 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 300,923 | 300,923 |
| 1976 | 24,397 | 17,851 | 18,447 | 18,447 | 16,661 | 18,447 | 20,153 | 19,749 | 2,975 | 3,074 | 3,074 | 2,975 | 166,250 | 122,217 |
| 1977 | 7,736 | 8,926 | 9,223 | 9,223 | 8,331 | 9,223 | 14,649 | 14,589 | 2,975 | 3,074 | 3,074 | 2,975 | 94,000 | 94,000 |
| 1978 | 7,736 | 8,926 | 9,223 | 9,223 | 8,331 | 9,223 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 239,336 | 283,369 |
| 1979 | 24,397 | 17,851 | 18,447 | 18,447 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 300,923 | 300,923 |
| 1980 | 24,397 | 17,851 | 18,447 | 18,447 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 300,923 | 300,923 |
| 1981 | 24,397 | 17,851 | 18,447 | 18,447 | 16,661 | 18,447 | 29,339 | 28,532 | 4,463 | 4,612 | 4,612 | 4,463 | 190,269 | 156,718 |
| 1982 | 12,744 | 10,711 | 11,068 | 11,068 | 9,997 | 11,068 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 253,329 | 286,880 |
| 1983 | 24,397 | 17,851 | 18,447 | 18,447 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 300,923 | 300,923 |
| 1984 | 24,397 | 17,851 | 18,447 | 18,447 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 300,923 | 300,923 |
| 1985 | 24,397 | 17,851 | 18,447 | 18,447 | 16,661 | 18,447 | 34,656 | 33,346 | 4,463 | 4,612 | 4,612 | 4,463 | 200,400 | 157,854 |
| 1986 | 9,223 | 8,926 | 9,223 | 9,223 | 8,331 | 9,223 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 240,823 | 283,369 |
| 1987 | 24,397 | 17,851 | 18,447 | 18,447 | 16,661 | 18,447 | 24,481 | 23,806 | 2,975 | 3,074 | 3,074 | 2,975 | 174,636 | 130,603 |
| 1988 | 7,736 | 8,926 | 9,223 | 9,223 | 8,331 | 9,223 | 14,649 | 14,589 | 2,975 | 3,074 | 3,074 | 2,975 | 94,000 | 94,000 |
| 1989 | 7,736 | 8,926 | 9,223 | 9,223 | 8,331 | 9,223 | 25,991 | 25,222 | 2,975 | 3,074 | 3,074 | 2,975 | 115,975 | 115,975 |
| 1990 | 7,736 | 8,926 | 9,223 | 9,223 | 8,331 | 9,223 | 19,362 | 19,008 | 2,975 | 3,074 | 3,074 | 2,975 | 103,131 | 103,131 |
| 1991 | 7,736 | 8,926 | 9,223 | 9,223 | 8,331 | 9,223 | 25,870 | 25,109 | 2,975 | 3,074 | 3,074 | 2,975 | 115,740 | 115,740 |
| 1992 | 7,736 | 8,926 | 9,223 | 9,223 | 8,331 | 9,223 | 19,995 | 19,601 | 2,975 | 3,074 | 3,074 | 2,975 | 104,357 | 104,357 |
| 1993 | 7,736 | 8,926 | 9,223 | 9,223 | 8,331 | 9,223 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 239,336 | 283,369 |
| 1994 | 24,397 | 17,851 | 18,447 | 18,447 | 16,661 | 18,447 | 25,903 | 25,140 | 2,975 | 3,074 | 3,074 | 2,975 | 177,391 | 134,846 |
| 1995 | 9,223 | 8,926 | 9,223 | 9,223 | 8,331 | 9,223 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 240,823 | 283,369 |
| 1996 | 24,397 | 17,851 | 18,447 | 18,447 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 300,923 | 300,923 |
| 1997 | 24,397 | 17,851 | 18,447 | 18,447 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 300,923 | 300,923 |
| 1998 | 24,397 | 17,851 | 18,447 | 18,447 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 300,923 | 300,923 |
| 1999 | 24,397 | 17,851 | 18,447 | 18,447 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 300,923 | 300,923 |
| 2000 | 24,397 | 17,851 | 18,447 | 18,447 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 300,923 | 300,923 |
| 2001 | 24,397 | 17,851 | 18,447 | 18,447 | 16,661 | 18,447 | 28,572 | 27,642 | 4,463 | 4,612 | 4,612 | 4,463 | 188,612 | 146,067 |
| 2002 | 9,223 | 8,926 | 9,223 | 9,223 | 8,331 | 9,223 | 32,729 | 31,539 | 4,463 | 4,612 | 4,612 | 4,463 | 136,567 | 136,567 |
| 2003 | 9,223 | 8,926 | 9,223 | 9,223 | 8,331 | 9,223 | 55,641 | 53,161 | 4,463 | 4,612 | 4,612 | 4,463 | 181,101 | 189,680 |
| 2004 | 13,240 | 10,413 | 10,760 | 10,760 | 9,719 | 10,760 | 28,696 | 27,758 | 4,463 | 4,612 | 4,612 | 4,463 | 140,257 | 131,678 |
| 2005 | 9,223 | 8,926 | 9,223 | 9,223 | 8,331 | 9,223 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 240,823 | 283,369 |
| 2006 | 24,397 | 17,851 | 18,447 | 18,447 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 300,923 | 300,923 |
| 2007 | 24,397 | 17,851 | 18,447 | 18,447 | 16,661 | 18,447 | 26,085 | 25,310 | 2,975 | 3,074 | 3,074 | 2,975 | 177,743 | 133,710 |
| 2008 | 7,736 | 8,926 | 9,223 | 9,223 | 8,331 | 9,223 | 27,470 | 26,609 | 2,975 | 3,074 | 3,074 | 2,975 | 118,840 | 120,328 |
| 2009 | 9,223 | 8,926 | 9,223 | 9,223 | 8,331 | 9,223 | 42,919 | 41,235 | 4,463 | 4,612 | 4,612 | 4,463 | 156,452 | |
| Average | 16,957 | 13,625 | 14,079 | 14,079 | 12,717 | 14,079 | 46,531 | 44,910 | 9,078 | 9,381 | 9,381 | 9,078 | 213,897 | 214,289 |
| Min | 7,736 | 8,926 | 9,223 | 9,223 | 8,331 | 9,223 | 14,649 | 14,589 | 2,975 | 3,074 | 3,074 | 2,975 | 94,000 | 94,000 |
| Max | 24,397 | 17,851 | 18,447 | 18,447 | 16,661 | 18,447 | 66,685 | 63,515 | 14,876 | 15,372 | 15,372 | 14,876 | 300,923 | 300,923 |

The values could also be tabled in the parameter's native unit of flow (cfs) representing the average daily flow requirement during each month. Annual totals are not included as the value is non-sensible. Table 5.6-2 illustrates the same parameter at before except the units are provided in average daily for a month.

| | |
|---|---|
| Conversion (0-5): | 5 |
| Sheet Name: | Output1 |
| Column Letter: | Z |
| Column No: | 26 |
| Label: | ELEASE-MI |
| Native Unit: | CFS |
| Convert Unit: | Native |

**Table 5.6-2. Table 1 Form (units of flow).**

Table 1
LAGRANGE RELEASE-MINQ (Output1)
CFS — Average Daily Value

| WY | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1971 | 397 | 300 | 300 | 300 | 300 | 300 | 1,121 | 1,033 | 75 | 75 | 75 | 75 |
| 1972 | 215 | 175 | 175 | 175 | 169 | 175 | 509 | 476 | 50 | 50 | 50 | 50 |
| 1973 | 150 | 150 | 150 | 150 | 150 | 150 | 1,080 | 1,007 | 250 | 250 | 250 | 250 |
| 1974 | 397 | 300 | 300 | 300 | 300 | 300 | 1,080 | 1,007 | 250 | 250 | 250 | 250 |
| 1975 | 397 | 300 | 300 | 300 | 300 | 300 | 1,080 | 1,007 | 250 | 250 | 250 | 250 |
| 1976 | 397 | 300 | 300 | 300 | 290 | 300 | 339 | 321 | 50 | 50 | 50 | 50 |
| 1977 | 126 | 150 | 150 | 150 | 150 | 150 | 246 | 237 | 50 | 50 | 50 | 50 |
| 1978 | 126 | 150 | 150 | 150 | 150 | 150 | 1,080 | 1,007 | 250 | 250 | 250 | 250 |
| 1979 | 397 | 300 | 300 | 300 | 300 | 300 | 1,080 | 1,007 | 250 | 250 | 250 | 250 |
| 1980 | 397 | 300 | 300 | 300 | 290 | 300 | 1,080 | 1,007 | 250 | 250 | 250 | 250 |
| 1981 | 397 | 300 | 300 | 300 | 300 | 300 | 493 | 464 | 75 | 75 | 75 | 75 |
| 1982 | 207 | 180 | 180 | 180 | 180 | 180 | 1,080 | 1,007 | 250 | 250 | 250 | 250 |
| 1983 | 397 | 300 | 300 | 300 | 300 | 300 | 1,080 | 1,007 | 250 | 250 | 250 | 250 |
| 1984 | 397 | 300 | 300 | 300 | 290 | 300 | 1,080 | 1,007 | 250 | 250 | 250 | 250 |
| 1985 | 397 | 300 | 300 | 300 | 300 | 300 | 582 | 542 | 75 | 75 | 75 | 75 |
| 1986 | 150 | 150 | 150 | 150 | 150 | 150 | 1,080 | 1,007 | 250 | 250 | 250 | 250 |
| 1987 | 397 | 300 | 300 | 300 | 300 | 300 | 411 | 387 | 50 | 50 | 50 | 50 |
| 1988 | 126 | 150 | 150 | 150 | 145 | 150 | 246 | 237 | 50 | 50 | 50 | 50 |
| 1989 | 126 | 150 | 150 | 150 | 150 | 150 | 437 | 410 | 50 | 50 | 50 | 50 |
| 1990 | 126 | 150 | 150 | 150 | 150 | 150 | 325 | 309 | 50 | 50 | 50 | 50 |
| 1991 | 126 | 150 | 150 | 150 | 150 | 150 | 435 | 408 | 50 | 50 | 50 | 50 |
| 1992 | 126 | 150 | 150 | 150 | 145 | 150 | 336 | 319 | 50 | 50 | 50 | 50 |
| 1993 | 126 | 150 | 150 | 150 | 150 | 150 | 1,080 | 1,007 | 250 | 250 | 250 | 250 |
| 1994 | 397 | 300 | 300 | 300 | 300 | 300 | 435 | 409 | 50 | 50 | 50 | 50 |
| 1995 | 150 | 150 | 150 | 150 | 150 | 150 | 1,080 | 1,007 | 250 | 250 | 250 | 250 |
| 1996 | 397 | 300 | 300 | 300 | 290 | 300 | 1,080 | 1,007 | 250 | 250 | 250 | 250 |
| 1997 | 397 | 300 | 300 | 300 | 300 | 300 | 1,080 | 1,007 | 250 | 250 | 250 | 250 |
| 1998 | 397 | 300 | 300 | 300 | 300 | 300 | 1,080 | 1,007 | 250 | 250 | 250 | 250 |
| 1999 | 397 | 300 | 300 | 300 | 300 | 300 | 1,080 | 1,007 | 250 | 250 | 250 | 250 |
| 2000 | 397 | 300 | 300 | 300 | 290 | 300 | 1,080 | 1,007 | 250 | 250 | 250 | 250 |
| 2001 | 397 | 300 | 300 | 300 | 300 | 300 | 480 | 450 | 75 | 75 | 75 | 75 |
| 2002 | 150 | 150 | 150 | 150 | 150 | 150 | 550 | 513 | 75 | 75 | 75 | 75 |
| 2003 | 150 | 150 | 150 | 150 | 150 | 150 | 935 | 865 | 75 | 75 | 75 | 75 |
| 2004 | 215 | 175 | 175 | 175 | 169 | 175 | 482 | 451 | 75 | 75 | 75 | 75 |
| 2005 | 150 | 150 | 150 | 150 | 150 | 150 | 1,080 | 1,007 | 250 | 250 | 250 | 250 |
| 2006 | 397 | 300 | 300 | 300 | 300 | 300 | 1,080 | 1,007 | 250 | 250 | 250 | 250 |
| 2007 | 397 | 300 | 300 | 300 | 300 | 300 | 438 | 412 | 50 | 50 | 50 | 50 |
| 2008 | 126 | 150 | 150 | 150 | 145 | 150 | 462 | 433 | 50 | 50 | 50 | 50 |
| 2009 | 150 | 150 | 150 | 150 | 150 | 150 | 721 | 671 | 75 | 75 | 75 | 75 |
| Average | 276 | 229 | 229 | 229 | 227 | 229 | 782 | 730 | 153 | 153 | 153 | 153 |
| Min | 126 | 150 | 150 | 150 | 145 | 150 | 246 | 237 | 50 | 50 | 50 | 50 |
| Max | 397 | 300 | 300 | 300 | 300 | 300 | 1,121 | 1,033 | 250 | 250 | 250 | 250 |

For each parameter the sequential, the chronological annual values and associated monthly values are also grouped by water type, in descending order of annual runoff. The rank ordering of the years within the simulation period is established by the naming of 6 year types, wet, above normal, normal, below normal, dry and critical. Using the water year runoff for the years 1921 through 2011 (91 years), the years were rank ordered from wettest to driest. The wettest 20 percent of the years (18 years) are designated the wet year type. The next wettest 18 years are designated the above normal year type. And so on for the normal and below normal year types.

The driest 20 percent of years are split between the dry and critical year types. After the demarcation occurs for each year the data set is reduced to only the 1971 through 2009 modeling period (39 years). A switch at cell X216 directs the monthly sequence of the year. For instance, if the year is to begin February 1 of the year and continue through January of the following year, the switch would be set to “Feb”. The switch can be set to any month February (Feb) through June (Jun). The first form of standardized table (Table 1a Form) (Figure 5.6-3) for this information follows, which identifies the year type associated with each chronologically-based listed year. Averages for each year type follow the listing.

**Table 5.6-3. Table 1a Form (chronological).**

| | Table 1a | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Prelim | LAGRANGE RELEASE-MINQ (Output1) | | | | | | | | | | | | | |
| Relicense | AF | | | | | | | | | | | | | |
| Yr-Type | Yr Begin | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Total |
| 3 | 1971 | 16,661 | 18,447 | 66,685 | 63,515 | 4,463 | 4,612 | 4,612 | 4,463 | 13,240 | 10,413 | 10,760 | 10,760 | 228,631 |
| 4 | 1972 | 9,719 | 10,760 | 30,288 | 29,251 | 2,975 | 3,074 | 3,074 | 2,975 | 9,223 | 8,926 | 9,223 | 9,223 | 128,713 |
| 3 | 1973 | 8,331 | 9,223 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 283,369 |
| 2 | 1974 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 300,923 |
| 2 | 1975 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 300,923 |
| 6 | 1976 | 16,661 | 18,447 | 20,153 | 19,749 | 2,975 | 3,074 | 3,074 | 2,975 | 7,736 | 8,926 | 9,223 | 9,223 | 122,217 |
| 6 | 1977 | 8,331 | 9,223 | 14,649 | 14,589 | 2,975 | 3,074 | 3,074 | 2,975 | 7,736 | 8,926 | 9,223 | 9,223 | 94,000 |
| 1 | 1978 | 8,331 | 9,223 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 283,369 |
| 3 | 1979 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 300,923 |
| 1 | 1980 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 300,923 |
| 5 | 1981 | 16,661 | 18,447 | 29,339 | 28,532 | 4,463 | 4,612 | 4,612 | 4,463 | 12,744 | 10,711 | 11,068 | 11,068 | 156,718 |
| 1 | 1982 | 9,997 | 11,068 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 286,880 |
| 1 | 1983 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 300,923 |
| 2 | 1984 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 300,923 |
| 4 | 1985 | 16,661 | 18,447 | 34,656 | 33,346 | 4,463 | 4,612 | 4,612 | 4,463 | 9,223 | 8,926 | 9,223 | 9,223 | 157,854 |
| 1 | 1986 | 8,331 | 9,223 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 283,369 |
| 6 | 1987 | 16,661 | 18,447 | 24,481 | 23,806 | 2,975 | 3,074 | 3,074 | 2,975 | 7,736 | 8,926 | 9,223 | 9,223 | 130,603 |
| 6 | 1988 | 8,331 | 9,223 | 14,649 | 14,589 | 2,975 | 3,074 | 3,074 | 2,975 | 7,736 | 8,926 | 9,223 | 9,223 | 94,000 |
| 4 | 1989 | 8,331 | 9,223 | 25,991 | 25,222 | 2,975 | 3,074 | 3,074 | 2,975 | 7,736 | 8,926 | 9,223 | 9,223 | 115,975 |
| 5 | 1990 | 8,331 | 9,223 | 19,362 | 19,008 | 2,975 | 3,074 | 3,074 | 2,975 | 7,736 | 8,926 | 9,223 | 9,223 | 103,131 |
| 4 | 1991 | 8,331 | 9,223 | 25,870 | 25,109 | 2,975 | 3,074 | 3,074 | 2,975 | 7,736 | 8,926 | 9,223 | 9,223 | 115,740 |
| 6 | 1992 | 8,331 | 9,223 | 19,995 | 19,601 | 2,975 | 3,074 | 3,074 | 2,975 | 7,736 | 8,926 | 9,223 | 9,223 | 104,357 |
| 2 | 1993 | 8,331 | 9,223 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 283,369 |
| 5 | 1994 | 16,661 | 18,447 | 25,903 | 25,140 | 2,975 | 3,074 | 3,074 | 2,975 | 9,223 | 8,926 | 9,223 | 9,223 | 134,846 |
| 1 | 1995 | 8,331 | 9,223 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 283,369 |
| 2 | 1996 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 300,923 |
| 1 | 1997 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 300,923 |
| 1 | 1998 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 300,923 |
| 2 | 1999 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 300,923 |
| 3 | 2000 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 300,923 |
| 4 | 2001 | 16,661 | 18,447 | 28,572 | 27,642 | 4,463 | 4,612 | 4,612 | 4,463 | 9,223 | 8,926 | 9,223 | 9,223 | 146,067 |
| 3 | 2002 | 8,331 | 9,223 | 32,729 | 31,539 | 4,463 | 4,612 | 4,612 | 4,463 | 9,223 | 8,926 | 9,223 | 9,223 | 136,567 |
| 3 | 2003 | 8,331 | 9,223 | 55,641 | 53,161 | 4,463 | 4,612 | 4,612 | 4,463 | 13,240 | 10,413 | 10,760 | 10,760 | 189,680 |
| 4 | 2004 | 9,719 | 10,760 | 28,696 | 27,758 | 4,463 | 4,612 | 4,612 | 4,463 | 9,223 | 8,926 | 9,223 | 9,223 | 131,678 |
| 1 | 2005 | 8,331 | 9,223 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 283,369 |
| 1 | 2006 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 300,923 |
| 5 | 2007 | 16,661 | 18,447 | 26,085 | 25,310 | 2,975 | 3,074 | 3,074 | 2,975 | 7,736 | 8,926 | 9,223 | 9,223 | 133,710 |
| 4 | 2008 | 8,331 | 9,223 | 27,470 | 26,609 | 2,975 | 3,074 | 3,074 | 2,975 | 9,223 | 8,926 | 9,223 | 9,223 | 120,328 |
| 3 | 2009 | 8,331 | 9,223 | 42,919 | 41,235 | 4,463 | 4,612 | 4,612 | 4,463 | | | | | |
| LAGRANGE RELEASE-MINQ (Output1) - AF | | | | | | | | | | | | | | |
| Water Year | Type | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Total |
| W | 1 | 12,663 | 14,019 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 292,497 |
| AN | 2 | 15,273 | 16,909 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 297,997 |
| N | 3 | 11,901 | 13,176 | 55,814 | 53,608 | 8,926 | 9,223 | 9,223 | 8,926 | 18,149 | 13,884 | 14,347 | 14,347 | 240,016 |
| BN | 4 | 11,108 | 12,298 | 28,792 | 27,848 | 3,613 | 3,733 | 3,733 | 3,613 | 8,798 | 8,926 | 9,223 | 9,223 | 130,908 |
| D | 5 | 14,579 | 16,141 | 25,172 | 24,497 | 3,347 | 3,459 | 3,459 | 3,347 | 9,360 | 9,372 | 9,684 | 9,684 | 132,101 |
| C | 6 | 11,663 | 12,913 | 18,786 | 18,467 | 2,975 | 3,074 | 3,074 | 2,975 | 7,736 | 8,926 | 9,223 | 9,223 | 109,035 |
| All | | 12,717 | 14,079 | 46,531 | 44,910 | 9,078 | 9,381 | 9,381 | 9,078 | 16,762 | 13,514 | 13,964 | 13,964 | 214,289 |

The second form of report (Table 1b Form) for the water year type based ranking is shown in Figure 5.6-4. This form rank orders the years according to descending volume of watershed runoff, named by the convention described above. The same averaging results occur for this format of report.

**Table 5.6-4. Table 1a Form (year type ranking, descending order of wetness).**

| | Table 1b | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Prelim | LAGRANGE RELEASE-MINQ (Output1) | | | | | | | | | | | | | |
| Relicense | AF | | | | | | | | | | | | | |
| Yr-Type | Yr Begin | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Total |
| W | 1983 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 300,923 |
| W | 1995 | 8,331 | 9,223 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 283,369 |
| W | 1982 | 9,997 | 11,068 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 286,880 |
| W | 1998 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 300,923 |
| W | 2006 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 300,923 |
| W | 1997 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 300,923 |
| W | 1980 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 300,923 |
| W | 1986 | 8,331 | 9,223 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 283,369 |
| W | 2005 | 8,331 | 9,223 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 283,369 |
| W | 1978 | 8,331 | 9,223 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 283,369 |
| AN | 1984 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 300,923 |
| AN | 1993 | 8,331 | 9,223 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 283,369 |
| AN | 1996 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 300,923 |
| AN | 1974 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 300,923 |
| AN | 1999 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 300,923 |
| AN | 1975 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 300,923 |
| N | 1973 | 8,331 | 9,223 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 283,369 |
| N | 2000 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 300,923 |
| N | 1979 | 16,661 | 18,447 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 300,923 |
| N | 1971 | 16,661 | 18,447 | 66,685 | 63,515 | 4,463 | 4,612 | 4,612 | 4,463 | 13,240 | 10,413 | 10,760 | 10,760 | 228,631 |
| N | 2009 | 8,331 | 9,223 | 42,919 | 41,235 | 4,463 | 4,612 | 4,612 | 4,463 | | | | | |
| N | 2003 | 8,331 | 9,223 | 55,641 | 53,161 | 4,463 | 4,612 | 4,612 | 4,463 | 13,240 | 10,413 | 10,760 | 10,760 | 189,680 |
| N | 2002 | 8,331 | 9,223 | 32,729 | 31,539 | 4,463 | 4,612 | 4,612 | 4,463 | 9,223 | 8,926 | 9,223 | 9,223 | 136,567 |
| BN | 1989 | 8,331 | 9,223 | 25,991 | 25,222 | 2,975 | 3,074 | 3,074 | 2,975 | 7,736 | 8,926 | 9,223 | 9,223 | 115,975 |
| BN | 2004 | 9,719 | 10,760 | 28,696 | 27,758 | 4,463 | 4,612 | 4,612 | 4,463 | 9,223 | 8,926 | 9,223 | 9,223 | 131,678 |
| BN | 1985 | 16,661 | 18,447 | 34,656 | 33,346 | 4,463 | 4,612 | 4,612 | 4,463 | 9,223 | 8,926 | 9,223 | 9,223 | 157,854 |
| BN | 1972 | 9,719 | 10,760 | 30,288 | 29,251 | 2,975 | 3,074 | 3,074 | 2,975 | 9,223 | 8,926 | 9,223 | 9,223 | 128,713 |
| BN | 2008 | 8,331 | 9,223 | 27,470 | 26,609 | 2,975 | 3,074 | 3,074 | 2,975 | 9,223 | 8,926 | 9,223 | 9,223 | 120,328 |
| BN | 1991 | 8,331 | 9,223 | 25,870 | 25,109 | 2,975 | 3,074 | 3,074 | 2,975 | 7,736 | 8,926 | 9,223 | 9,223 | 115,740 |
| BN | 2001 | 16,661 | 18,447 | 28,572 | 27,642 | 4,463 | 4,612 | 4,612 | 4,463 | 9,223 | 8,926 | 9,223 | 9,223 | 146,067 |
| D | 1981 | 16,661 | 18,447 | 29,339 | 28,532 | 4,463 | 4,612 | 4,612 | 4,463 | 12,744 | 10,711 | 11,068 | 11,068 | 156,718 |
| D | 2007 | 16,661 | 18,447 | 26,085 | 25,310 | 2,975 | 3,074 | 3,074 | 2,975 | 7,736 | 8,926 | 9,223 | 9,223 | 133,710 |
| D | 1990 | 8,331 | 9,223 | 19,362 | 19,008 | 2,975 | 3,074 | 3,074 | 2,975 | 7,736 | 8,926 | 9,223 | 9,223 | 103,131 |
| D | 1994 | 16,661 | 18,447 | 25,903 | 25,140 | 2,975 | 3,074 | 3,074 | 2,975 | 9,223 | 8,926 | 9,223 | 9,223 | 134,846 |
| C | 1992 | 8,331 | 9,223 | 19,995 | 19,601 | 2,975 | 3,074 | 3,074 | 2,975 | 7,736 | 8,926 | 9,223 | 9,223 | 104,357 |
| C | 1988 | 8,331 | 9,223 | 14,649 | 14,589 | 2,975 | 3,074 | 3,074 | 2,975 | 7,736 | 8,926 | 9,223 | 9,223 | 94,000 |
| C | 1976 | 16,661 | 18,447 | 20,153 | 19,749 | 2,975 | 3,074 | 3,074 | 2,975 | 7,736 | 8,926 | 9,223 | 9,223 | 122,217 |
| C | 1987 | 16,661 | 18,447 | 24,481 | 23,806 | 2,975 | 3,074 | 3,074 | 2,975 | 7,736 | 8,926 | 9,223 | 9,223 | 130,603 |
| C | 1977 | 8,331 | 9,223 | 14,649 | 14,589 | 2,975 | 3,074 | 3,074 | 2,975 | 7,736 | 8,926 | 9,223 | 9,223 | 94,000 |

| LAGRANGE RELEASE-MINQ (Output1) - AF | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water Year | Type | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Total |
| W | 1 | 12,663 | 14,019 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 292,497 |
| AN | 2 | 15,273 | 16,909 | 64,241 | 61,936 | 14,876 | 15,372 | 15,372 | 14,876 | 24,397 | 17,851 | 18,447 | 18,447 | 297,997 |
| N | 3 | 11,901 | 13,176 | 55,814 | 53,608 | 8,926 | 9,223 | 9,223 | 8,926 | 18,149 | 13,884 | 14,347 | 14,347 | 240,016 |
| BN | 4 | 11,108 | 12,298 | 28,792 | 27,848 | 3,613 | 3,733 | 3,733 | 3,613 | 8,798 | 8,926 | 9,223 | 9,223 | 130,908 |
| D | 5 | 14,579 | 16,141 | 25,172 | 24,497 | 3,347 | 3,459 | 3,459 | 3,347 | 9,360 | 9,372 | 9,684 | 9,684 | 132,101 |
| C | 6 | 11,663 | 12,913 | 18,786 | 18,467 | 2,975 | 3,074 | 3,074 | 2,975 | 7,736 | 8,926 | 9,223 | 9,223 | 109,035 |
| All | | 12,717 | 14,079 | 46,531 | 44,910 | 9,078 | 9,381 | 9,381 | 9,078 | 16,762 | 13,514 | 13,964 | 13,964 | 214,289 |

### 5.6.2 Standardized Graphs

Several standardized graphs are also provided for each parameter. The first form of graph provides a trace of the monthly sequence of data developed for the standardized chronological table. Figure 5.6-2 illustrates the minimum flow requirement at La Grange Bridge synthesized as monthly volume during the simulation.

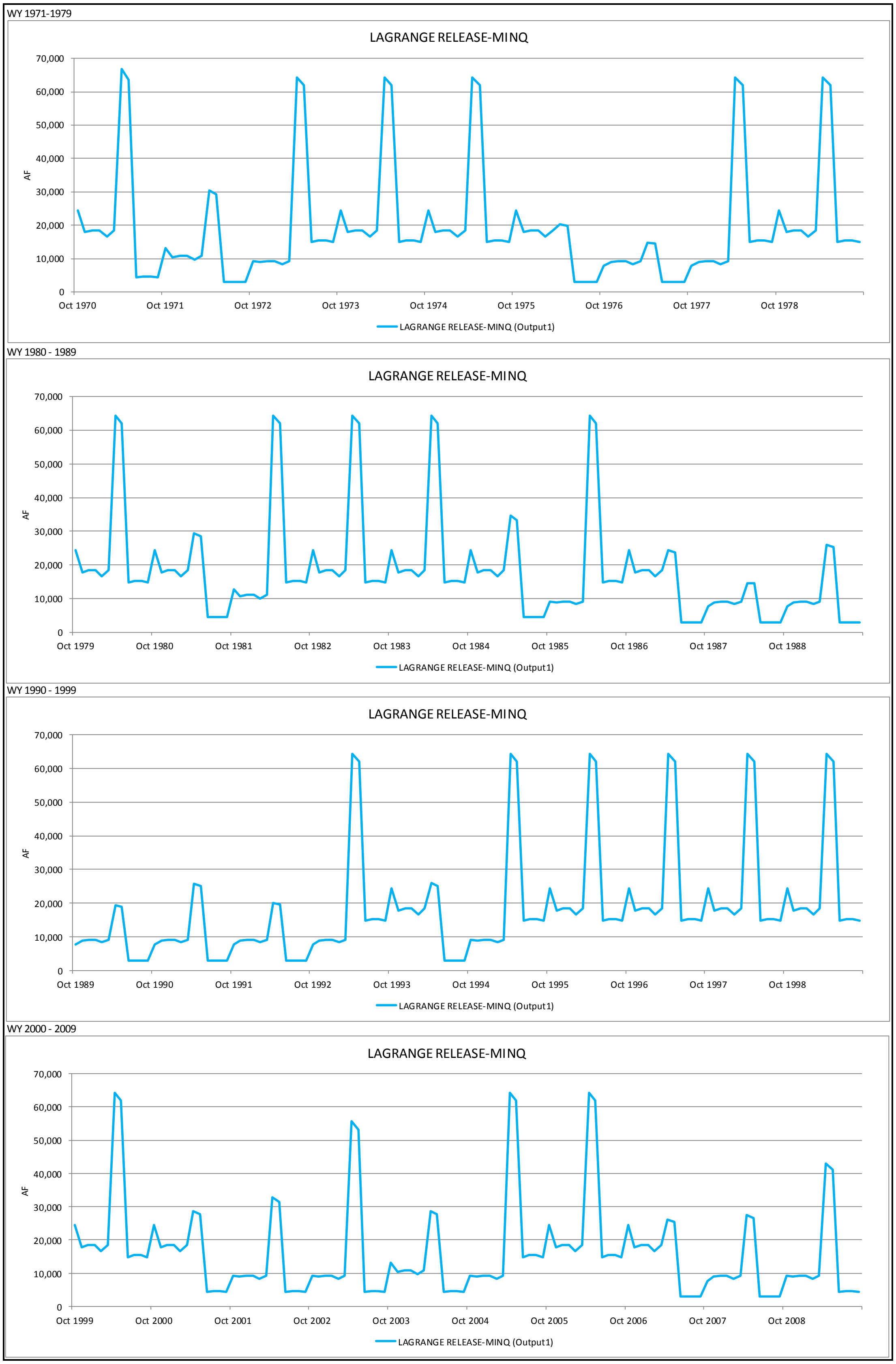



**Figure 5.6-2. Chronological Illustration of Parameter.**

A user-defined graph is also available to depict a particular column of data from the water year-based standardized table (Table 1 Form) described above. A column of interest within the Table 1 standardized table is selected (such as column AI representing a water year total volume) in cell AN116 to display the 39 annual values. Figure 5.6-3 illustrates this form of graphic.

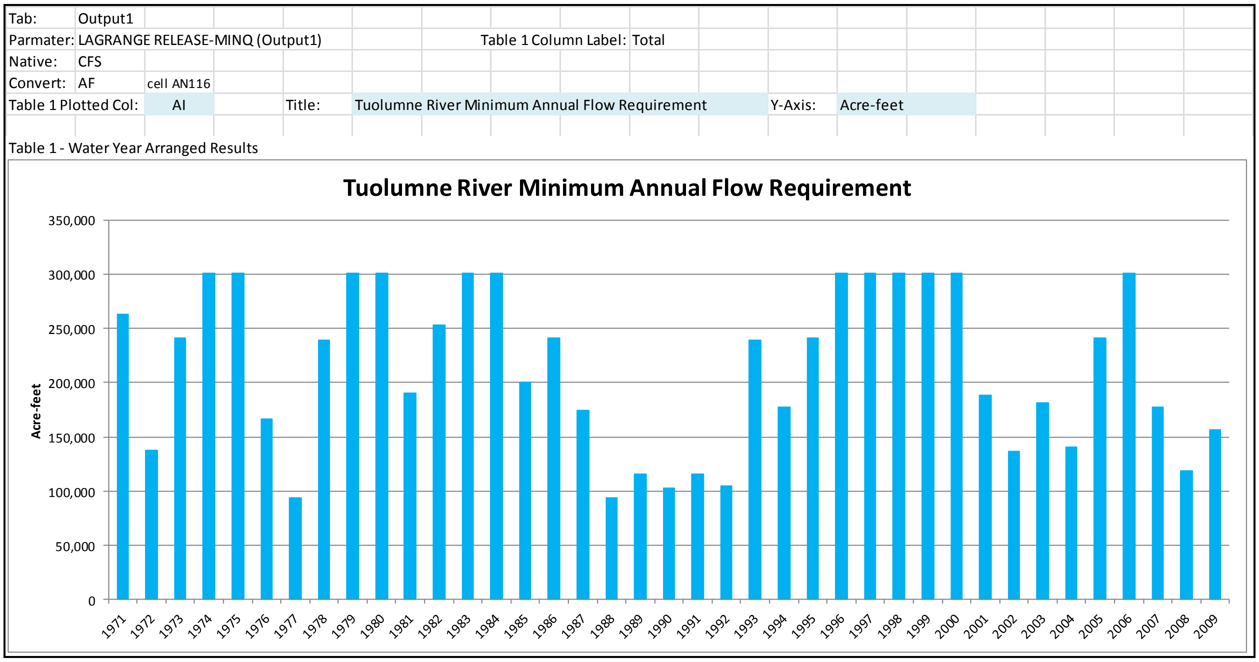



**Figure 5.6-3. Annual Parameter Graphic – Tagged to Water Year Table.**

A similar display of columnar results can be keyed to the chronological sequence year table described above. Entry of the desired column of information from the table (e.g., Table 1a) is done at cell AN143. Figure 5.6-4 illustrates this form of graphic.

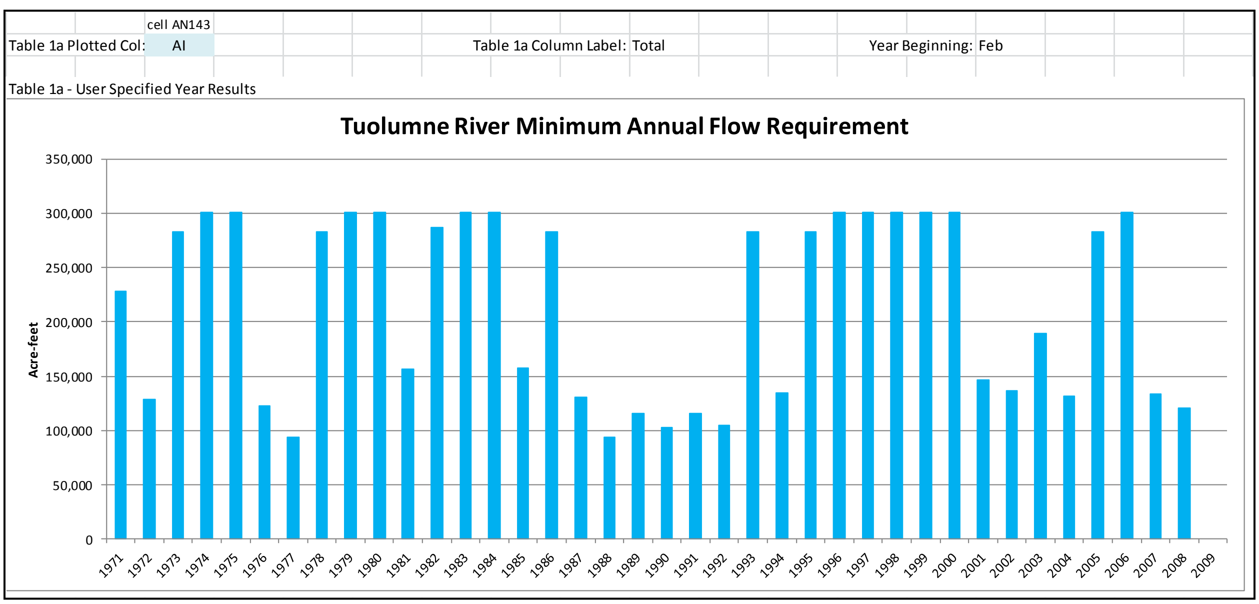



**Figure 5.6-4. Annual Parameter Graphic – Tagged to Chronological Sequence Year Table.**

The third version of standardized graph for the same information displays results from a column of a table that rank-ordered the years of simulation according to descending runoff (e.g., Table 1b). Entry of the desired column of information from that table is done at cell AN170, with results exemplified by the following graph. Figure 5.6-5 illustrates this form of graphic.

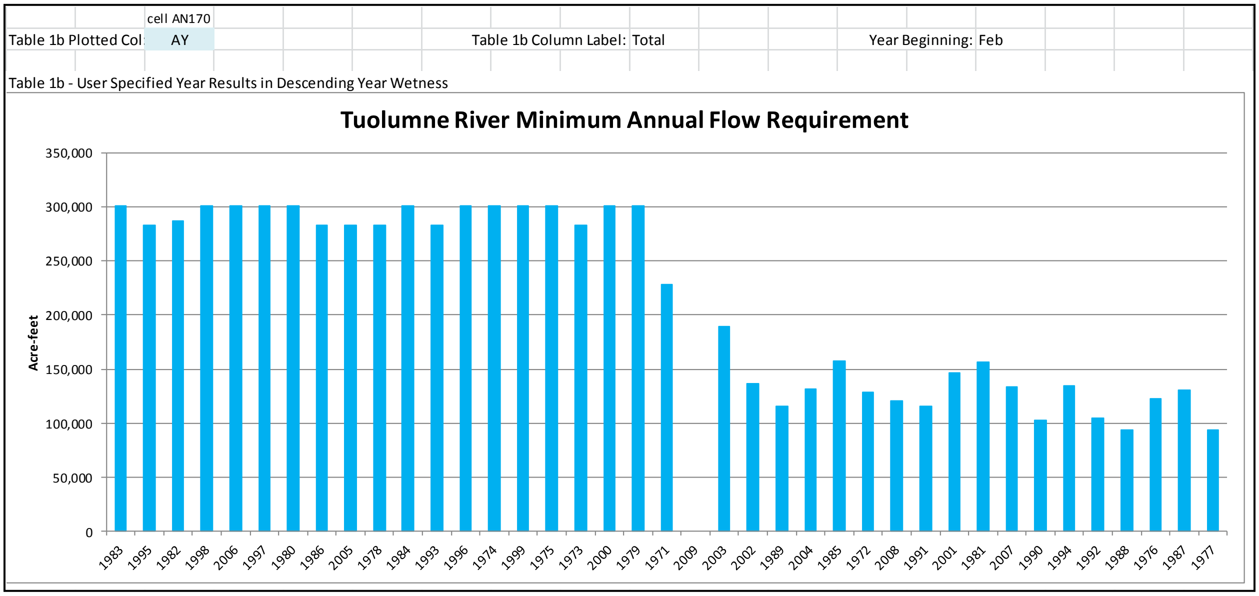



**Figure 5.6-5. Annual Parameter Graphic–Tagged to Rank-ordering of Results by Year Wetness.**

The same tables and graphics are provided for each of the three other parameters. Additionally, standardized graphics are provided for a columnar comparison of Table 1 and Table 2 values. An example of those graphics is shown below, with the column(s) of interest defined by the Table 1-specific and Table 2-specific entries. Figure 5.6-6 illustrates this form of graphic.

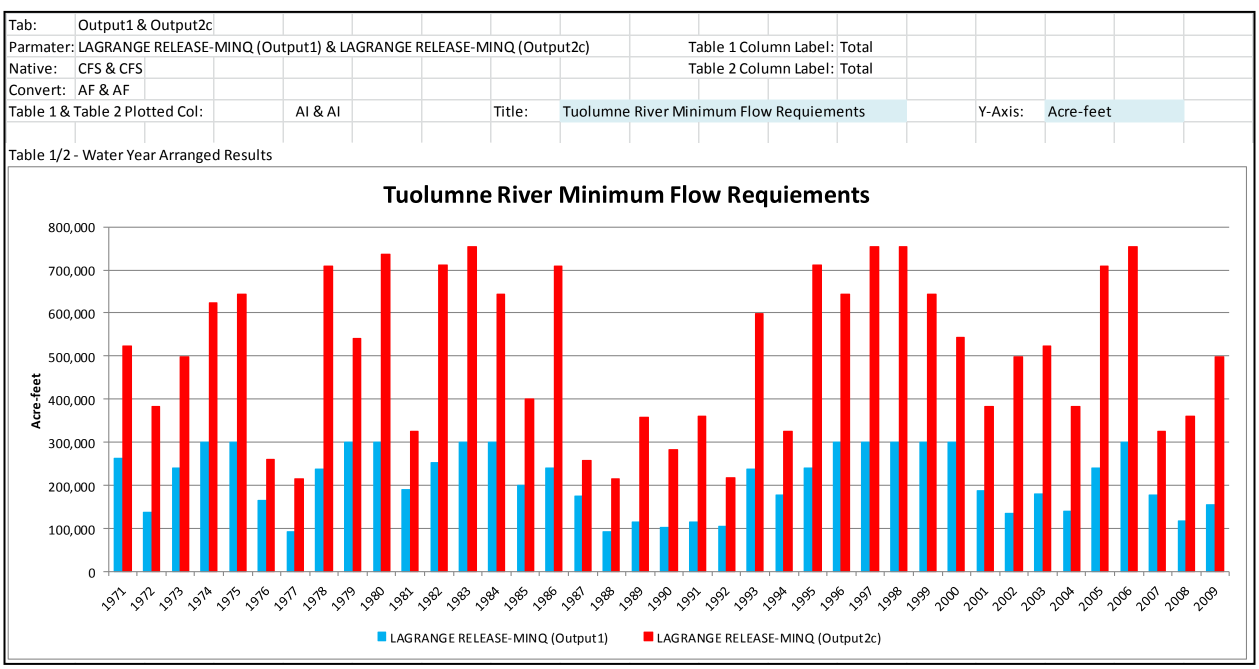



**Figure 5.6-6. Annual Parameter Graphic – Comparison of 2 Tables.**

A standardized graphic comparison of Table 1, Table 2, and Table 3, and all 4 tables of values is also provided. The four-way comparison graphs are shown in Figure 5.6-7.

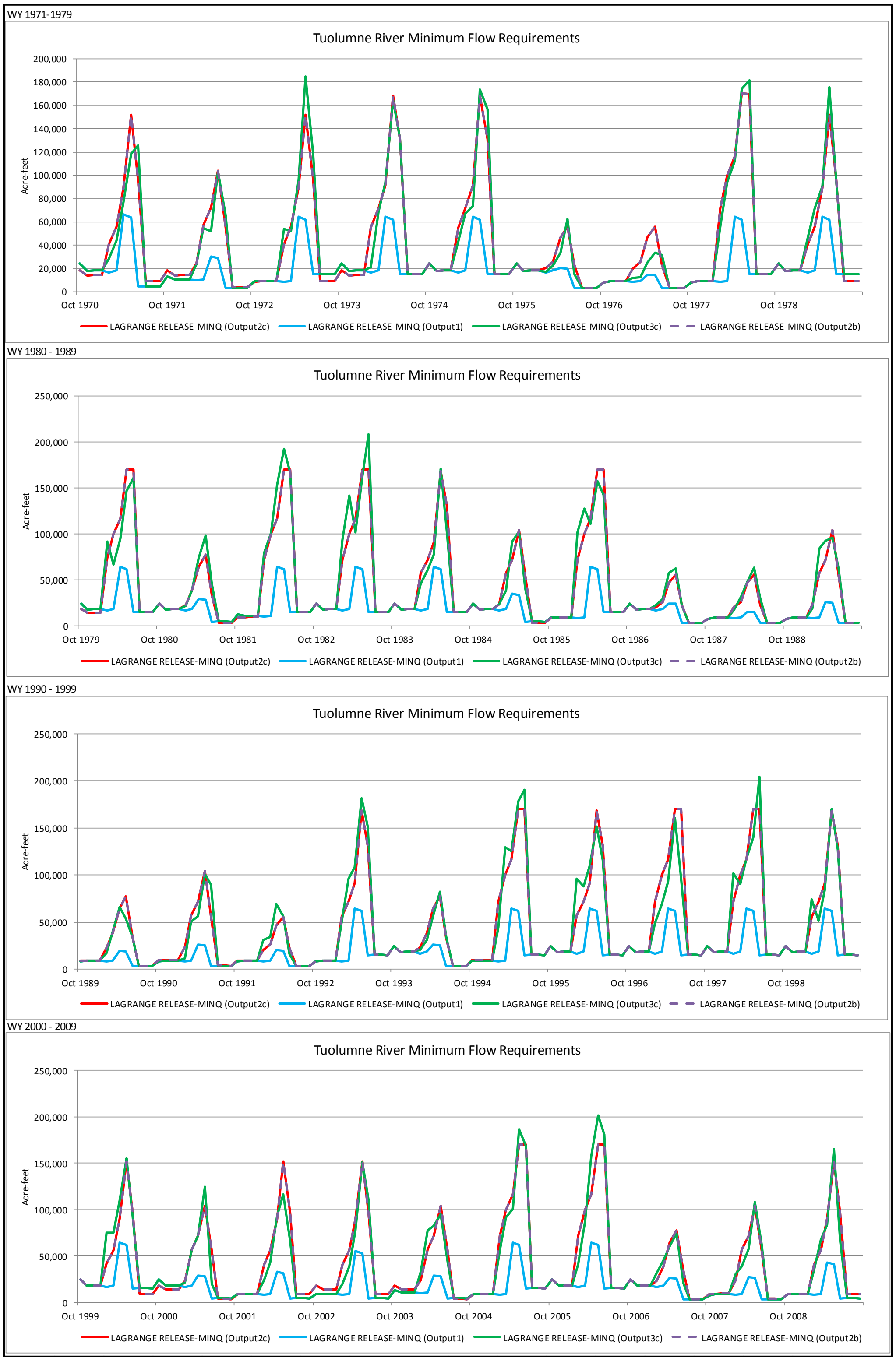



**Figure 5.6-7. Comparison of 4 Tables.**

## 5.7 Switches Worksheet

This worksheet (Switches) enables the documentation of all input assumptions and values of a particular study. Almost all user defined parameters entered into the UserInput and Control worksheets are provided as values to the Output worksheet. These parameters are echoed to the Switches worksheet upon identification of worksheet Output or another equally formatted worksheet of results. Figure 5.7-1 is a snapshot of the entry cell for the referenced output worksheet. The results shown in worksheet Switches mirror the formats of worksheet UserInput and Control.

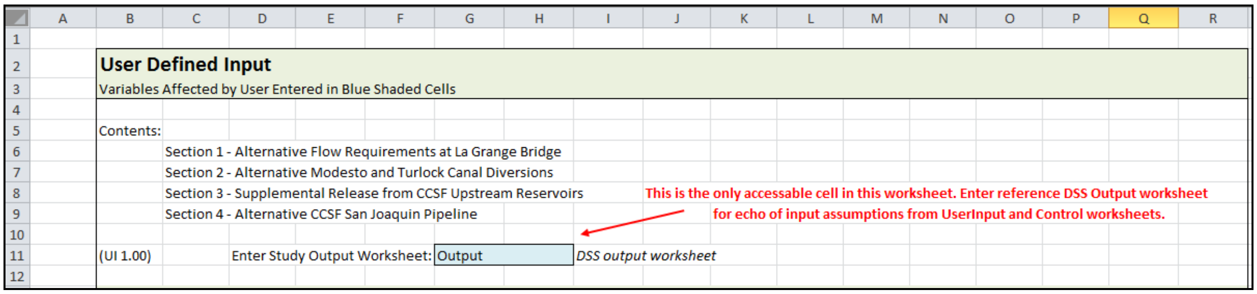



**Figure 5.7-1. Switches Worksheet Input Interface.**

## 5.8 XXGroup Worksheets

These worksheets provide graphical display of a single calendar year of operation for several model components. The model components represent groupings of physical features of the Tuolumne River system that make up logical components of operation. The model components are:

Don Pedro Reservoir, the Districts' facilities, and the Lower Tuolumne River
Modeled with computational worksheet DonPedro and displayed by worksheet DPGroup

Hetch Hetchy Reservoir, the San Joaquin Pipeline and downstream releases
Modeled with computational worksheet SFHetchHetchy and displayed by worksheet HHGroup

Lake Lloyd, Holm Powerhouse and its downstream releases
Modeled with computational worksheet SFLloyd and displayed by worksheet LloydGroup

Lake Eleanor, the Eleanor-Cherry Tunnel and its downstream releases
Modeled with computational worksheet SFEleanor and displayed by worksheet ELGroup

CCSF Water Bank and Supplemental Releases
Modeled with computational worksheet SFWaterBank and displayed by worksheet WBGroup

CCSF System Storage displayed by worksheet SFSysGroup.

Both the Districts' and CCSF's operations are additionally displayed for the 1986 through 1994, or any 9-year period by worksheets DPGroup86_94 and SFGroup86_94. These component-specific display worksheets provide plotting of numerous parameters provided in the computation worksheets. One calendar year (the same year) of data for all parameters can be plotted. These display worksheets are similar to worksheet DSSAnyGroup except they rely upon the data being computed by the current study within the computational worksheets. A comparison between the same parameter from two different studies is not possible. Those comparisons are intended to be made through the worksheet Output and its tools. The parameter(s) to be plotted are identified by reference worksheet name and column. Figure 5.8-1 is a snapshot of the identification parameters and result values is shown below for worksheet DPGroup.

Values are plotted to either the primary y-axis or secondary y-axis. The "axis reference" indicates to which axis the value will be plotted by default. The designation of y-axis assignment is not modified by this field, and the user must edit the series data within the plot to change the y-axis assignment, graph type or line or shape characteristics. The "enter graph year" is a user entry. The same year or different year of a parameter or multiple parameters can be plotted. "Sheet name" is a user entry, and identifies from which Output-formatted worksheet the parameter is to be acquired. The "enter column" entry identifies from which column the parameter occurs. Upon proper entry of a parameter a return of the parameter's label and source worksheet will occur in the "data reference" field. Values for the specified calendar year will also be returned in the data field. If a plotting position is not used, a "#VALUE" or "#REF" will be returned. The "scaler" field is provided to allow the conversion or scaling of the data returned from the result worksheet. For instance, if the daily data occurs in the result worksheet in units of daily average flow (cfs) it could be plotted in units of daily volume (acre-feet) by entering the conversion factor of 1.983471. The entry in the field acts as a multiplier to the value occurring in the result worksheet. This field can also be used to scale two different "order of magnitude" parameters to use the same y-axis. An example of the several plotted parameters from an active scenario study is shown in Figure 5.8-2.

| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 1 | **DPGroup** | | | | | | | |
| 2 | This sheet illustrates a CY of daily results for Don Pedro operations in graphic format. | | | | | | | |
| 3 | Axis Reference | 1 | 1 | 2 | 2 | 2 | 2 | 2 |
| 4 | Enter CY Graph Year: | 1983 | 1983 | 1983 | 1983 | 1983 | 1983 | 1983 |
| 5 | Enter Sheet Name: | DonPedro | DonPedro | DonPedro | DonPedro | DonPedro | DonPedro | DonPedro |
| 6 | Column: | 28 | 72 | 5 | 7 | 13 | 15 | 70 |
| 7 | Enter Column: | AB | BT | E | G | M | O | BR |
| 8 | Data Reference: | COE Rainflood Space - AF | Don Pedro Storage - AF | Reservoir Inflow - CFS | Minimum La Grange Req Release - CFS | MID Canal - CFS | TID Canal - CFS | La Grange Release - CFS |
| 9 | Enter Scaler: | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 10 | 1-Jan-83 | 1,690,000 | 1,752,672 | 2,688 | 300 | 70 | 98 | 4,301 |
| 11 | 2-Jan-83 | 1,690,000 | 1,748,069 | 2,138 | 300 | 70 | 98 | 4,301 |
| 12 | 3-Jan-83 | 1,690,000 | 1,742,799 | 1,801 | 300 | 70 | 98 | 4,301 |
| 13 | 4-Jan-83 | 1,690,000 | 1,737,746 | 1,911 | 300 | 70 | 98 | 4,301 |
| 14 | 5-Jan-83 | 1,690,000 | 1,732,665 | 1,897 | 300 | 70 | 98 | 4,301 |
| 15 | 6-Jan-83 | 1,690,000 | 1,730,261 | 1,501 | 300 | 70 | 98 | 2,555 |
| 16 | 7-Jan-83 | 1,690,000 | 1,728,957 | 2,055 | 300 | 70 | 98 | 2,555 |
| 17 | 8-Jan-83 | 1,690,000 | 1,726,043 | 1,244 | 300 | 70 | 98 | 2,555 |
| 18 | 9-Jan-83 | 1,690,000 | 1,724,497 | 1,933 | 300 | 70 | 98 | 2,555 |

**Figure 5.8-1. DPGroup Worksheet Input Interface.**

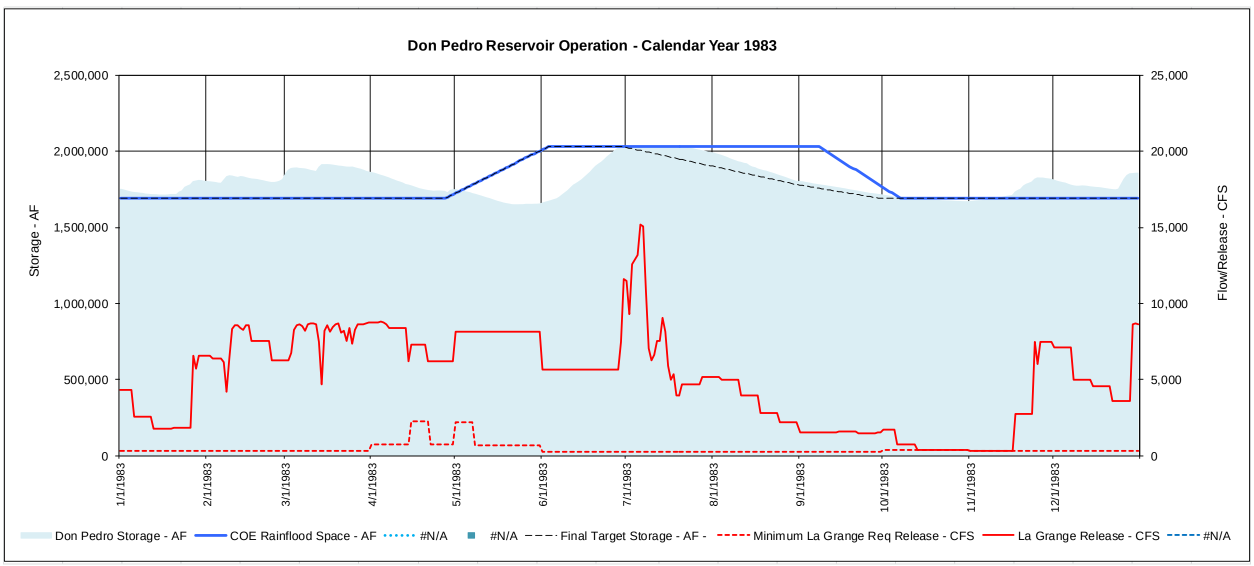



**Figure 5.8-2. DPGroup Worksheet Plotting.**

Unused plotting positions will appear with values plotted at “zero” and will have legends of “#VALUE!”, “#REF!” or “#N/A”. To create graphs without unused positions a copy of the plot can be made and positioned elsewhere in the worksheet. The unwanted positions can then be deleted from the plot.

## 5.9 ModelYearofDaily Worksheet

This worksheet (ModelYearofDaily) provides graphical and table display of the daily result for a single calendar or water year for any parameter within a Model component worksheet (e.g., worksheet DonPedro). A snapshot of the data entry interface and a sample of graphical display are shown in Figure 5.9-1.

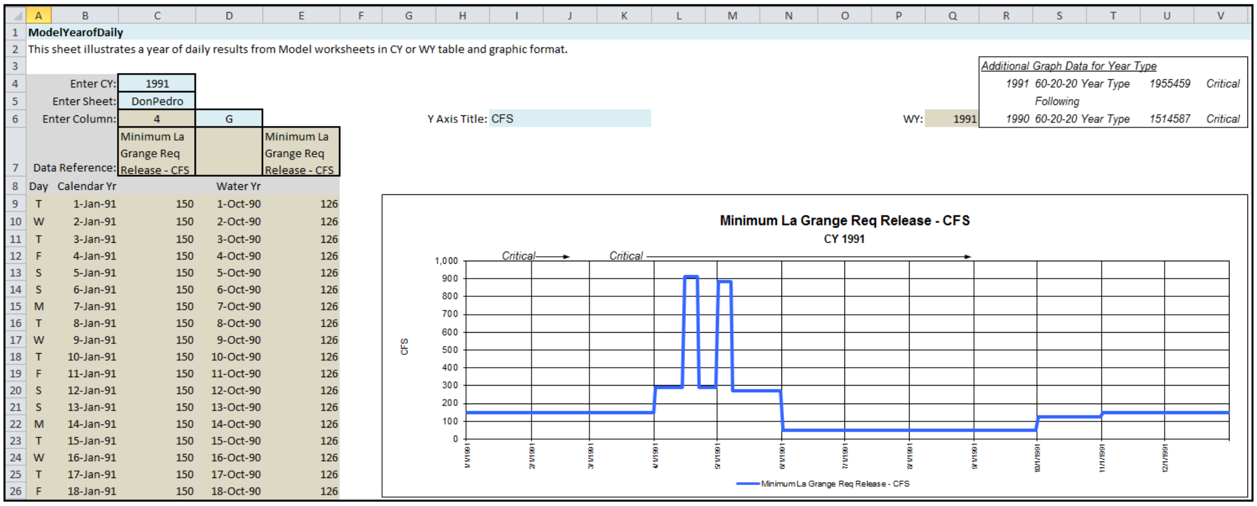



**Figure 5.9-1. DPGroup Worksheet Input Interface.**

The calendar year, Model worksheet, and column of interest are entered by the user. The result data are plotted by calendar year and water year. The result data are also tabled by calendar year (Figure 5.9-2) and water year.

| Minimum La Grange Req Release - CFS | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CY 1991 | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| 1 | 150 | 150 | 150 | 289 | 886 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 2 | 150 | 150 | 150 | 289 | 886 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 3 | 150 | 150 | 150 | 289 | 886 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 4 | 150 | 150 | 150 | 289 | 886 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 5 | 150 | 150 | 150 | 289 | 886 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 6 | 150 | 150 | 150 | 289 | 886 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 7 | 150 | 150 | 150 | 289 | 886 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 8 | 150 | 150 | 150 | 289 | 269 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 9 | 150 | 150 | 150 | 289 | 269 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 10 | 150 | 150 | 150 | 289 | 269 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 11 | 150 | 150 | 150 | 289 | 269 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 12 | 150 | 150 | 150 | 289 | 269 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 13 | 150 | 150 | 150 | 289 | 269 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 14 | 150 | 150 | 150 | 289 | 269 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 15 | 150 | 150 | 150 | 913 | 269 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 16 | 150 | 150 | 150 | 913 | 269 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 17 | 150 | 150 | 150 | 913 | 269 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 18 | 150 | 150 | 150 | 913 | 269 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 19 | 150 | 150 | 150 | 913 | 269 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 20 | 150 | 150 | 150 | 913 | 269 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 21 | 150 | 150 | 150 | 913 | 269 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 22 | 150 | 150 | 150 | 289 | 269 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 23 | 150 | 150 | 150 | 289 | 269 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 24 | 150 | 150 | 150 | 289 | 269 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 25 | 150 | 150 | 150 | 289 | 269 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 26 | 150 | 150 | 150 | 289 | 269 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 27 | 150 | 150 | 150 | 289 | 269 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 28 | 150 | 150 | 150 | 289 | 269 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 29 | 150 | --- | 150 | 289 | 269 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 30 | 150 | --- | 150 | 289 | 269 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| 31 | 150 | --- | 150 | --- | 269 | --- | 50 | 50 | --- | 126 | --- | 150 |
| Ave | 150 | 150 | 150 | 435 | 408 | 50 | 50 | 50 | 50 | 126 | 150 | 150 |
| AF | 9,223 | 8,331 | 9,223 | 25,871 | 25,109 | 2,975 | 3,074 | 3,074 | 2,975 | 7,736 | 8,926 | 9,223 |
| Annual | 115,742 AF | | 160 Ave CFS | | | | | | | | | |

**Figure 5.9-2. ModelYearofDaily Output Table (calendar year).**

## 5.10 ModelAnyGroup Worksheet

This worksheet (ModelAnyGroup) provides plotting of up to ten parameters provided in any Model component worksheet (e.g., worksheet DonPedro). One calendar year (the same year or different years) of data for a parameter can be plotted. The parameter(s) to be plotted are identified by reference worksheet name and column. A snapshot of the identification parameters and result values is shown in Figure 5.10-1. This worksheet performs the same function as the DSSAnyGroup worksheet except the source of its data are the Model component worksheets instead of DSS interface worksheets.

Values are plotted to either the primary y-axis or secondary y-axis. The "axis reference" indicates to which axis the value will be plotted by default. The designation of y-axis assignment is not modified by this field, and the user must edit the series data within the plot to change the y-axis assignment, graph type or line or shape characteristics. The "enter CY graph year" is a user entry. The same year or different year of a parameter or multiple parameters can be plotted. "Sheet name" is a user entry, and identifies from which Model component worksheet the parameter is to be acquired. The "enter column" entry identifies from which column the parameter occurs. Upon proper entry of a parameter a return of the parameter's label and source worksheet will occur in the "data reference" field. Values for the specified calendar year will also be returned in the data field. If a plotting position is not used, a "#VALUE!" or "#REF!" will be returned. The "scaler" field is provided to allow the conversion or scaling of the data returned from the result worksheet. For instance, if the daily data occurs in the result worksheet in units of daily average flow (cfs) it could be plotted in units of daily volume (acre-feet) by entering the conversion factor of 1.983471. The entry in the field acts as a multiplier to the value occurring in the result worksheet. This field can also be used to scale two different "order of magnitude" parameters to use the same y-axis.

The results of up to ten parameters will be plotted. An example of the several plotted parameters from an active scenario is shown in Figure 5.10-2.

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **ModelAnyGroup** | | | | | | | | | | | | | |
| 2 | This sheet illustrates a CY of daily results from Model worksheets in graphic format. | | | | | | | | | | | | | |
| 3 | Axis Reference | 1 | | 1 | | 2 | | 2 | | 2 | | 2 | | 1 |
| 4 | Enter CY Graph Year: | 2004 | | 2004 | | 2004 | | 2004 | | 2004 | | 2004 | | 2004 |
| 5 | Enter Sheet Name: | DonPedro | | DonPedro | | DonPedro | | DonPedro | | DonPedro | | DonPedro | | DonPedro |
| 6 | Column: | #N/A | | 72 | | 6 | | 7 | | #N/A | | 70 | | #N/A |
| 7 | Enter Column: | | | BT | | F | | G | | | | BR | | |
| 8 | Data Reference: | #N/A | Date | Don Pedro Storage - AF (DonPedro) | Date | Reservoir Inflow - AF (DonPedro) | Date | La Grange Req Release - CFS | Date | #N/A | Date | La Grange Release - CFS (DonPedro) | Date | #N/A |
| 9 | Enter Scaler: | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 |
| 10 | 1-Jan-04 | #N/A | 1-Jan-04 | 1,622,829 | 1-Jan-04 | 8,300 | 1-Jan-04 | 175 | 1-Jan-04 | #N/A | 1-Jan-04 | 175 | 1-Jan-04 | #N/A |
| 11 | 2-Jan-04 | #N/A | 2-Jan-04 | 1,625,102 | 2-Jan-04 | 2,934 | 2-Jan-04 | 175 | 2-Jan-04 | #N/A | 2-Jan-04 | 175 | 2-Jan-04 | #N/A |
| 12 | 3-Jan-04 | #N/A | 3-Jan-04 | 1,626,670 | 3-Jan-04 | 2,229 | 3-Jan-04 | 175 | 3-Jan-04 | #N/A | 3-Jan-04 | 175 | 3-Jan-04 | #N/A |
| 13 | 4-Jan-04 | #N/A | 4-Jan-04 | 1,628,860 | 4-Jan-04 | 2,850 | 4-Jan-04 | 175 | 4-Jan-04 | #N/A | 4-Jan-04 | 175 | 4-Jan-04 | #N/A |
| 14 | 5-Jan-04 | #N/A | 5-Jan-04 | 1,629,314 | 5-Jan-04 | 1,115 | 5-Jan-04 | 175 | 5-Jan-04 | #N/A | 5-Jan-04 | 175 | 5-Jan-04 | #N/A |
| 15 | 6-Jan-04 | #N/A | 6-Jan-04 | 1,630,546 | 6-Jan-04 | 1,892 | 6-Jan-04 | 175 | 6-Jan-04 | #N/A | 6-Jan-04 | 175 | 6-Jan-04 | #N/A |
| 16 | 7-Jan-04 | #N/A | 7-Jan-04 | 1,631,507 | 7-Jan-04 | 1,621 | 7-Jan-04 | 175 | 7-Jan-04 | #N/A | 7-Jan-04 | 175 | 7-Jan-04 | #N/A |
| 17 | 8-Jan-04 | #N/A | 8-Jan-04 | 1,632,196 | 8-Jan-04 | 1,349 | 8-Jan-04 | 175 | 8-Jan-04 | #N/A | 8-Jan-04 | 175 | 8-Jan-04 | #N/A |
| 18 | 9-Jan-04 | #N/A | 9-Jan-04 | 1,632,895 | 9-Jan-04 | 1,359 | 9-Jan-04 | 175 | 9-Jan-04 | #N/A | 9-Jan-04 | 175 | 9-Jan-04 | #N/A |
| 19 | 10-Jan-04 | #N/A | 10-Jan-04 | 1,634,514 | 10-Jan-04 | 2,279 | 10-Jan-04 | 175 | 10-Jan-04 | #N/A | 10-Jan-04 | 175 | 10-Jan-04 | #N/A |
| 20 | 11-Jan-04 | #N/A | 11-Jan-04 | 1,634,300 | 11-Jan-04 | 446 | 11-Jan-04 | 175 | 11-Jan-04 | #N/A | 11-Jan-04 | 175 | 11-Jan-04 | #N/A |
| 21 | 12-Jan-04 | #N/A | 12-Jan-04 | 1,636,320 | 12-Jan-04 | 2,680 | 12-Jan-04 | 175 | 12-Jan-04 | #N/A | 12-Jan-04 | 175 | 12-Jan-04 | #N/A |
| 22 | 13-Jan-04 | #N/A | 13-Jan-04 | 1,637,275 | 13-Jan-04 | 1,615 | 13-Jan-04 | 175 | 13-Jan-04 | #N/A | 13-Jan-04 | 175 | 13-Jan-04 | #N/A |
| 23 | 14-Jan-04 | #N/A | 14-Jan-04 | 1,638,581 | 14-Jan-04 | 1,967 | 14-Jan-04 | 175 | 14-Jan-04 | #N/A | 14-Jan-04 | 175 | 14-Jan-04 | #N/A |
| 24 | 15-Jan-04 | #N/A | 15-Jan-04 | 1,639,327 | 15-Jan-04 | 1,406 | 15-Jan-04 | 175 | 15-Jan-04 | #N/A | 15-Jan-04 | 175 | 15-Jan-04 | #N/A |
| 25 | 16-Jan-04 | #N/A | 16-Jan-04 | 1,640,134 | 16-Jan-04 | 1,466 | 16-Jan-04 | 175 | 16-Jan-04 | #N/A | 16-Jan-04 | 175 | 16-Jan-04 | #N/A |

**Figure 5.10-1. ModelAnyGroup Worksheet Input Interface.**

Unused plotting positions will appear with values plotted at "zero" and will have legends of "#VALUE!" or "#REF!". To create graphs without unused positions a copy of the plot can be made and positioned elsewhere in the worksheet. The unwanted positions can then be deleted from the plot.

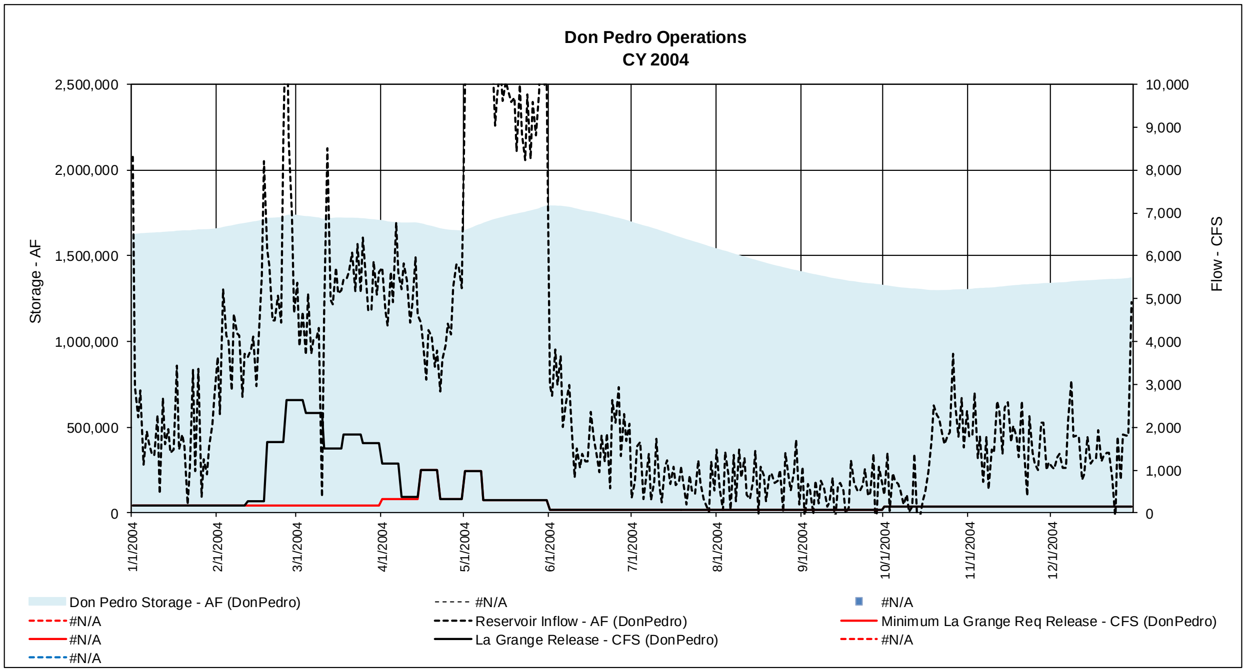



**Figure 5.10-2. ModelAnyGroup Worksheet Plotting.**

## 5.11 ModelMonthTable Worksheet

This worksheet (ModelMonthTable) provides summation or averaging, and plotting of up to four parameters provided in Model component worksheets (e.g., DonPedro worksheet). The function of this worksheet is to provide a synthesis of the daily result data into monthly results thus reducing the handling and display of over 14,000 values for each parameter (39 years of days) to 468 values (39 years of months). This worksheet and its functionality are identical to the DSSMonthTable worksheet except the source of its data are the Model component worksheets instead of DSS interface worksheets.

The parameter(s) to be plotted or tabled are identified by reference worksheet name and column, very similarly to the method identified for the ModelAnyGroup worksheet. A snapshot of the identification parameters and result values is shown in Figure 5.11-1.

Each parameter is tabled and plotted separately for the entire 39-year simulation period. “Sheet name” is a user entry, and identifies from which Model component worksheet the parameter is to be acquired. The “enter column letter” entry identifies from which column the parameter occurs. Upon proper entry of a parameter a return of the parameter’s label, source worksheet and the native unit of the parameter will occur. Depending on need, the “conversion” entry is provided. This entry, a keyed value of 0 to 5, directs the worksheet on the handling of the daily data. An entry of 1 will direct the worksheet to sum the daily data into monthly increments in the parameter’s native units (e.g., daily acre-feet into monthly volumes). An entry of 1 will convert the daily data from a native unit of flow (cfs) into monthly volumes of acre-feet. An entry of 2 will convert the daily data from a native unit of volume (acre-feet) into a monthly sum of daily flow in units of cfs. An entry of 3 will act as an entry of 1 except convert the result into monthly volumes with units of 1,000 acre-feet. An entry of 4 will table and plot the daily value associated with the last day of each month in its native unit, and is primarily intended to analyze reservoir storage. An entry of 5 will report the average of daily values within a month. Depending on the entry in the conversion field, the converted unit will be returned to "converted unit" field. Values for the each month of the simulation period will also be returned in the data field. If a plotting position is not used, a "#VALUE!" or "#REF!" will be returned.

A "scaler" field is also provided for each parameter (in the row above the data fields) to allow the conversion or scaling of the data returned from the result worksheet.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5 | | | | Conversion Key: | | | |
| 6 | | | | 0 | 1 >> 1 | Native | 1 |
| 7 | | | | 1 | CFS >> AF | AF | 1.9834700 |
| 8 | | | | 2 | AF >> CFS | CFS | 0.5041669 |
| 9 | | | | 3 | CFS >> TAF | TAF | 0.0019835 |
| 10 | | | | 4 | EOM Stor | AF | 1 |
| 11 | | | | 5 | Ave Day | Native | 1 |
| 12 | Enter Conversion (0-5): | | | 4 | 1 | 1 | 1 |
| 13 | Enter Sheet Name: | | | DonPedro | DonPedro | DonPedro | DonPedro |
| 14 | Enter Column Letter: | | | BT | F | BR | G |
| 15 | Column No: | | | 72 | 6 | 70 | 7 |
| 16 | Label: | | | ro Storage | oir Inflow ( | ge Release | ange Req F |
| 17 | Native Unit: | | | AF | AF | CFS | CFS |
| 18 | Convert Unit: | | | AF | AF | AF | AF |
| 19 | Index | Date | Day | 1 | 1 | 1 | 1 |
| 20 | 1970.10 | 10/1/1970 | T | 1,666,767 | 1,268 | 787 | 787 |
| 21 | 1970.10 | 10/2/1970 | F | 1,664,567 | 1,783 | 787 | 787 |
| 22 | 1970.10 | 10/3/1970 | S | 1,662,719 | 2,130 | 787 | 787 |
| 23 | 1970.10 | 10/4/1970 | S | 1,659,892 | 2,460 | 787 | 787 |
| 24 | 1970.10 | 10/5/1970 | M | 1,656,745 | 296 | 787 | 787 |
| 25 | 1970.10 | 10/6/1970 | T | 1,654,119 | 1,870 | 787 | 787 |

**Figure 5.11-1. ModelMonthTable Worksheet Input Interface.**

The results of up to four parameters will be tabled and plotted. The content formats of reports are identified below. Refer to section 5.6 DSSMonthTable for illustrations of each format.

*Standardized Tables*

- Data synthesized into monthly volumes for the simulation period.
- Chronological annual values and associated monthly values are also grouped by water type, in descending order of annual runoff.

*Standardized Graphs*

- Graphs providing a trace of the monthly sequence of data developed for the standardized chronological table.
- Graphs depicting a particular column of data from the water year-based standardized table.
- Graphs for the same information displayed rank-ordered according to descending runoff.
- Standardized graphics are provided for a columnar comparison of the four parameters.

## 5.12 DonPedro Worksheet

This Model component worksheet (DonPedro) simulates the operation of Don Pedro Reservoir. Several sections of logic provide a systematic operation of the reservoir based on inflow and forecasted hydrology and water demands. As described earlier, the Model will direct releases from the Don Pedro Project under a "hold-unless-need-to-release" protocol, except as conditioned by minimum release requirements, diversions, preferred/maximum storage, and snowmelt management releases. The several sections of logic are illustrated and discussed below.

### 5.12.1 Don Pedro Reservoir Release Demands.

The Don Pedro Reservoir release requirements section of logic (Figure 5.12-1) assembles the underlying water demands placed for Don Pedro Reservoir releases. Reservoir inflow is derived from other Model component worksheets and is the sum of unregulated inflow to Don Pedro Reservoir (Hydrology worksheet) and regulated releases from the CCSF System (SFHetchHetchy worksheet, SFLLoyd worksheet and SFEleanor worksheet). The minimum flow requirement for the Tuolumne River is provided by worksheet LaGrangeSchedule as directed by worksheet UserInput. The "Existing Level Full Diversion Demand" is a projection of canal diversion requirements if no water supply shortages occurred and full demands are provided. "Scenario Canal Diversion Demand" is the canal diversions of MID and TID for the active scenario. These diversions are determined by either pre-processed computations of diversions (e.g., fixed Test Case diversions), user specified diversions, or dynamic computations. "Total DP Demands" are the summation of minimum release requirements for the river and canal diversions. Other information is developed in this section concerning the difference between scenario diversions and full diversion demand, and an overall summary of water disposition for the entire simulation period.

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 1 | | Don Pedro Model | | | | | | | | | | | | | | | | | | | |
| 2 | Unit Title | | 2 | | CFS | AF | CFS | AF | CFS | AF | CFS | AF | CFS | AF | CFS | AF | CFS | AF | | | | | CFS | AF |
| 3 | Parameter Title | | 3 | | DP Reserv | DP Reserv | Minimum La | Minimum | MID Full D | MID Full D | TID Full Di | TID Full Di | MID Canal | MID Canal | TID Canal | TID Canal | Total Cana | Total Canals | | | | | Total Rese | Total Rese |
| 4 | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | Acre-foot to CFS conversion | | | | This Scenario | | | | | | | | | | | | | Difference from Base | | | | | | |
| 6 | divide by : | 1.983471 | | | Check Sums | | Sum AF | 39-ave | | Other | 39-ave | | | 39-ave | 39-ave | | | | 39-yr Ave | 39-yr Ave | | | | |
| 7 | | | | | | Inflow | 65,915,187 | 1,690,133 | | MID Canal | 284,177 | | Inflow | 1,690,133 | 284,177 | MID Canal | | Inflow | 0 | 0 | MID Canal | | | |
| 8 | | | | | | Evap | 1,740,362 | 44,625 | | TID Canal | 559,697 | | Evap | 44,625 | 559,697 | TID Canal | | Evap | 0 | 0 | TID Canal | | | |
| 9 | | | | | | River | 31,532,459 | 808,525 | | | | | River | 808,525 | | | | River | 0 | | | | | |
| 10 | | | | | | Canals | 32,911,098 | 843,874 | | Minimum River | 213,897 | | Canals | 843,874 | 213,897 | Minimum River | | Canals | 0 | 0 | Minimum River | | | |
| 11 | | | | | | Net | -268,732 | | | | | | | | | | | | | | | | | |
| 12 | | | | | | Chng Stor | -268,732 | | | | | | | | | | | | | | | | | |
| 13 | | 39-year Ave or Max | | | | | | | | | | | 1,257 | 284,177 | 2,404 | 559,697 | | 843,874 | | 16,777 | | 41,518 | | 1,057,771 |
| 14 | | | | Min | | | | | | Using WSF = 1.000 All Years | | | 41 | | 1 | | | | | | | | | |
| 15 | | | | | Inflow | | La Grange Require | | Existing Level Full Diversion Demand | | | | Scenario Canal Diversions | | | | | | Diversion Shortage from Full Demand | | | | Total DP Demands | |
| 16 | | | | | | | | | | 300,954 | | 601,215 | | | | | | | | | | | Total | Total |
| 17 | Month | | | | Reservoir | Reservoir | Minimum | Minimum | MID | MID | TID | TID | MID | MID | TID | TID | Total | Total | MID | MID | TID | TID | Res Rel | Res Rel |
| 18 | Index | Date | Day | Days | Inflow | Inflow | Req | Req | Canal | Canal | Canal | Canal | Canal | Canal | Canal | Canal | Canals | Canals | Canal | Canal | Canal | Canal | Demands | Demands |
| 19 | | | | | CFS | AF | CFS | AF | CFS | AF | CFS | AF | CFS | AF | CFS | AF | CFS | AF | CFS | AF | CFS | AF | CFS | AF |
| 20 | 1970.10 | 10/1/1970 | T | 31 | 322 | 639 | 397 | 787 | 531 | 1,053 | 1,406 | 2,789 | 531 | 1,053 | 1,406 | 2,789 | 1,937 | 3,842 | 0 | 0 | 0 | 0 | 2,334 | 4,629 |
| 21 | 1970.10 | 10/2/1970 | F | 31 | 453 | 899 | 397 | 787 | 434 | 860 | 661 | 1,311 | 434 | 860 | 661 | 1,311 | 1,094 | 2,171 | 0 | 0 | 0 | 0 | 1,491 | 2,958 |
| 22 | 1970.10 | 10/3/1970 | S | 31 | 541 | 1,074 | 397 | 787 | 424 | 840 | 582 | 1,154 | 424 | 840 | 582 | 1,154 | 1,006 | 1,994 | 0 | 0 | 0 | 0 | 1,402 | 2,781 |
| 23 | 1970.10 | 10/4/1970 | S | 31 | 625 | 1,240 | 397 | 787 | 463 | 918 | 1,119 | 2,220 | 463 | 918 | 1,119 | 2,220 | 1,582 | 3,139 | 0 | 0 | 0 | 0 | 1,979 | 3,926 |
| 24 | 1970.10 | 10/5/1970 | M | 31 | 75 | 149 | 397 | 787 | 461 | 915 | 733 | 1,453 | 461 | 915 | 733 | 1,453 | 1,194 | 2,368 | 0 | 0 | 0 | 0 | 1,591 | 3,155 |
| 25 | 1970.10 | 10/6/1970 | T | 31 | 475 | 943 | 397 | 787 | 491 | 973 | 841 | 1,668 | 491 | 973 | 841 | 1,668 | 1,332 | 2,641 | 0 | 0 | 0 | 0 | 1,728 | 3,428 |

**Figure 5.12-1. Don Pedro Reservoir Release Demands.**

### 5.12.2 Reservoir Evaporation / Initial Storage Computation and Encroachment Release

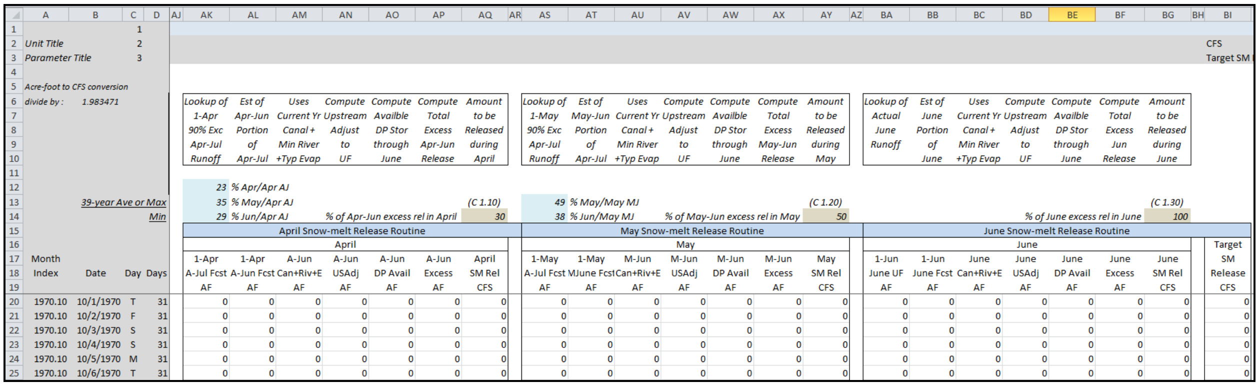
This section (Figure 5.12-2) performs an initial check of reservoir storage assuming the previously described minimum releases for the river and canals. A daily mass balance is performed: *change in reservoir storage = inflow, minus outflow (releases), minus reservoir losses*. The prior day's reservoir evaporation is included in the calculation. If the computation produces resulting Don Pedro Reservoir storage in excess (encroachment) of the preferred storage target, the encroachment is computed. Every 7th day the model checks for an encroachment, and if it exists a check release is computed. It is assumed that a constant supplemental release (in excess of minimum releases) will be initiated at a rate equal to the encroachment divided equally over the next 10 days. This protocol repeats itself every 7th day, reestablishing the level of check release each time. The end result of this procedure will allow encroachment of storage space above the preferred storage target and not require unrealistic hard releases of water to exactly conform to the target.

| | A | B | C | D | Y | Z | AA | AB | AC | AD | AE | AF | AG | AH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 1 | | | | | | | | | | | |
| 2 | *Unit Title* | | 2 | | | | | AF | | | | | | |
| 3 | *Parameter Title* | | 3 | | rvoir Release Demands | | | COE Rainfl | Final Target Storage - AF | | | | | |
| 4 | | | | | | | | | | | | | | |
| 5 | *Acre-foot to CFS conversion* | | | | | | | | | | | | | |
| 6 | *divide by :* | *1.983471* | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | | | |
| 13 | | *39-year Ave or Max* | | | | | | | | | | | | |
| 14 | | | | *Min* | | | | | | | | | | |
| 15 | | | | | | Evap/loss | Initial Storage Computation and Encroachment Release | | | | | | | |
| 16 | | | | | | | Initial | COE | | | | Spread | Spread | |
| 17 | Month | | | | | Net Res | DP | Rainflood | Target | Initial | Encroach | Encroach | 7th Day | |
| 18 | Index | Date | Day | Days | | Evap/Loss | Storage | Target | Stroage | Encroach | 7th Day | 10 days | 10 days | 7-day |
| 19 | | | | | | AF | 1,670,900 | AF | AF | AF | AF | AF | CFS | Count |
| 20 | 1970.10 | 10/1/1970 | T | 31 | | 143 | 1,666,767 | 1,760,900 | 1,690,000 | 0 | 0 | 0 | 0 | 1 |
| 21 | 1970.10 | 10/2/1970 | F | 31 | | 141 | 1,664,567 | 1,749,200 | 1,690,000 | 0 | 0 | 0 | 0 | 0 |
| 22 | 1970.10 | 10/3/1970 | S | 31 | | 141 | 1,662,719 | 1,737,500 | 1,690,000 | 0 | 0 | 0 | 0 | 0 |
| 23 | 1970.10 | 10/4/1970 | S | 31 | | 141 | 1,659,892 | 1,725,800 | 1,690,000 | 0 | 0 | 0 | 0 | 0 |
| 24 | 1970.10 | 10/5/1970 | M | 31 | | 141 | 1,656,745 | 1,714,100 | 1,690,000 | 0 | 0 | 0 | 0 | 0 |
| 25 | 1970.10 | 10/6/1970 | T | 31 | | 141 | 1,654,119 | 1,702,400 | 1,690,000 | 0 | 0 | 0 | 0 | 0 |

**Figure 5.12-2. Reservoir Evaporation/Initial Storage Computation and Encroachment Release.**

### 5.12.3 Snow-melt Management

A second check release is made during the April through June period for management of anticipated snowmelt runoff (Figure 5.12-3). On the first day of each of these months a forecast is made of anticipated runoff into the reservoir and minimum releases and losses from the reservoir from the date of forecast through the end of June (the assumed target date of reservoir filling). These forecasts determine the volume of water (if any) that will require release in excess of minimum releases and losses and storage gain by the end of June. For April and May, the DWR 90 percent exceedence forecast is used for anticipated runoff, along with known minimum releases and losses, and upstream impairment. The user defines the percentage of volume (of the total volume) to be additionally released during each month. For April, 30 percent of the 3-month volume is advised for release, and during May 50 percent of the 2-month volume is advised for released. For June, the historically reported UF flow is assumed for the runoff computation. This assumes pre-knowledge of the runoff volume for the month, and 100 percent of the excess is spread across the month. The snowmelt check release is evenly distributed across the days of the month. The release made in a day is the greater of the two check releases or the minimum release. At no time is the maximum capacity of the reservoir (2,030,000 acre-feet) allowed to be exceeded, and if necessary a release, regardless of magnitude, will be made by the model to not exceed maximum storage capacity.



Unit Title 2 — CFS; Parameter Title 3 — Target SM
Acre-foot to CFS conversion divide by : 1.983471

| Lookup of 1-Apr 90% Exc Apr-Jul Runoff | Est of Apr-Jun Portion of Apr-Jul | Uses Current Yr Canal + Min River +Typ Evap | Compute Upstream Adjust to UF | Compute Availble DP Stor through June | Compute Total Excess Apr-Jun Release | Amount to be Released during April |
|---|---|---|---|---|---|---|
| 23 % Apr/Apr AJ | | | | | | |
| 35 % May/Apr AJ | | | | | | (C 1.10) |
| 29 % Jun/Apr AJ | | % of Apr-Jun excess rel in April | | | | 30 |

| Lookup of 1-May 90% Exc Apr-Jul Runoff | Est of May-Jun Portion of Apr-Jul | Uses Current Yr Canal + Min River +Typ Evap | Compute Upstream Adjust to UF | Compute Availble DP Stor through June | Compute Total Excess May-Jun Release | Amount to be Released during May |
|---|---|---|---|---|---|---|
| 49 % May/May MJ | | | | | | (C 1.20) |
| 38 % Jun/May MJ | | % of May-Jun excess rel in May | | | | 50 |

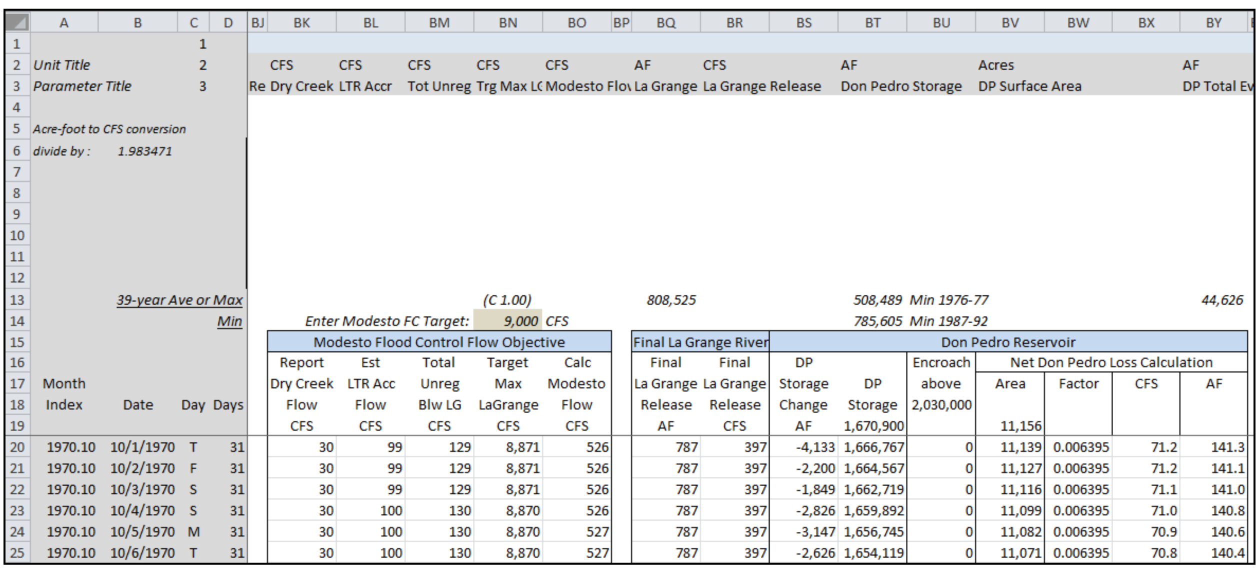
| Lookup of Actual June Runoff | Est of June Portion of June | Uses Current Yr Canal + Min River +Typ Evap | Compute Upstream Adjust to UF | Compute Availble DP Stor through June | Compute Total Excess Jun Release | Amount to be Released during June |
|---|---|---|---|---|---|---|
| | | | | | | (C 1.30) |
| | | | | % of June excess rel in June | | 100 |

| Month Index | Date | Day | Days | April: 1-Apr A-Jul Fcst AF | 1-Apr A-Jun Fcst AF | A-Jun Can+Riv+E AF | A-Jun USAdj AF | A-Jun DP Avail AF | A-Jun Excess AF | April SM Rel CFS | May: 1-May A-Jul Fcst AF | 1-May MJune Fcst AF | M-Jun Can+Riv+E AF | M-Jun USAdj AF | M-Jun DP Avail AF | M-Jun Excess AF | May SM Rel CFS | June: 1-Jun June UF AF | 1-Jun June Fcst AF | June Can+Riv+E AF | June USAdj AF | June DP Avail AF | June Excess AF | June SM Rel CFS | Target SM Release CFS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1970.10 | 10/1/1970 | T | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970.10 | 10/2/1970 | F | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970.10 | 10/3/1970 | S | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970.10 | 10/4/1970 | S | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970.10 | 10/5/1970 | M | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970.10 | 10/6/1970 | T | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Figure 5.12-3. Snow-melt Management.**

## 5.12.4 Modesto Flow Objective, Don Pedro Reservoir, and Tuolumne River Release

A Modesto flood control objective is incorporated into release logic (Figure 5.12-4). The objective is to maintain a flow at Modesto no greater than a user-specified flow rate. The logic checks against an allowable river release that would not exceed the flood control objective after considering the lower Tuolumne River accretions and Dry Creek flow. The previous check releases are compared to the allowable release. The release is then reduced if necessary to not exceed the Modesto flow target objective, even if it results in an encroachment in Don Pedro Reservoir. The exception is when the reservoir reaches full (2,030,000 AF). Any computed encroachment above a full reservoir is passed and the Modesto flow objective is exceeded.



Acre-foot to CFS conversion divide by : 1.983471

| | BK | BL | BM | BN | BO | BQ | BR | BS | BT | BU | BV | BW | BX | BY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unit Title | CFS | CFS | CFS | CFS | CFS | AF | CFS | | AF | | Acres | | | AF |
| Parameter Title | Re Dry Creek | LTR Accr | Tot Unreg | Trg Max L( | Modesto Flo\ | La Grange | La Grange Release | | Don Pedro Storage | | DP Surface Area | | | DP Total Ev |
| 39-year Ave or Max | | | | (C 1.00) | | 808,525 | | | 508,489 | Min 1976-77 | | | | 44,626 |
| Min | | Enter Modesto FC Target: | | 9,000 | CFS | | | | 785,605 | Min 1987-92 | | | | |

| Month Index | Date | Day | Days | Modesto Flood Control Flow Objective: Report Dry Creek Flow CFS | Est LTR Acc Flow CFS | Total Unreg Blw LG CFS | Target Max LaGrange CFS | Calc Modesto Flow CFS | Final La Grange River: Final La Grange Release AF | Final La Grange Release CFS | Don Pedro Reservoir: DP Storage Change AF | DP Storage | Encroach above 2,030,000 | Net Don Pedro Loss Calculation: Area | Factor | CFS | AF |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | 1,670,900 | | 11,156 | | | |
| 1970.10 | 10/1/1970 | T | 31 | 30 | 99 | 129 | 8,871 | 526 | 787 | 397 | -4,133 | 1,666,767 | 0 | 11,139 | 0.006395 | 71.2 | 141.3 |
| 1970.10 | 10/2/1970 | F | 31 | 30 | 99 | 129 | 8,871 | 526 | 787 | 397 | -2,200 | 1,664,567 | 0 | 11,127 | 0.006395 | 71.2 | 141.1 |
| 1970.10 | 10/3/1970 | S | 31 | 30 | 99 | 129 | 8,871 | 526 | 787 | 397 | -1,849 | 1,662,719 | 0 | 11,116 | 0.006395 | 71.1 | 141.0 |
| 1970.10 | 10/4/1970 | S | 31 | 30 | 100 | 130 | 8,870 | 526 | 787 | 397 | -2,826 | 1,659,892 | 0 | 11,099 | 0.006395 | 71.0 | 140.8 |
| 1970.10 | 10/5/1970 | M | 31 | 30 | 100 | 130 | 8,870 | 527 | 787 | 397 | -3,147 | 1,656,745 | 0 | 11,082 | 0.006395 | 70.9 | 140.6 |
| 1970.10 | 10/6/1970 | T | 31 | 30 | 100 | 130 | 8,870 | 527 | 787 | 397 | -2,626 | 1,654,119 | 0 | 11,071 | 0.006395 | 70.8 | 140.4 |

**Figure 5.12-4. Modesto Flow Objective, Don Pedro Reservoir, and Tuolumne River Release.**

The several advised releases, storage conditions and water demands all culminate in determining the "Final La Grange River" release. The "Don Pedro Reservoir" section of logic reports the final reservoir storage of a day and the computation of Don Pedro Reservoir losses. Reservoir losses are computed in accordance with procedures of the Fourth Agreement.

### 5.12.5 Don Pedro Project Generation and River Flows

Based on the hydrologic operation of Don Pedro Reservoir in the Model, power characteristics of the scenario are computed. Equations of Don Pedro powerhouse generation characteristics define capacity (MW) and efficiency (kWh/AF), based on reservoir storage. Capacity potential uses minimum storage of the day, while efficiency uses average storage of the day. The maximum water through plant is assumed to be 5,400 cfs. Water that does not appear as passing through the generators is computed to be "spilled-bypassed". The power generation is "cutoff" at reservoir storage of 308,960 acre-feet, the top of the dead pool.

Flow in the river below La Grange diversion dam is computed and reported. The flow is a determined value by the Model. The same hydrologic information used within the Modesto flow objective logic is added to La Grange releases to estimate flow at downstream points in the river. Currently an estimate of total Tuolumne River accretion between La Grange Bridge and the confluence of Dry Creek is added to La Grange releases to provide an estimate of flow above the Dry Creek confluence. The estimated flow of Dry Creek is added to that estimate to provide an estimate of flow below the Dry Creek confluence at "Modesto". Additional flow points can be added as information becomes available. Figure 5.12-5 is a snapshot of these sections of logic.

| | A | B | C | D | BZ | CA | CB | CC | CD | CE | CF | CG | CH | CI | CJ | CK | CL | CM | CN | CO | CP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 1 | | | | | | | | | | | | | | | | | | |
| 2 | *Unit Title* | | 2 | | | | | MW | kWh/AF | AF | AF | AF | MWh | | CFS | | | | CFS | CFS | |
| 3 | *Parameter Title* | | 3 | | vaporation | | | DP PH Cap | DP PH Eff | Total DP R | DP Power I | DP Spill / I | Don Pedro Er | | La Grange Release | | | | TR abv Mc | TR blw Dry Creek | |
| 4 | | | | | | | | | | | | | | | | | | | | | |
| 5 | *Acre-foot to CFS conversion* | | | | | | | | | | | | | | | | | | | | |
| 6 | *divide by :* | *1.983471* | | | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | | | | |
| 11 | | | | | | | | | | | (C 1.22) | | | | | | | | | | |
| 12 | | | | | | | *39-yr Ave* | *191* | *392* | *1,652,399* | *1,488,570* | *163,829* | *607,705* | | | | | | | | |
| 13 | | *39-year Ave or Max* | | | | | *Max* | *198* | *440* | *154,471* | *10,711* | *143,760* | *4,710* | | | | | | | | |
| 14 | | | | *Min* | | | *Min* | *127* | *258* | *410* | *410* | *0* | *106* | | | | | | | | |
| 15 | | | | | | Don Pedro Power Operations | | | | | | | | | River Flows | | | | | | |
| 16 | | | | | | Per Ave | Per Min | (C 1.20) | | Total | Thru | | Don | | | | | | LTR abv | LTR blw | |
| 17 | Month | | | | | DPStor | DPStor | 308,960 | | DP | PH (cfs) | Spill/ | Pedro | | La Grange | Waterford | Hickman | Santa Fe | Modesto | Modesto | Mouth |
| 18 | Index | Date | Day | Days | | (for Eff) | (for Cap) | Capability | Efficiency | Release | 5,400 | Bypass | Energy | | RM 51.8 | RM 42.0 | RM 31.0 | RM 21.6 | RM 16.2 | RM | RM 0.0 |
| 19 | | | | | | AF | AF | MW | kWh/AF | AF | AF | AF | MWh | | CFS | CFS | CFS | CFS | CFS | CFS | CFS |
| 20 | 1970.10 | 10/1/1970 | T | 31 | | 1,668,834 | 1,666,767 | 195 | 408 | 4,629 | 4,629 | 0 | 1,888 | | 397 | | | | 496 | 526 | |
| 21 | 1970.10 | 10/2/1970 | F | 31 | | 1,665,667 | 1,664,567 | 195 | 408 | 2,958 | 2,958 | 0 | 1,205 | | 397 | | | | 496 | 526 | |
| 22 | 1970.10 | 10/3/1970 | S | 31 | | 1,663,643 | 1,662,719 | 195 | 407 | 2,781 | 2,781 | 0 | 1,133 | | 397 | | | | 496 | 526 | |
| 23 | 1970.10 | 10/4/1970 | S | 31 | | 1,661,305 | 1,659,892 | 195 | 407 | 3,926 | 3,926 | 0 | 1,598 | | 397 | | | | 496 | 526 | |
| 24 | 1970.10 | 10/5/1970 | M | 31 | | 1,658,319 | 1,656,745 | 195 | 407 | 3,155 | 3,155 | 0 | 1,284 | | 397 | | | | 497 | 527 | |
| 25 | 1970.10 | 10/6/1970 | T | 31 | | 1,655,432 | 1,654,119 | 195 | 407 | 3,428 | 3,428 | 0 | 1,394 | | 397 | | | | 497 | 527 | |

**Figure 5.12-5. Don Pedro Project Generation and River Flows.**

### 5.12.6 Don Pedro Inflow Components

This section of logic (Figure 5.12-6) assembles the Don Pedro Reservoir inflow components from other Model component worksheets.

| | A | B | C | D | CT | CU | CV | CW | CX | CY | CZ | DA | DB | DC | DD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 1 | | | | | | | | | | | | |
| 2 | *Unit Title* | | 2 | | | AF | CFS | AF | CFS | AF | CFS | AF | CFS | AF | CFS |
| 3 | *Parameter Title* | | 3 | | | DP Inflow | DP Inflow | DP Inflow | DP Inflow | DP Inflow | DP Inflow | Unreg Infl | Unreg Infl | DP Inflow | DP Inflow |
| 4 | | | | | | | | | | | | | | | |
| 5 | *Acre-foot to CFS conversion* | | | | | | | | | | | | | | |
| 6 | *divide by :* | *1.983471* | | | | *Read* | | *Read* | | *Read* | | | *Read* | | *Read by* |
| 7 | | | | | | *from* | | *from* | | *from* | | | *from* | | *Model* |
| 8 | | | | | | *SFHetchHetchy* | | *SFLloyd* | | *SFEleanor* | | | *Hydrology* | | |
| 9 | | | | | | *Incl* | | | | | | | | | |
| 10 | | | | | | *Return of* | | | | | | | | | |
| 11 | | | | | | *Moc Hatch* | | | | | | | | | |
| 12 | | | | | | | | | | | | | | | |
| 13 | | *39-year Ave or Max* | | | | *39-year average* | | | | | | | | | |
| 14 | | | | *Min* | | *525,724* | | *378,296* | | *102,781* | | *683,332* | | *1,690,133* | |
| 15 | | | | | | Inflow to Don Pedro Reservoir | | | | | | | | | |
| 16 | | | | | | Inflow | Inflow | Inflow | Inflow | Inflow | Inflow | | | | |
| 17 | Month | | | | | from | from | from | from | from | from | Unreg | Unreg | DP | DP |
| 18 | Index | Date | Day | Days | | HH | HH | Lloyd | Lloyd | Eleanor | Eleanor | Inflow | Inflow | Inflow | Inflow |
| 19 | | | | | | AF | CFS | AF | CFS | AF | CFS | AF | CFS | AF | CFS |
| 20 | 1970.10 | 10/1/1970 | T | 31 | | 179 | 90 | 443 | 223 | 20 | 10 | -2 | -1 | 639 | 322 |
| 21 | 1970.10 | 10/2/1970 | F | 31 | | 179 | 90 | 443 | 223 | 20 | 10 | 258 | 130 | 899 | 453 |
| 22 | 1970.10 | 10/3/1970 | S | 31 | | 179 | 90 | 443 | 223 | 20 | 10 | 433 | 218 | 1,074 | 541 |
| 23 | 1970.10 | 10/4/1970 | S | 31 | | 179 | 90 | 443 | 223 | 20 | 10 | 599 | 302 | 1,240 | 625 |
| 24 | 1970.10 | 10/5/1970 | M | 31 | | 179 | 90 | 443 | 223 | 20 | 10 | -492 | -248 | 149 | 75 |
| 25 | 1970.10 | 10/6/1970 | T | 31 | | 179 | 90 | 443 | 223 | 20 | 10 | 302 | 152 | 943 | 475 |

**Figure 5.12-6. Don Pedro Reservoir Inflow Components.**

## 5.13 SFHetchHetchy Worksheet

This Model component worksheet (SFHetchHetchy) simulates the operation of Hetch Hetchy Reservoir. Several sections of logic provide a systematic operation of the reservoir based on inflow and forecasted hydrology and water demands. As described earlier, the Model will direct releases from Hetch Hetchy Reservoir under a "hold-unless-need-to-release" protocol, except as conditioned by minimum release requirements, diversions, preferred/maximum storage, and snowmelt management releases. The several sections of logic are illustrated and discussed below.

### 5.13.1 Hetch Hetchy Release Demands / Reservoir Evaporation / Initial Storage Computation and Encroachment Release

This section (Figure 5.13-1) of logic assembles the underlying water demands placed for Hetch Hetchy Reservoir releases. Reservoir inflow is derived from worksheet Hydrology and is the unimpaired flow entering the reservoir. The initial releases are comprised of the minimum flow requirement below Hetch Hetchy Reservoir (from the worksheet CCSF) and represent requirements prior to consideration of Canyon Tunnel flows, Mountain Tunnel flows that consist of diversions for the SJPL (from the worksheet CCSF), Moccasin Fish Hatchery releases and diversions by Groveland CSD from Mountain Tunnel.

This section also performs an initial check of reservoir storage assuming the previously described minimum releases for the river and Mountain Tunnel. A daily mass balance is performed: *change in reservoir storage = inflow, minus outflow (releases), minus reservoir* *losses*. The prior day's reservoir evaporation is included in the calculation. If the computation produces resulting Hetch Hetchy Reservoir storage in excess (encroachment) of the preferred storage target, the encroachment is computed. Every 7$^{th}$ day the model checks for an encroachment, and if it exists a check release is computed. For the preferred reservoir storage target encroachment it is assumed that a constant supplemental release (in excess of minimum releases) will be initiated at a rate equal to the encroachment divided equally over the next 7 days. This protocol repeats itself every 7$^{th}$ day, reestablishing the level of check release each time. The end result of this procedure will allow encroachment of storage space above the preferred storage target and not require unrealistic hard releases of water to exactly conform to the target.

### 5.13.2 Supplemental Releases and Final Reservoir and Release Computation

This section (Figure 5.13-2) of logic performs the final computation of reservoir storage and releases. Incorporated into the logic is inclusion of user specified supplemental releases (from WaterBankRel or SFWaterBank worksheets) and snowmelt management releases (described later). Reservoir losses are computed in accordance with procedures of the Fourth Agreement.

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 1 | | **Hetch Hetchy Reservoir Model** | | | | | | | | | | | | | | | | | |
| 2 | *Unit Title* | | 2 | | CFS | AF | | CFS | AF | CFS | AF | CFS | AF | AF | | | | | | | | |
| 3 | *Parameter Title* | | 3 | | Hetch Het | Hetch Het | | SJPL + Mo | SJPL + Mo | SJPL | SJPL | HH Req St | HH Req St | HH Net Evap | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | | |
| 5 | *Acre-foot to CFS conversion* | | | | *This scenario* | | | | | | | | *Base* | | | | *Difference from Base* | | | | | |
| 6 | *divide by :* | *1.983471* | | | *Check Sums* | | *Sum AF* | *39-ave* | | *Other Sums* | | *Sum AF* | | *39-ave* | | *Sum AF* | | *39-ave* | | *Sum AF* | | |
| 7 | | | | | | *Inflow* | *29,761,289* | *763,110* | | | *Supplmtl* | *0* | *Inflow* | *763,110* | *Supplmtl* | *0* | *Inflow* | *0* | *Supplmtl* | *0* | | |
| 8 | | | | | | *Evap* | *149,655* | *3,837* | | | | | *Evap* | *3,837* | | | *Evap* | *0* | | | | |
| 9 | | | | | | *SJPL+* | *9,922,420* | *254,421* | | | | | *SJPL+* | *254,421* | | | *SJPL+* | *0* | | | | |
| 10 | | | | | | *Non-SJPL* | *19,655,587* | *503,989* | | | | | *Non-SJPL* | *503,989* | | | *Non-SJPL* | *0* | | | | |
| 11 | | | | | | *Net* | *33,627* | | | | | | | | | | | | | | | |
| 12 | | | | | | *Chng Stor* | *33,627* | | | | | | | | | | | | | | | |
| 13 | | | | *39-year Ave* | | *763,110* | | | *254,421* | | *231,238* | | | *3,837* | | | | | | | | |
| 14 | | | | | | | | *32* | *Moc Hatch + Groveland (CFS)* | | | | | | | | | | | | | |
| 15 | | | | | Inflow | | | Initial Releases | | | | | | Evap/loss | Initial Storage Computation and Encroachment Release | | | | | | | |
| 16 | | | | | HH | HH | | SJPL | SJPL | | | w/o 64 | w/o 64 | | Initial | Target | Hard | | | Spread | Spread | |
| 17 | Month | | | | Reservoir | Reservoir | | + Moc Hat | + Moc Hat | | | Req | Req | Net Res | HH | HH | Limit | Initial | Encroach | Encroach | 7th Day | |
| 18 | Index | Date | Day | Days | Inflow | Inflow | | Grove | Grove | SJPL | SJPL | Blw HH | Blw HH | Evap/Loss | Storage | Storage | Storage | Encroach | 7th Day | over 7 | Enc over 7 | 7-day |
| 19 | | | | | CFS | AF | | CFS | AF | CFS | AF | CFS | AF | AF | 250,000 | 360,360 | AF | AF | AF | AF | CFS | Count |
| 20 | 1970.10 | 10/1/1970 | T | 31 | 79 | 157 | | 341 | 677 | 309 | 614 | 60 | 119 | 11 | 249,349 | 359,381 | 360,360 | 0 | 0 | 0 | 0 | 1 |
| 21 | 1970.10 | 10/2/1970 | F | 31 | -82 | -163 | | 341 | 677 | 309 | 614 | 60 | 119 | 11 | 248,379 | 358,401 | 360,360 | 0 | 0 | 0 | 0 | 0 |
| 22 | 1970.10 | 10/3/1970 | S | 31 | 25 | 50 | | 341 | 677 | 309 | 614 | 60 | 119 | 11 | 247,622 | 357,422 | 360,360 | 0 | 0 | 0 | 0 | 0 |
| 23 | 1970.10 | 10/4/1970 | S | 31 | 110 | 218 | | 341 | 677 | 309 | 614 | 60 | 119 | 11 | 247,032 | 356,443 | 360,360 | 0 | 0 | 0 | 0 | 0 |
| 24 | 1970.10 | 10/5/1970 | M | 31 | -38 | -75 | | 341 | 677 | 309 | 614 | 60 | 119 | 11 | 246,150 | 355,463 | 360,360 | 0 | 0 | 0 | 0 | 0 |
| 25 | 1970.10 | 10/6/1970 | T | 31 | 9 | 18 | | 341 | 677 | 309 | 614 | 60 | 119 | 11 | 245,360 | 354,484 | 360,360 | 0 | 0 | 0 | 0 | 0 |

**Figure 5.13-1. Reservoir Evaporation/Initial Storage Computation and Encroachment Release.**

| | A | B | C | D | W | X | Y | Z | AA | AB | AC | AD | AE | AF | AG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 1 | | | | | | | | | | | | |
| 2 | *Unit Title* | | 2 | | | AF | CFS | AF | AF | | | | | | CFS |
| 3 | *Parameter Title* | | 3 | | | HH Supple | HH Releas | HH Releas | HH Storag | | | | | | Total HH Re |
| 4 | | | | | | | | | | | | | | | |
| 5 | *Acre-foot to CFS conversion* | | | | | | | | | | | | | | |
| 6 | *divide by :* | *1.983471* | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | | | | |
| 13 | | *39-year Ave* | | | | | | *503,989* | | | | | | | |
| 14 | | | | | | | | | | | | | | | |
| 15 | | | | | Final Release and Storage | | | | | | | | | | |
| 16 | | | | | | | HH | HH | | HH | Hetch Hetchy Reservoir Loss Calculation | | | | HH |
| 17 | Month | | | | Supplmtl | Supplmtl | Release | Release | HH | Storage | Area | Factor | CFS | AF | Total |
| 18 | Index | Date | Day | Days | Release | Release | abv Mnt | abv Mnt | Storage | Change | | | | | Release |
| 19 | | | | | CFS | AF | CFS | AF | 250,000 | AF | | | | | CFS |
| 20 | 1970.10 | 10/1/1970 | T | 31 | 0 | 0 | 60 | 119 | 249,349 | -651 | 1,722 | 0.003253 | 5.6 | 11.1 | 401 |
| 21 | 1970.10 | 10/2/1970 | F | 31 | 0 | 0 | 60 | 119 | 248,379 | -970 | 1,721 | 0.003253 | 5.6 | 11.1 | 401 |
| 22 | 1970.10 | 10/3/1970 | S | 31 | 0 | 0 | 60 | 119 | 247,622 | -758 | 1,718 | 0.003253 | 5.6 | 11.1 | 401 |
| 23 | 1970.10 | 10/4/1970 | S | 31 | 0 | 0 | 60 | 119 | 247,032 | -589 | 1,716 | 0.003253 | 5.6 | 11.1 | 401 |
| 24 | 1970.10 | 10/5/1970 | M | 31 | 0 | 0 | 60 | 119 | 246,150 | -883 | 1,714 | 0.003253 | 5.6 | 11.1 | 401 |
| 25 | 1970.10 | 10/6/1970 | T | 31 | 0 | 0 | 60 | 119 | 245,360 | -789 | 1,711 | 0.003253 | 5.6 | 11.0 | 401 |

**Figure 5.13-2. Supplemental Release, Reservoir Storage and Release.**

### 5.13.3 Snow-melt Management

A second check release is made during the February through June period for management of anticipated snowmelt runoff. On the first day of each of these months a forecast is made of anticipated runoff into the reservoir and minimum releases and losses from the reservoir, from the date of forecast through the end of June (assumed target of reservoir filling). These forecasts (Figure 5.13-3) determine the volume of water (if any) that will require release in excess of minimum releases and losses and storage gain by the end of June.

Pre-knowledge is used for anticipated runoff, minimum releases and losses. The user defines the percentage of volume (of the total volume for the period) to be additionally released during each month. For February through April, 10 percent of the additional release volume is advised for release, and may be additionally capped. This approach tends to hold Hetch Hetchy Reservoir releases for later release during May. The snowmelt check release is evenly distributed across the days of the month and can be capped in terms of rate (cfs) or minimum volume of the reservoir to which it can be drawn during the month. The particular release made in a day is the greater of the two check releases or the minimum release. At no time is the maximum capacity of the reservoir allowed to be exceeded, and if necessary a release, regardless of magnitude, will be made by the model to not exceed maximum storage capacity.

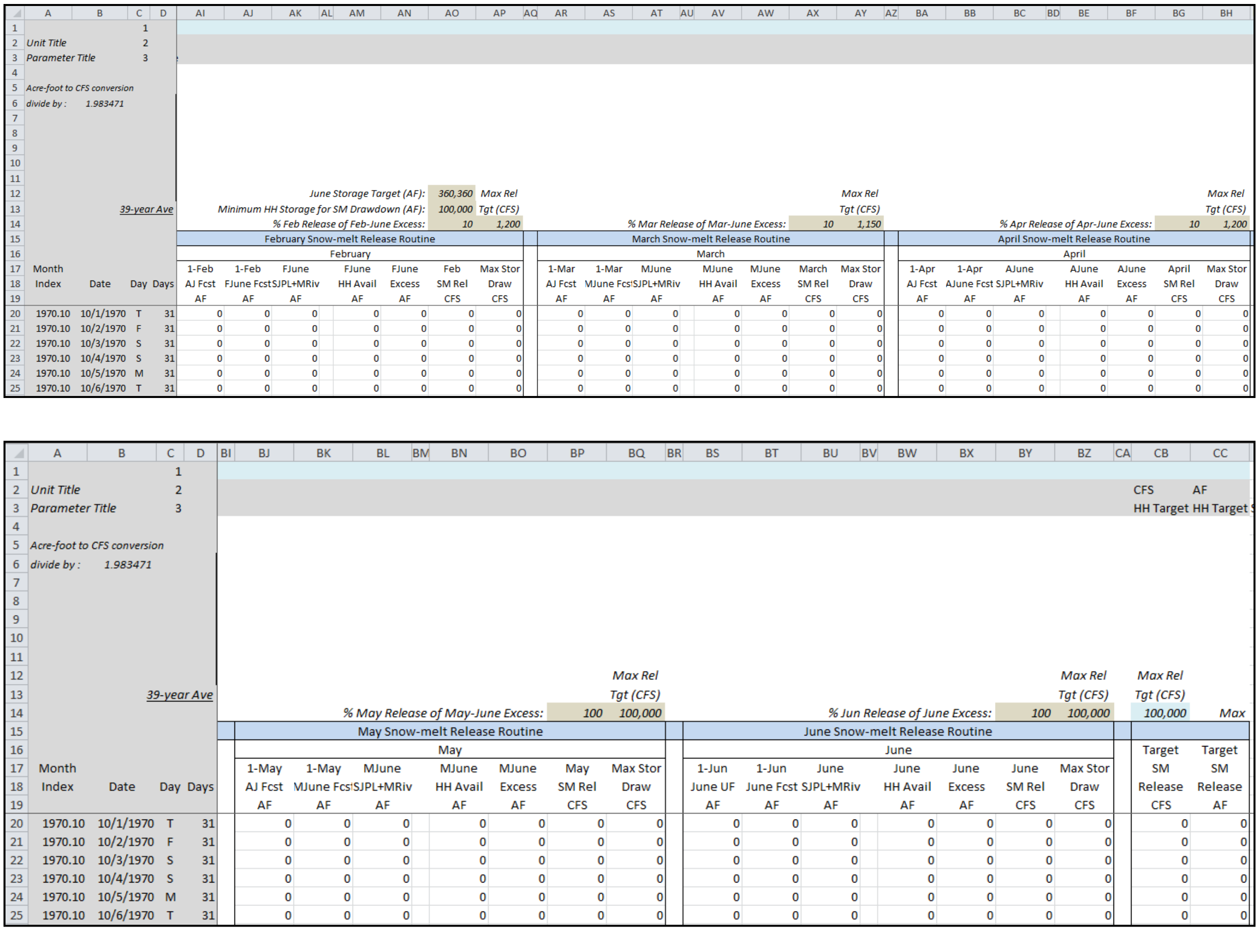



**Figure 5.13-3. Snow-melt Management.**

## 5.14 SFLloyd Worksheet

This Model component worksheet (SFLloyd) simulates the operation of Lake Lloyd. Several sections of logic provide a systematic operation of the reservoir based on inflow and forecasted hydrology and water demands. The Model will direct releases from Lake Lloyd under a “hold-unless-need-to-release” protocol, except as conditioned by minimum release requirements, diversions, preferred/maximum storage, snowmelt management releases and target releases for Holm Powerhouse. The several sections of logic are illustrated and discussed below.

### 5.14.1 Lake Lloyd Release Demands, Initial Storage Computation and Encroachment Release

This section of logic (Figure 5.14-1) assembles the underlying water demands placed for Lake Lloyd releases. Reservoir inflow is derived from the Hydrology worksheet and is the unimpaired flow entering the reservoir. The initial releases are comprised of the minimum flow requirement below Lake Lloyd (from worksheet CCSF) and target releases for Holm Powerhouse (from worksheet CCSF).

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 1 | | Lake Lloyd Model | | | | | | | | | | | | | | | | |
| 2 | Unit Title | | 2 | | CFS | AF | CFS | AF | | AF | CFS | AF | | AF | | AF | AF | | | | |
| 3 | Parameter Title | | 3 | | Lake Lloyc | Lake Lloyc | Min Holm Ta | Min Holm | | Suppleme | Lloyd Req | Lloyd Req | | Lloyd Net Evap | | Lloyd Targe | Lloyd Limi | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | |
| 5 | Acre-foot to CFS conversion | | | | This scenario | | | | | | | | Base | | | | Difference from Base | | | | |
| 6 | divide by : | 1.983471 | | | Check Sums | | Sum AF | 39-ave | | Other Sums | | Sum AF | | 39-ave | | Sum AF | | 39-ave | | Sum AF | |
| 7 | | | | | | Inflow | 11,743,646 | 301,119 | | | Supplmtl | 171,708 | Inflow | 301,119 | Supplmtl | 171,708 | Inflow | 0 | Supplmtl | 0 | |
| 8 | | | | | | Tun Inflow | 3,196,266 | 81,956 | | | | | Tun Inflow | 81,956 | | | Tun Inflow | 0 | | | |
| 9 | | | | | | Evap | 136,660 | 3,504 | | | | | Evap | 3,504 | | | Evap | 0 | | | |
| 10 | | | | | | Stream | 1,298,823 | 33,303 | | | | | Stream | 33,303 | | | Stream | 0 | | | |
| 11 | | | | | | Holm | 13,454,734 | 344,993 | | | | | Holm | 344,993 | | | Holm | 0 | | | |
| 12 | | | | | | Net | 49,694 | | | | | | | | | | | | | | |
| 13 | | | | | | Chng Stor | 49,694 | | | | | | | | | | | | | | |
| 14 | | | | 39-year Ave | | 301,119 | | 38,628 | | 4,403 | | 5,538 | | 3,504 | | | | | | | |
| 15 | | | | | Inflow | | Initial Release | | | Suppl | Initial Release | | | Evap/loss | Initial Storage and Encroachment Release | | | | | | |
| 16 | | | | | Lake | Lake | Min | Min | | 171,708 | Stream | Stream | | | Initial | Lloyd | | | | Spread | Spread |
| 17 | Month | | | | Lloyd | Lloyd | Holm | Holm | | Supplmtl | Req | Req | | Net Res | Lloyd | Target | Limit | Initial | Encroach | Encroach | 7th Day |
| 18 | Index | Date | Day | Days | Inflow | Inflow | Target | Target | | Release | Blw Lloyd | Blw Lloyd | | Evap/Loss | Storage | Storage | Storage | Encroach | 7th Day | over 7 | Enc over 7 |
| 19 | | | | | CFS | AF | CFS | AF | | AF | CFS | AF | | AF | 200,000 | 200,000 | AF | AF | AF | AF | CFS |
| 20 | 1970.10 | 10/1/1970 | T | 31 | 56 | 111 | 0 | 0 | | 0 | 5 | 10 | | 10 | 200,091 | 248,000 | 273,300 | 0 | 0 | 0 | 0 |
| 21 | 1970.10 | 10/2/1970 | F | 31 | 5 | 10 | 0 | 0 | | 0 | 5 | 10 | | 10 | 200,080 | 248,000 | 273,300 | 0 | 0 | 0 | 0 |
| 22 | 1970.10 | 10/3/1970 | S | 31 | 15 | 30 | 0 | 0 | | 0 | 5 | 10 | | 10 | 200,090 | 248,000 | 273,300 | 0 | 0 | 0 | 0 |
| 23 | 1970.10 | 10/4/1970 | S | 31 | -399 | -791 | 0 | 0 | | 0 | 5 | 10 | | 10 | 199,278 | 248,000 | 273,300 | 0 | 0 | 0 | 0 |
| 24 | 1970.10 | 10/5/1970 | M | 31 | 322 | 638 | 0 | 0 | | 0 | 5 | 10 | | 10 | 199,896 | 248,000 | 273,300 | 0 | 0 | 0 | 0 |
| 25 | 1970.10 | 10/6/1970 | T | 31 | -48 | -94 | 0 | 0 | | 0 | 5 | 10 | | 10 | 199,781 | 248,000 | 273,300 | 0 | 0 | 0 | 0 |

**Figure 5.14-1. Reservoir Evaporation/Initial Storage Computation and Encroachment Release.**

This section also performs an initial check of reservoir storage assuming the previously described minimum releases for the river and Holm Powerhouse. A daily mass balance is performed: *change in reservoir storage = inflow, minus outflow (releases), minus reservoir losses*. The prior day's reservoir evaporation is included in the calculation. If the computation produces resulting Lake Lloyd storage in excess (encroachment) of the preferred storage target, the encroachment is computed. Every 7$^{th}$ day the model checks for an encroachment, and if it exists a check release is computed. It is assumed that a constant supplemental release (in excess of minimum releases) will be initiated at a rate equal to the encroachment divided equally over the next 7 days. This protocol repeats itself every 7$^{th}$ day, reestablishing the level of check release each time. The end result of this procedure will allow encroachment of storage space above the preferred storage target and not require unrealistic hard releases of water to exactly conform to the target. User specified supplemental releases are reported in this section but are not incorporated into the worksheet's logic until later.

### 5.14.2 Supplemental Releases, Lake Eleanor Transfers and Final Reservoir and Release Computation

This section of logic (Figure 5.14-2) performs the final computation of reservoir storage and releases, including consideration of snowmelt management releases (described later) and transfers from Lake Eleanor.

Both the initial check release for preferred storage encroachment and the snowmelt check release are computed and advised for reservoir operations. If supplemental releases above minimum releases are computed the Model routes the additional release through Holm Powerhouse up to its available capacity. The remainder of the supplemental release is routed to the stream below Lake Lloyd. A comparison is made between "Lloyd-only" use of Holm Powerhouse capacity and maximum capacity for passage to the Lake Eleanor model component.

The operation goal linkage between Lake Lloyd and Lake Eleanor assumes that Lake Eleanor will transfer water from its watershed to Lake Lloyd for the purpose of enhancing power generation at Holm Powerhouse. Thus, any available capacity at Holm Powerhouse after the

Lloyd-only operation is assumed available and desired for use of a Lake Eleanor transfer. If water is transferred from Lake Eleanor the Model assumes the water to be directly routed to Holm Powerhouse which then becomes additional release from Lake Lloyd.

Also incorporated into the logic is inclusion of user specified supplemental releases (from the WaterBankRel or SFWaterBank worksheets). Supplemental releases are added to any other release established for Lake Lloyd. Reservoir losses are compute in accordance with procedures of the Fourth Agreement.

| | A | B | C | D | W | X | Y | Z | AA | AB | AC | AD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 1 | | | | | | | | | |
| 2 | Unit Title | | 2 | | | | | | | | CFS | |
| 3 | Parameter Title | | 3 | | | | | | | | Lloyd-only Holm | |
| 4 | | | | | | | | | | | | |
| 5 | Acre-foot to CFS conversion | | | | | | | | | | | |
| 6 | divide by : | 1.983471 | | | | | | | | | | |
| 7 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | |
| 12 | | | | | Holm | (C 2.41) | | | | | | |
| 13 | | | | | 950 | CFS Max | | | | | | |
| 14 | | | | 39-year Ave | | | | | | | | |
| 15 | | | | | Prior to Eleanor | | | | | | | |
| 16 | | | | | Holm | Holm | Llyd-only | Llyd-only | Revised | Revised | Holm | Holm |
| 17 | Month | | | | Capacity | Capacity | Rel w/o | Rel w/o | Routed | Routed | Prior to | Prior to |
| 18 | Index | Date | Day | Days | for Elnr | for Elnr | Suppl Rel | Suppl Rel | Holm | Holm | Tun Infl | Tun Infl |
| 19 | | | | | CFS | AF | CFS | AF | CFS | AF | CFS | AF |
| 20 | 1970.10 | 10/1/1970 | T | 31 | 950 | 1,884 | 5 | 10 | 0 | 0 | 0 | 0 |
| 21 | 1970.10 | 10/2/1970 | F | 31 | 950 | 1,884 | 5 | 10 | 0 | 0 | 0 | 0 |
| 22 | 1970.10 | 10/3/1970 | S | 31 | 950 | 1,884 | 5 | 10 | 0 | 0 | 0 | 0 |
| 23 | 1970.10 | 10/4/1970 | S | 31 | 950 | 1,884 | 5 | 10 | 0 | 0 | 0 | 0 |
| 24 | 1970.10 | 10/5/1970 | M | 31 | 950 | 1,884 | 5 | 10 | 0 | 0 | 0 | 0 |
| 25 | 1970.10 | 10/6/1970 | T | 31 | 950 | 1,884 | 5 | 10 | 0 | 0 | 0 | 0 |

| | AE | AF | AG | AH | AI | AJ | AK | AL | AM | AN | AO | AP | AQ | AR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | CFS | AF | CFS | AF | CFS | AF | CFS | AF | AF | | | | | |
| 3 | Final Strea | Final Strea | Tunnel Inf | Tunnel Inf | Final Holn | Final Holn | Total Lloy | Total Lloy | Lake Lloyc | | | | | |
| 15 | Final Routing | | | | | | | | Final Storage | | | | | |
| 16 | Stream | Stream | | | Final | Final | Lloyd | Lloyd | Lake | Lloyd | Lake Lloyd Loss Calculation | | | |
| 17 | w/ Suppl | w/ Suppl | Eleanor | Eleanor | Holm | Holm | Total | Total | Lloyd | Storage | Area | Factor | CFS | AF |
| 18 | Release | Release | to Holm | to Holm | Total | Total | Release | Release | Storage | Change | | | | |
| 19 | CFS | AF | CFS | AF | CFS | AF | CFS | AF | 200,000 | AF | | | | |
| 20 | 5 | 10 | 218 | 433 | 218 | 433 | 223 | 443 | 200,091 | 91 | 1,607 | 0.003253 | 5.2 | 10.4 |
| 21 | 5 | 10 | 218 | 433 | 218 | 433 | 223 | 443 | 200,080 | -11 | 1,607 | 0.003253 | 5.2 | 10.4 |
| 22 | 5 | 10 | 218 | 433 | 218 | 433 | 223 | 443 | 200,090 | 10 | 1,607 | 0.003253 | 5.2 | 10.4 |
| 23 | 5 | 10 | 218 | 433 | 218 | 433 | 223 | 443 | 199,278 | -811 | 1,607 | 0.003253 | 5.2 | 10.4 |
| 24 | 5 | 10 | 218 | 433 | 218 | 433 | 223 | 443 | 199,896 | 617 | 1,605 | 0.003253 | 5.2 | 10.4 |
| 25 | 5 | 10 | 218 | 433 | 218 | 433 | 223 | 443 | 199,781 | -115 | 1,607 | 0.003253 | 5.2 | 10.4 |

**Figure 5.14-2. Supplemental Releases, Lake Eleanor Transfers and Final Reservoir Operation.**

### 5.14.3 Snow-melt Management

A second check release is made during the February through June period for management of anticipated snowmelt runoff. On the first day of each of these months a forecast is made of anticipated runoff into the reservoir and minimum releases and losses from the reservoir, from the date of forecast through the end of June (assumed target of reservoir filling). These forecasts (Figure 5.14-3) determine the volume of water (if any) that will require release in excess of minimum releases and losses and storage gain by the end of June. Pre-knowledge is used for anticipated runoff, minimum releases and losses. The user defines the percentage of volume (of the total volume for the period) to be additionally released during each month. For February through May, a varying percentage of the additional release volume is advised for release, and is capped in rate as a means to confine releases within the capacity of Holm Powerhouse. The snowmelt check release is evenly distributed across the days of the month. The release can also be capped in terms of minimum volume of the reservoir to which it can be drawn during the month.

| | A | B | C | D |
|---|---|---|---|---|
| 1 | | | 1 | |
| 2 | *Unit Title* | | 2 | |
| 3 | *Parameter Title* | | 3 | |
| 5 | *Acre-foot to CFS conversion* | | | |
| 6 | *divide by :* | *1.983471* | | |

*June Storage Target (AF):* 273,300 *Max Rel*
*Minimum HH Storage for SM Drawdown (AF):* 100,000 *Tgt (CFS)*
*39-year Ave* — *% Feb Release of Feb-June Excess:* 20 1,000
*% Mar Release of Mar-June Excess:* 25 1,000 (*Max Rel Tgt (CFS)*)
*% Apr Release of Apr-June Excess:* 33 1,000 (*Max Rel Tgt (CFS)*)

| | Month Index | Date | Day | Days | February Snow-melt Release Routine: 1-Feb AJ Fcst AF | 1-Feb FJune Fcst AF | FJune Riv+Trg Holm AF | FJune Ch Avail AF | FJune Excess AF | Feb SM Rel CFS | Max Stor Draw CFS | March Snow-melt Release Routine: 1-Mar AJ Fcst AF | 1-Mar MJune Fcst AF | MJune Riv+Trg Holm AF | MJune Ch Avail AF | MJune Excess AF | March SM Rel CFS | Max Stor Draw CFS | April Snow-melt Release Routine: 1-Apr AJ Fcst AF | 1-Apr AJune Fcst AF | AJune Riv+Trg Holm AF | AJune Ch Avail AF | AJune Excess AF | April SM Rel CFS | Max Stor Draw CFS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 1970.10 | 10/1/1970 | T | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21 | 1970.10 | 10/2/1970 | F | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22 | 1970.10 | 10/3/1970 | S | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 23 | 1970.10 | 10/4/1970 | S | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 24 | 1970.10 | 10/5/1970 | M | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 25 | 1970.10 | 10/6/1970 | T | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | A | B | C | D | CL | CM |
|---|---|---|---|---|---|---|
| 1 | | | 1 | | | |
| 2 | *Unit Title* | | 2 | | CFS | AF |
| 3 | *Parameter Title* | | 3 | | Lloyd Targ | Lloyd Targ |
| 5 | *Acre-foot to CFS conversion* | | | | | |
| 6 | *divide by :* | *1.983471* | | | | |

*39-year Ave* — *% May Rlease of Ma y-June Excess:* 50 1,000 (*Max Rel Tgt (CFS)*)
*% Jun Release of June Excess:* 100 1,000 (*Max Rel Tgt (CFS)*)
*Max Rel Tgt (CFS)* 1,000 *Max*

| | Month Index | Date | Day | Days | May Snow-melt Release Routine: 1-May AJ Fcst AF | 1-May MJune Fcst AF | MJune Riv+Trg Holm AF | MJune Ch Avail AF | MJune Excess AF | May SM Rel CFS | Max Stor Draw CFS | June Snow-melt Release Routine: 1-Jun June UF AF | 1-Jun June Fcst AF | June Riv+Trg Holm AF | June Ch Avail AF | June Excess AF | June SM Rel CFS | Max Stor Draw CFS | Target SM Release CFS | Target SM Release AF |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 1970.10 | 10/1/1970 | T | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21 | 1970.10 | 10/2/1970 | F | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22 | 1970.10 | 10/3/1970 | S | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 23 | 1970.10 | 10/4/1970 | S | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 24 | 1970.10 | 10/5/1970 | M | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 25 | 1970.10 | 10/6/1970 | T | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Figure 5.14-3. Snow-melt Management.**

## 5.15 SFEleanor Worksheet

This Model component worksheet (SFEleanor) simulates the operation of Lake Eleanor. Several sections of logic provide a systematic operation of the reservoir based on inflow and forecasted hydrology and water demands. The Model will direct releases from Lake Eleanor under a "hold-unless-need-to-release" protocol, except as conditioned by minimum release requirements, diversions, preferred/maximum storage, snowmelt management releases. When advised releases exceed the minimum Model logic attempts to transfer water to Lake Lloyd. The several sections of logic are illustrated and discussed below.

### 5.15.1 Lake Eleanor Release Demands, Initial Storage Computation and Encroachment Release

This section of logic (Figure 5.15-1) assembles the underlying water demands placed for Lake Eleanor releases. Reservoir inflow is derived from the Hydrology worksheet and is the unimpaired flow entering the reservoir. The initial releases are comprised of the minimum flow requirement below Lake Eleanor (from the CCSF worksheet). An initial check of reservoir storage occurs assuming the minimum releases for the river. A daily mass balance is performed: *change in reservoir storage = inflow, minus outflow (releases), minus reservoir losses*. The prior day's reservoir evaporation is included in the calculation. If the computation produces resulting Lake Eleanor storage in excess (encroachment) of the preferred storage target, the encroachment is computed. Every 7th day the model checks for an encroachment, and if it exists a check release is computed. For the preferred reservoir storage target encroachment it is assumed that a constant supplemental release (in excess of minimum releases) will be initiated at a rate equal to the encroachment divided equally over the next 7 days. This protocol repeats itself every 7th day, reestablishing the level of check release each time. The end result of this procedure will allow encroachment of storage space above the preferred storage target and not require unrealistic hard releases of water to exactly conform to the target.

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 1 | | Lake Eleanor Model | | | | | | | | | | | | | | | | | |
| 2 | Unit Title | | 2 | | CFS | AF | | | | | CFS | AF | | | | AF | AF | | | | | |
| 3 | Parameter Title | | 3 | | Lake Elear | Lake Eleanor Inflow | | | | | Eleanor R‹ | Eleanor Req Stream Rel | | | | Eleanor Ta | Eleanor Limit Storage | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | | |
| 5 | Acre-foot to CFS conversion | | | | This scenario | | | | | | | | Base | | | | Difference from Base | | | | | |
| 6 | divide by : | 1.983471 | | | Check Sums | | Sum AF | 39-ave | | Other Sums | | 39-yr Ave | | 39-ave | | 39-yr Ave | | 39-ave | | 39-yr Ave | | |
| 7 | | | | | | Inflow | 7,276,607 | 186,580 | | | Tunnel | 81,956 | Inflow | 186,580 | Tunnel | 81,956 | Inflow | 0 | Tunnel | 0 | | |
| 8 | | | | | | Evap | 72,708 | 1,864 | | | | | Evap | 1,864 | | | Evap | 0 | | | | |
| 9 | | | | | | Tun Out | 3,196,266 | 81,956 | | | | | Tun Out | 81,956 | | | Tun Out | 0 | | | | |
| 10 | | | | | | Stream | 4,008,460 | 102,781 | | | | | Stream | 102,781 | | | Stream | 0 | | | | |
| 11 | | | | | | Net | -826 | | | | | | | | | | | | | | | |
| 12 | | | | | | Chng Stor | -826 | | | | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | | | | | | | | | | | |
| 14 | | | | 39-year Ave | | 186,580 | | | | | | 9,087 | | 1,864 | | | | | | | | |
| 15 | | | | | Inflow | | | | | | Initial Release | | | Evap/loss | Initial Storage and Encroachment Release | | | | | | | |
| 16 | | | | | Lake | Lake | | | | | Stream | Stream | | | Initial | Eleanor | Hard | | | Spread | Spread | |
| 17 | Month | | | | Eleanor | Eleanor | | | | | Req | Req | | Net Res | Eleanor | Target | Limit | Initial | Encroach | Encroach | 7th Day | |
| 18 | Index | Date | Day | Days | Inflow | Inflow | | | | | Bl Eleanor | Bl Eleanor | | Evap/Loss | Storage | Storage | Storage | Encroach | 7th Day | over 7 | Enc over 7 | 7-day |
| 19 | | | | | CFS | AF | | | | | CFS | AF | | AF | 18,000 | AF | AF | AF | AF | AF | CFS | Count |
| 20 | 1970.10 | 10/1/1970 | T | 31 | 25 | 50 | | | | | 10 | 20 | | 6 | 18,030 | 15,000 | 27,100 | 3,030 | 3,030 | 433 | 218 | 1 |
| 21 | 1970.10 | 10/2/1970 | F | 31 | 2 | 4 | | | | | 10 | 20 | | 6 | 17,576 | 15,000 | 27,100 | 2,576 | 3,030 | 433 | 218 | 0 |
| 22 | 1970.10 | 10/3/1970 | S | 31 | 7 | 14 | | | | | 10 | 20 | | 6 | 17,131 | 15,000 | 27,100 | 2,131 | 3,030 | 433 | 218 | 0 |
| 23 | 1970.10 | 10/4/1970 | S | 31 | -179 | -355 | | | | | 10 | 20 | | 6 | 16,317 | 15,000 | 27,100 | 1,317 | 3,030 | 433 | 218 | 0 |
| 24 | 1970.10 | 10/5/1970 | M | 31 | 144 | 287 | | | | | 10 | 20 | | 6 | 16,145 | 15,000 | 27,100 | 1,145 | 3,030 | 433 | 218 | 0 |
| 25 | 1970.10 | 10/6/1970 | T | 31 | -21 | -42 | | | | | 10 | 20 | | 6 | 15,644 | 15,000 | 27,100 | 644 | 3,030 | 433 | 218 | 0 |

**Figure 5.15-1. Reservoir Evaporation/Initial Storage Computation and Encroachment Release.**

### 5.15.2 Lake Eleanor Transfers and Final Reservoir and Release Computation

This section of logic (Figure 5.15-2) performs the final computation of reservoir storage and releases, including consideration of snowmelt management releases (described later) and transfers from Lake Eleanor to Lake Lloyd.

Both the initial check release for preferred storage encroachment and the snowmelt check release are computed and advised for reservoir operations. If excess releases above minimum releases are computed the Model routes the additional release through the tunnel up to the limit of its available capacity or the capacity available at Holm Powerhouse. The remainder of the supplemental release is routed to the stream below Lake Eleanor. The Lake Eleanor operation protocol will transfer water that would otherwise be released in excess of minimum flow requirements (largely dependent upon the preferred target storage and snowmelt releases) but it will not allow water to be "pulled" from Lake Eleanor to Lake Lloyd.

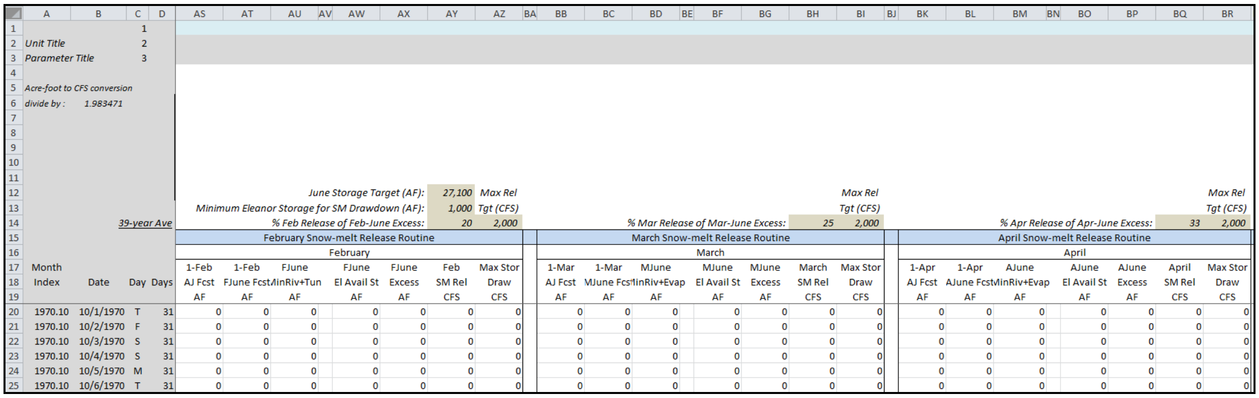
The operation goal linkage between Lake Lloyd and Lake Eleanor assumes that Lake Eleanor will transfer water from its watershed to Lake Lloyd for the purpose of enhancing power generation at Holm Powerhouse. Thus, any available capacity at Holm Powerhouse after the Lloyd-only operation is assumed available and desired for use of a Lake Eleanor transfer. If water is transferred from Lake Eleanor the model assumes the water to be directly routed to Holm Powerhouse which then becomes additional release from Lake Lloyd. Reservoir losses are computed in accordance with procedures of the Fourth Agreement.

| | A | B | C | D | W | X | Y | Z | AA | AB | AC | AD | AE | AF | AG | AH | AI | AJ | AK | AL | AM | AN | AO | AP | AQ | AR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 1 | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | Unit Title | | 2 | | | | | | CFS | AF | CFS | AF | | | | | CFS | AF | CFS | AF | AF | | | | | |
| 3 | Parameter Title | | 3 | | | | | | Tunnel | Tunnel | Eleanor St | Eleanor Stream Release | | | | | Tun Trans | Tun Trans | Total Elea | Total Elea | Lake Eleanor Storage | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | Acre-foot to CFS conversion | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | divide by : | 1.983471 | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | | | Tunnel Capacity (C 2.81) | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | | | | 400 | CFS Max | | | | | | | | | | |
| 13 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 14 | | | | 39-year Ave | | | | | | 81,956 | | 102,781 | | | | | | | | 184,737 | | | | | | |
| 15 | | | | | Revised and Final Routing | | | | | | | | | | | | | | | | Final Storage | | | | | |
| 16 | | | | | Revised | Revised | Excess | Excess | Put | Put | | | Avail | Avail | Limit by | Limit by | | | Total | Total | Revised | Eleanor | Lake Eleanor Loss Calculation | | | |
| 17 | Month | | | | Stream | Stream | abv Min | abv Min | to | to | Final | Final | Holm Cap | Holm Cap | Tunnel | Tunnel | Transfer | Transfer | Eleanor | Eleanor | Eleanor | Storage | Area | Factor | | |
| 18 | Index | Date | Day | Days | Release | Release | Stream | Stream | Tunnel | Tunnel | Stream | Stream | for El | for El | Available | Available | Capacity | Capacity | Release | Release | Storage | Change | | | | |
| 19 | | | | | CFS | AF | CFS | AF | CFS | AF | CFS | AF | CFS | AF | CFS | AF | CFS | AF | CFS | AF | 18,000 | AF | Acres | | CFS | AF |
| 20 | 1970.10 | 10/1/1970 | T | 31 | 228 | 453 | 218 | 433 | 218 | 433 | 10 | 20 | 950 | 1,884 | 400 | 793 | 400 | 793 | 228 | 453 | 17,591 | -409 | 896 | 0.003253 | 2.9 | 5.8 |
| 21 | 1970.10 | 10/2/1970 | F | 31 | 228 | 453 | 218 | 433 | 218 | 433 | 10 | 20 | 950 | 1,884 | 400 | 793 | 400 | 793 | 228 | 453 | 17,137 | -454 | 893 | 0.003253 | 2.9 | 5.8 |
| 22 | 1970.10 | 10/3/1970 | S | 31 | 228 | 453 | 218 | 433 | 218 | 433 | 10 | 20 | 950 | 1,884 | 400 | 793 | 400 | 793 | 228 | 453 | 16,692 | -445 | 890 | 0.003253 | 2.9 | 5.7 |
| 23 | 1970.10 | 10/4/1970 | S | 31 | 228 | 453 | 218 | 433 | 218 | 433 | 10 | 20 | 950 | 1,884 | 400 | 793 | 400 | 793 | 228 | 453 | 15,878 | -814 | 885 | 0.003253 | 2.9 | 5.7 |
| 24 | 1970.10 | 10/5/1970 | M | 31 | 228 | 453 | 218 | 433 | 218 | 433 | 10 | 20 | 950 | 1,884 | 400 | 793 | 400 | 793 | 228 | 453 | 15,707 | -172 | 876 | 0.003253 | 2.8 | 5.7 |
| 25 | 1970.10 | 10/6/1970 | T | 31 | 228 | 453 | 218 | 433 | 218 | 433 | 10 | 20 | 950 | 1,884 | 400 | 793 | 400 | 793 | 228 | 453 | 15,206 | -501 | 874 | 0.003253 | 2.8 | 5.6 |

**Figure 5.15-2. Lake Eleanor Transfers and Final Reservoir Operation.**

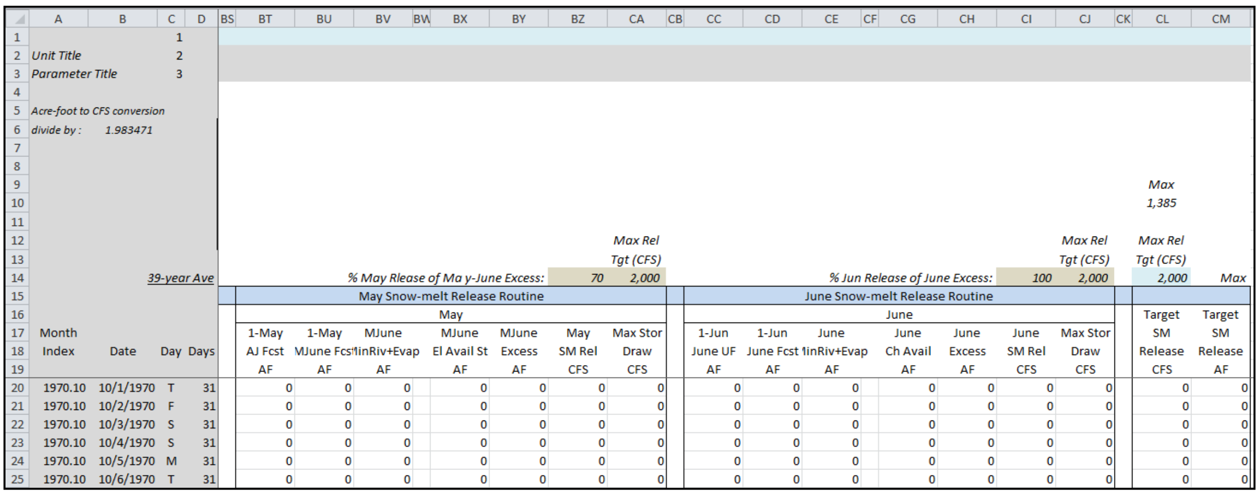
### 5.15.3 Snow-melt Management

A second check release is made during the February through June period for management of anticipated snowmelt runoff. On the first day of each of these months a forecast is made of anticipated runoff into the reservoir and minimum releases and losses from the reservoir, from the date of forecast through the end of June (assumed target of reservoir filling). These forecasts (Figure 5.15-3) determine the volume of water (if any) that will require release in excess of minimum releases and losses and storage gain by the end of June. Pre-knowledge is used for anticipated runoff, minimum releases and losses. The user defines the percentage of volume (of the total volume for the period) to be additionally released during each month. For February through May, a varying percentage of the additional release volume is advised for release. The snowmelt check release is evenly distributed across the days of the month. The release can also be capped in terms of minimum volume of the reservoir to which it can be drawn during the month.



Unit Title 2
Parameter Title 3
Acre-foot to CFS conversion
divide by : 1.983471
June Storage Target (AF): 27,100
Minimum Eleanor Storage for SM Drawdown (AF): 1,000
% Feb Release of Feb-June Excess: 20 — Max Rel Tgt (CFS) 2,000
% Mar Release of Mar-June Excess: 25 — Max Rel Tgt (CFS) 2,000
% Apr Release of Apr-June Excess: 33 — Max Rel Tgt (CFS) 2,000
39-year Ave

| | | | | February Snow-melt Release Routine | | | | | | | March Snow-melt Release Routine | | | | | | | April Snow-melt Release Routine | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | February | | | | | | | March | | | | | | | April | | | | | | |
| Month Index | Date | Day | Days | 1-Feb AJ Fcst AF | 1-Feb FJune Fcst AF | FJune MinRiv+Tun AF | FJune El Avail St AF | FJune Excess AF | Feb SM Rel CFS | Max Stor Draw CFS | 1-Mar AJ Fcst AF | 1-Mar MJune Fcst AF | MJune MinRiv+Evap AF | MJune El Avail St AF | MJune Excess AF | March SM Rel CFS | Max Stor Draw CFS | 1-Apr AJ Fcst AF | 1-Apr AJune Fcst AF | AJune MinRiv+Evap AF | AJune El Avail St AF | AJune Excess AF | April SM Rel CFS | Max Stor Draw CFS |
| 1970.10 | 10/1/1970 | T | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970.10 | 10/2/1970 | F | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970.10 | 10/3/1970 | S | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970.10 | 10/4/1970 | S | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970.10 | 10/5/1970 | M | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970.10 | 10/6/1970 | T | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |



Unit Title 2
Parameter Title 3
Acre-foot to CFS conversion
divide by : 1.983471
% May Rlease of Ma y-June Excess: 70 — Max Rel Tgt (CFS) 2,000
% Jun Release of June Excess: 100 — Max Rel Tgt (CFS) 2,000
Max 1,385 — Max Rel Tgt (CFS) 2,000 — Max
39-year Ave

| | | | | May Snow-melt Release Routine | | | | | | | June Snow-melt Release Routine | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | May | | | | | | | June | | | | | | | | |
| Month Index | Date | Day | Days | 1-May AJ Fcst AF | 1-May MJune Fcst AF | MJune MinRiv+Evap AF | MJune El Avail St AF | MJune Excess AF | May SM Rel CFS | Max Stor Draw CFS | 1-Jun June UF AF | 1-Jun June Fcst AF | June MinRiv+Evap AF | June Ch Avail AF | June Excess AF | June SM Rel CFS | Max Stor Draw CFS | Target SM Release CFS | Target SM Release AF |
| 1970.10 | 10/1/1970 | T | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970.10 | 10/2/1970 | F | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970.10 | 10/3/1970 | S | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970.10 | 10/4/1970 | S | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970.10 | 10/5/1970 | M | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1970.10 | 10/6/1970 | T | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Figure 5.15-3. Snow-melt Management.**

## 5.16 SFWaterBank Worksheet

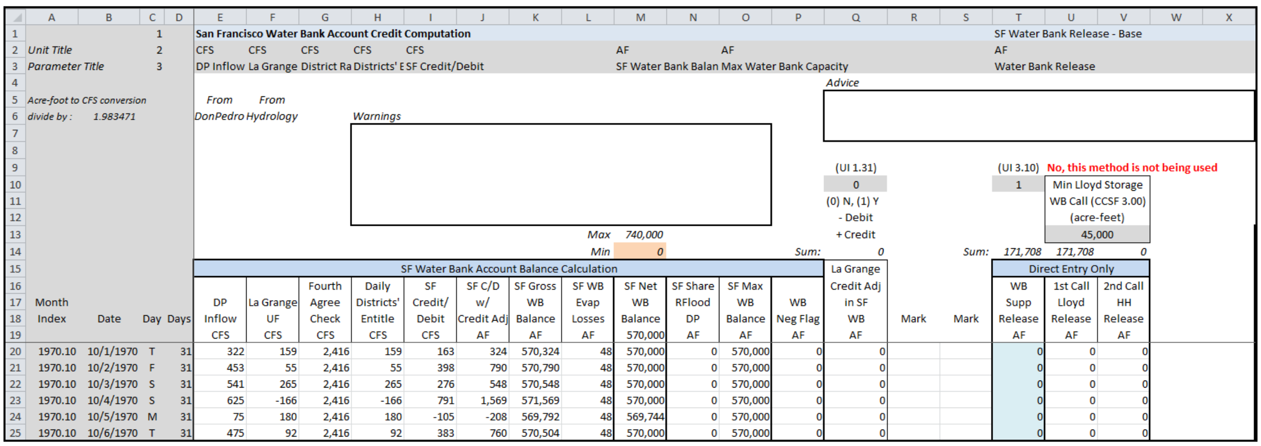
This worksheet (SFWaterBank) provides for entry of daily supplemental releases from the CCSF System. The worksheet is comparable to worksheet WaterBankRel except that this worksheet provides alternative methods of identifying supplemental releases (UI 3.10 = 0). Employing this option, the user can identify year type table-based supplemental flow, without or without addition of the pre-processed Test Case supplemental release.

Without any other manual intervention the Model will direct releases from the CCSF System under a "hold-unless-need-to-release" protocol. Additional releases greater than provided by the default protocol may be needed. An example of such a need is during periods when CCSF System operations would otherwise deplete the Water Bank Account to a point of a "negative" balance.

The manual adjustment to releases from the CCSF System is provided to allow the user to "pull" additional water from the CCSF System as supplemental inflow to Don Pedro Reservoir. An entry of supplemental release is established that will first pull water from Lake Lloyd so that water supply is preserved in the Hetch Hetchy Reservoir system for diversion to the SJPL. At a point when such supplemental releases strain Lake Lloyd storage, the supplemental releases are directed to Hetch Hetchy Reservoir. The supplemental release is directed from a reservoir at a point in logic after the default protocol releases occur. Thus, the release occurs in addition to what operation is already occurring by default. Such a release can affect the following day's default operation or previous periods' operations, thus results require review to determine if the user's desired result occurs.

### 5.16.1 CCSF Water Bank Account Balance Accounting, CCSF La Grange Flow Responsibility and Test Case Supplemental Releases

Figure 5.16-1 is a snapshot of the worksheet. The worksheet provides the daily accounting of the Water Bank Account Balance for the Model. Information ported from other worksheets of the Model into this worksheet is Don Pedro Reservoir inflow (Column E) and the unimpaired flow at La Grange (Column F). These data and the protocols associated with Fourth Agreement Water Bank Account Balance accounting (Columns G through Column O) derive the daily credit or debit of CCSF and then the daily balance of the Water Bank Account (Column M).




| Month Index | Date | Day | Days | DP Inflow CFS | La Grange UF CFS | Fourth Agree Check CFS | Daily Districts' Entitle CFS | SF Credit/ Debit CFS | SF C/D w/ Credit Adj AF | SF Gross WB Balance AF | SF WB Evap Losses AF | SF Net WB Balance 570,000 | SF Share RFlood DP AF | SF Max WB Balance AF | WB Neg Flag AF | La Grange Credit Adj in SF WB AF | Mark | Mark | WB Supp Release AF | 1st Call Lloyd Release AF | 2nd Call HH Release AF |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1970.10 | 10/1/1970 | T | 31 | 322 | 159 | 2,416 | 159 | 163 | 324 | 570,324 | 48 | 570,000 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 |
| 1970.10 | 10/2/1970 | F | 31 | 453 | 55 | 2,416 | 55 | 398 | 790 | 570,790 | 48 | 570,000 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 |
| 1970.10 | 10/3/1970 | S | 31 | 541 | 265 | 2,416 | 265 | 276 | 548 | 570,548 | 48 | 570,000 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 |
| 1970.10 | 10/4/1970 | S | 31 | 625 | -166 | 2,416 | -166 | 791 | 1,569 | 571,569 | 48 | 570,000 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 |
| 1970.10 | 10/5/1970 | M | 31 | 75 | 180 | 2,416 | 180 | -105 | -208 | 569,792 | 48 | 569,744 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 |
| 1970.10 | 10/6/1970 | T | 31 | 475 | 92 | 2,416 | 92 | 383 | 760 | 570,504 | 48 | 570,000 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 |

**Figure 5.16-1. CCSF Water Bank Balance Accounting.**

For purposes of the FERC investigation, the protocols of Fourth Agreement Water Bank Accounting have been amended to incorporate a hypothetical implementation of "shared responsibility" for incremental increases in FERC-required flows for the Tuolumne River.[3] If running the scenario with shared responsibility has been selected (worksheet UserInput Switch UI 1.31 = 1), the incremental increase in FERC-required flows is determined by the daily difference between the current 1995 FERC Settlement requirements and scenario-required minimum flows. This computation occurs in worksheet LaGrangeSchedule with information regarding the scenario-required flows directed through worksheet UserInput. Approximately fifty-two percent (51.7121%) of the incremental difference between the flow schedules is assigned as CCSF's responsibility and shows in Column Q as a "debit". This debit then enters Fourth Agreement Water Bank Accounting at Column J, and subsequently contributes to the determination of the daily Water Bank Account Balance (Column M).

[3] The "shared responsibility" assumption is presented for the purpose of evaluating alternative operations. The assumption shall not be used as evidence in any proceeding relating to and shall not act as precedence for any allocation of Tuolumne River water between CCSF and the Districts for any purpose under the Fourth Agreement.

Water Bank Account Balances which are less than zero ("negative") are highlighted, and the minimum balance, whether negative or positive, is reported in Cell M14. By default, the base supplemental releases to maintain a positive Water Bank Account Balance at or above zero have been entered into Column T (WB Supplemental Release). An alternative time series can be used. The Model will first direct the supplemental release to Lake Lloyd, and continue releases until storage at Lake Lloyd is drawn to a specified 45,000 acre-feet minimum level (shown in Cell Q10 and entered at worksheet CCSF Switch 3.00). Subsequent supplemental releases will be drawn from Hetch Hetchy Reservoir any time storage is less than the Lake Lloyd minimum.

### 5.16.2 User Specified Table of Supplemental Releases and Reservoir Status Computation

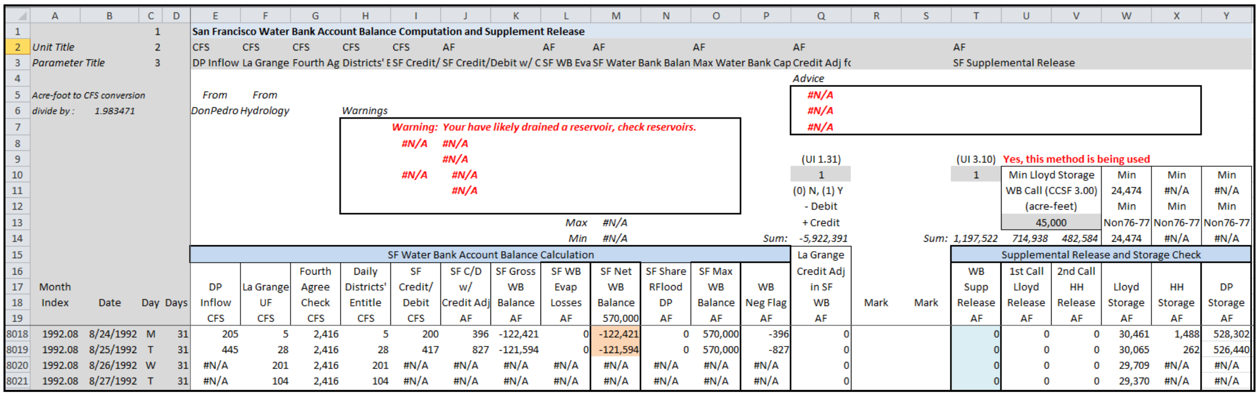
Figure 5.16-2 illustrates the section of logic that incorporates a user Specified table of supplemental releases (UI 3.40) into the Model. A daily time series (Column Y) of supplemental releases is developed from the user specified table in worksheet UserInput. By selection, the user identifies whether or not the year type table-based supplemental release is added the preprocessed Test Case supplemental releases (Column T previously described). The Model then uses the selected supplemental release in its computation of operations.

| | A | B | C | D | Y | Z | AA | AB | AC | AD | AE | AF | AG | AH | AI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 1 | | User-defined SF Upstream Supplemental Release | | | | | | | | | | |
| 2 | *Unit Title* | | 2 | | | | | | | AF | | | | | |
| 3 | *Parameter Title* | | 3 | | | | | | | Total SF Suppl Release | | | | | |
| 4 | | | | | | | | | | | | | | | |
| 5 | *Acre-foot to CFS conversion* | | | | | | | | | | | | | | |
| 6 | *divide by :* | *1.983471* | | | | | | | | *(UI 3.10)* | 1 | No, this method is not being used | | | |
| 7 | | | | | *2,704,000* | *2,875,708* | *2,875,708* | *0* | | | | | | | |
| 8 | | | | | | Add Base | | | | | | | | | |
| 9 | | | | | | Supp | | | | Final Supplimental Release from Other Method | | | | | |
| 10 | | | | | | 1 | N/A | | | 0 | *(UI 3.20)* | | | | |
| 11 | | | | | | *(0) no* | *(UI 3.30)* | | | *(0) Base* | | | Min | Min | Min |
| 12 | | | | | | *(1) yes* | | | | *(1) User-defined* | | | 103,852 | 84,135 | 508,489 |
| 13 | | | | | Supplemental Table Entry | | | | | | | | Min | Min | Min |
| 14 | | | | | | Supp | | | | | | | Non 76-77 | Non 76-77 | Non 76-77 |
| 15 | | | | | Supp | Table | 1st Call | 2nd Call | | | | | 103,852 | 114,720 | 785,605 |
| 16 | | | | | Table | Only, or | To | To | *Sum:* | *171,708* | *171,708* | *0* | | | |
| 17 | Month | | | | Release | Table + | Lloyd | HH | | | Lloyd | HH | Lloyd | HH | DP |
| 18 | Index | Date | Day | Days | Only | Existing | Release | Release | | Total | Release | Release | Storage | Storage | Storage |
| 19 | | | | | AF | AF | AF | AF | | AF | AF | AF | AF | AF | AF |
| 20 | 1970.10 | 10/1/1970 | T | 31 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 200,091 | 249,349 | 1,666,767 |
| 21 | 1970.10 | 10/2/1970 | F | 31 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 200,080 | 248,379 | 1,664,567 |
| 22 | 1970.10 | 10/3/1970 | S | 31 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 200,090 | 247,622 | 1,662,719 |
| 23 | 1970.10 | 10/4/1970 | S | 31 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 199,278 | 247,032 | 1,659,892 |
| 24 | 1970.10 | 10/5/1970 | M | 31 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 199,896 | 246,150 | 1,656,745 |
| 25 | 1970.10 | 10/6/1970 | T | 31 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 199,781 | 245,360 | 1,654,119 |

**Figure 5.16-2. CCSF Supplemental Release.**

The result of entering the supplemental release will cause a recalculation of the entire Model with results refreshed in the worksheet. Lake Lloyd, Hetch Hetchy Reservoir and Don Pedro Reservoir storage is ported from other worksheets to provide the status of their storage as supplemental releases are entered.

Warnings and advice are provided in the worksheet when several conditions occur. The snapshots below illustrate the occurrence of these conditions. In this first example (Figure 5.16-3) a warning has been provided that a reservoir has likely been depleted by the current operation assumptions. In this particular example, Tuolumne River minimum flows were increased with responsibility shared with CCSF, and a set of supplemental releases were established. In this iteration of results it is discovered in Column X (Hetch Hetchy Reservoir storage) an error (reported as "#N/A") on August 26, 1992 has occurred in the Model.

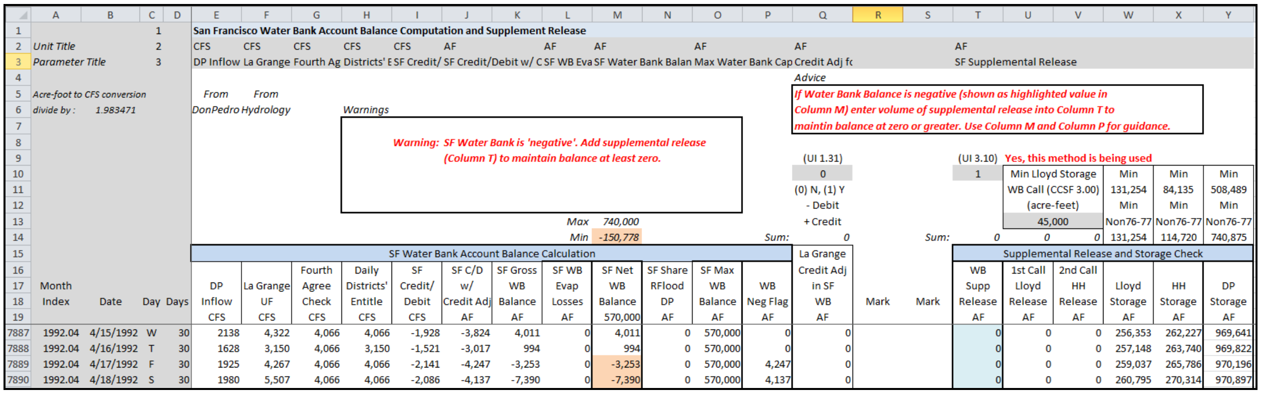



*Note: This screen save is from the worksheet WaterBankRel description. Identical warnings are included in worksheet SFWaterBank.*

**Figure 5.16-3. Example 1: A Reservoir Empties and the Model Crashes.**

By review of the previous day's storage results for Lake Lloyd (Column W), Hetch Hetchy Reservoir (Column X) and Don Pedro Reservoir (Column Y), and the rate of depletion for each of these reservoirs, it is concluded that Hetch Hetchy Reservoir likely drained on August 26 and thus crashed the Model. Although noted, a negative Water Bank Account Balance (Column M) will not cause the Model to crash. To remedy the condition, the user uses worksheet UserInput to revise (lower) SJPL diversions from Hetch Hetchy Reservoir (UI 4.10 and UI 4.20) and retain water in Hetch Hetchy Reservoir for release. If Don Pedro Reservoir storage was the culprit of causing the Model to crash, the user uses worksheet UserInput to revise (lower) MID and TID canal diversions (UI 2.10, UI 2.20 and UI 2.30 to retain water in Don Pedro Reservoir for release. Alternatively, the user could reduce the scenario's designated minimum flow requirement, which would change flow needed from the upstream systems.

In a second example (Figure 5.16-4), a warning has been provided that the Water Bank Account Balance is negative for one or more days of the scenario. In this instance, all Model reservoirs are operating within a viable operation (the Model did not crash due an emptying reservoir); however, the objective to maintain a positive Water Bank Account Balance has been violated. Upon inspection of the results the user can find the first instance of violation and remedy the violation by entry into Column T an amount of release that maintains at least a zero balance in the Water Bank Account Balance, and/or modify the year type table-based supplemental flows in worksheet UserInput. For the first day of violation the reported negative balance (e.g., -3,253 acre-feet) is needed as a supplemental release. The ensuing days of supplemental release are informed by Column P.


San Francisco Water Bank Account Balance Computation and Supplement Release

Unit Title: CFS, CFS, CFS, CFS, CFS, AF, AF, AF, AF, AF, AF

Parameter Title: DP Inflow, La Grange, Fourth Ag, Districts' E, SF Credit/, SF Credit/Debit w/ C, SF WB Eva, SF Water Bank Balan, Max Water Bank Cap, Credit Adj fc, SF Supplemental Release

Acre-foot to CFS conversion divide by : 1.983471

From DonPedro / From Hydrology

Warnings

Warning: SF Water Bank is 'negative'. Add supplemental release (Column T) to maintain balance at least zero.

Advice

If Water Bank Balance is negative (shown as highlighted value in Column M) enter volume of supplemental release into Column T to maintin balance at zero or greater. Use Column M and Column P for guidance.

Max 740,000 / Min -150,778

(UI 1.31) 0 (0) N, (1) Y - Debit + Credit — Sum: 0

(UI 3.10) 1 Yes, this method is being used — Sum: 0 0 0

| Min Lloyd Storage WB Call (CCSF 3.00) (acre-feet) | Min | Min | Min |
|---|---|---|---|
| | 131,254 | 84,135 | 508,489 |
| | Min | Min | Min |
| 45,000 | Non76-77 | Non76-77 | Non76-77 |
| | 131,254 | 114,720 | 740,875 |

SF Water Bank Account Balance Calculation / Supplemental Release and Storage Check

| Row | Month Index | Date | Day | Days | DP Inflow CFS | La Grange UF CFS | Fourth Agree Check CFS | Daily Districts' Entitle CFS | SF Credit/ Debit CFS | SF C/D w/ Credit Adj AF | SF Gross WB Balance AF | SF WB Evap Losses AF | SF Net WB Balance 570,000 | SF Share RFlood DP AF | SF Max WB Balance AF | WB Neg Flag AF | La Grange Credit Adj in SF WB AF | Mark | Mark | WB Supp Release AF | 1st Call Lloyd Release AF | 2nd Call HH Release AF | Lloyd Storage AF | HH Storage AF | DP Storage AF |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7887 | 1992.04 | 4/15/1992 | W | 30 | 2138 | 4,322 | 4,066 | 4,066 | -1,928 | -3,824 | 4,011 | 0 | 4,011 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 | 256,353 | 262,227 | 969,641 |
| 7888 | 1992.04 | 4/16/1992 | T | 30 | 1628 | 3,150 | 4,066 | 3,150 | -1,521 | -3,017 | 994 | 0 | 994 | 0 | 570,000 | 0 | 0 | | | 0 | 0 | 0 | 257,148 | 263,740 | 969,822 |
| 7889 | 1992.04 | 4/17/1992 | F | 30 | 1925 | 4,267 | 4,066 | 4,066 | -2,141 | -4,247 | -3,253 | 0 | -3,253 | 0 | 570,000 | 4,247 | 0 | | | 0 | 0 | 0 | 259,037 | 265,786 | 970,196 |
| 7890 | 1992.04 | 4/18/1992 | S | 30 | 1980 | 5,507 | 4,066 | 4,066 | -2,086 | -4,137 | -7,390 | 0 | -7,390 | 0 | 570,000 | 4,137 | 0 | | | 0 | 0 | 0 | 260,795 | 270,314 | 970,897 |

*Note: This screen save is from the worksheet WaterBankRel description. Identical warnings are included in worksheet SFWaterBank.*

**Figure 5.16-4. Example 2: Water Bank is Negative.**

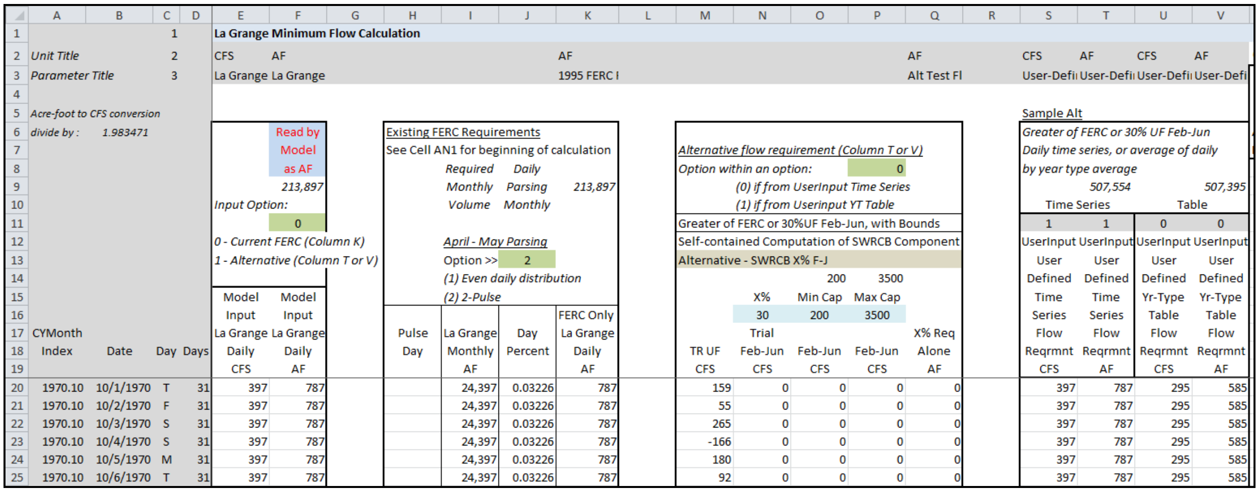
It is possible that within the remedy of Example 2 the error exemplified by Example 1 may occur as Hetch Hetchy Reservoir may be drained through the efforts of maintaining a positive Water Bank Account Balance. At that point, the procedures of Example 1 will be required and the values already derived for supplemental releases may need to be revisited and possibly changed.

## 5.17 LaGrangeSchedule Worksheet

This worksheet (LaGrangeSchedule) assembles the designation of the minimum flow requirement for the Tuolumne River. By user specification (UI 1.10) either the current 1995 FERC schedule is selected (UI 1.10 = 0) or the user defined minimum flow requirement is selected (UI 1.10 = 1). If the current 1995 FERC schedule is selected the computation of the schedule is computed in this worksheet (later described).

### 5.17.1 Minimum Flow Requirement Options

When using current 1995 FERC minimum flow requirements, the user can direct (worksheet Control, switch C 1.60) which shape of releases to assume for pulse flows during April and May. This section of the worksheet (Figure 5.17-1) performs the parsing the monthly flow requirements into daily flow requirements. If using the user specified flow schedule (identified and processed in worksheet UserInput), this section prepares the use of that data for use by the Model. Upon selection of the flow requirement, Column F is used to provide the minimum flow requirement to the rest of the Model. Although not directly linked through user switches, this section of the worksheet illustrates an example of developing an alternative flow requirement for testing. Columns M through Column Q perform a synthesis of an alternative flow requirement as has been suggested by the SWRCB. This particular flow requirement currently serves as the example alternative requirement for this documentation. The specifics of this component of flow requirement (February through June) in combination with the current 1995 FERC minimum flow requirement has been provided to worksheet UserInput for illustration purposes.

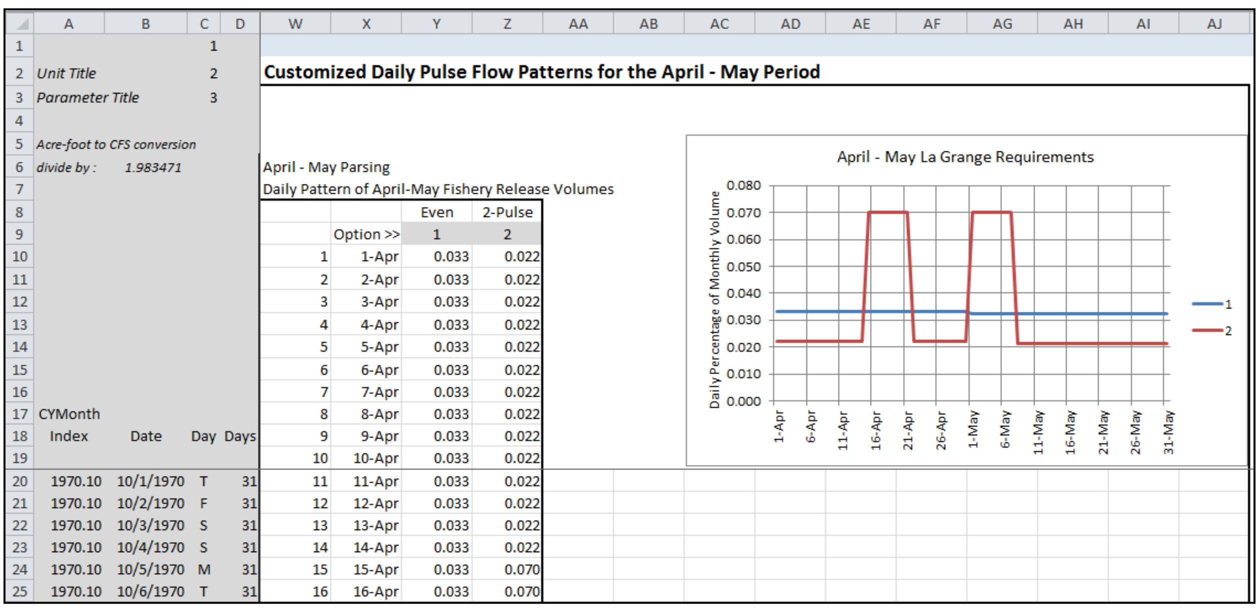



| | A CYMonth Index | B Date | C Day | D Days | E Model Input La Grange Daily CFS | F Model Input La Grange Daily AF | H Pulse Day | I La Grange Monthly AF | J Day Percent | K FERC Only La Grange Daily AF | M TR UF CFS | N Trial Feb-Jun CFS | O Feb-Jun CFS | P Feb-Jun CFS | Q X% Req Alone AF | S UserInput User Defined Time Series Flow Reqrmnt CFS | T UserInput User Defined Time Series Flow Reqrmnt AF | U UserInput User Defined Yr-Type Table Flow Reqrmnt CFS | V UserInput User Defined Yr-Type Table Flow Reqrmnt AF |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 1970.10 | 10/1/1970 | T | 31 | 397 | 787 | | 24,397 | 0.03226 | 787 | 159 | 0 | 0 | 0 | 0 | 397 | 787 | 295 | 585 |
| 21 | 1970.10 | 10/2/1970 | F | 31 | 397 | 787 | | 24,397 | 0.03226 | 787 | 55 | 0 | 0 | 0 | 0 | 397 | 787 | 295 | 585 |
| 22 | 1970.10 | 10/3/1970 | S | 31 | 397 | 787 | | 24,397 | 0.03226 | 787 | 265 | 0 | 0 | 0 | 0 | 397 | 787 | 295 | 585 |
| 23 | 1970.10 | 10/4/1970 | S | 31 | 397 | 787 | | 24,397 | 0.03226 | 787 | -166 | 0 | 0 | 0 | 0 | 397 | 787 | 295 | 585 |
| 24 | 1970.10 | 10/5/1970 | M | 31 | 397 | 787 | | 24,397 | 0.03226 | 787 | 180 | 0 | 0 | 0 | 0 | 397 | 787 | 295 | 585 |
| 25 | 1970.10 | 10/6/1970 | T | 31 | 397 | 787 | | 24,397 | 0.03226 | 787 | 92 | 0 | 0 | 0 | 0 | 397 | 787 | 295 | 585 |

**Figure 5.17-1. Daily Parsing of Minimum FERC Flow Requirement.**

## 5.17.2 April – May Daily Parsing of Flow Requirements

This section of the worksheet (Figure 5.17-2) provides information to parse monthly-designated minimum flow requirements into daily patterns during April and May. Worksheet Control designates which parsing pattern is to be used.




| Row | A | B | C | D | W | X | Y Even | Z 2-Pulse |
|---|---|---|---|---|---|---|---|---|
| 9 | | | | | | Option >> | 1 | 2 |
| 10 | | | | | 1 | 1-Apr | 0.033 | 0.022 |
| 11 | | | | | 2 | 2-Apr | 0.033 | 0.022 |
| 12 | | | | | 3 | 3-Apr | 0.033 | 0.022 |
| 13 | | | | | 4 | 4-Apr | 0.033 | 0.022 |
| 14 | | | | | 5 | 5-Apr | 0.033 | 0.022 |
| 15 | | | | | 6 | 6-Apr | 0.033 | 0.022 |
| 16 | | | | | 7 | 7-Apr | 0.033 | 0.022 |
| 17 | | | | | 8 | 8-Apr | 0.033 | 0.022 |
| 18 | | | | | 9 | 9-Apr | 0.033 | 0.022 |
| 19 | | | | | 10 | 10-Apr | 0.033 | 0.022 |
| 20 | 1970.10 | 10/1/1970 | T | 31 | 11 | 11-Apr | 0.033 | 0.022 |
| 21 | 1970.10 | 10/2/1970 | F | 31 | 12 | 12-Apr | 0.033 | 0.022 |
| 22 | 1970.10 | 10/3/1970 | S | 31 | 13 | 13-Apr | 0.033 | 0.022 |
| 23 | 1970.10 | 10/4/1970 | S | 31 | 14 | 14-Apr | 0.033 | 0.022 |
| 24 | 1970.10 | 10/5/1970 | M | 31 | 15 | 15-Apr | 0.033 | 0.070 |
| 25 | 1970.10 | 10/6/1970 | T | 31 | 16 | 16-Apr | 0.033 | 0.070 |

**Figure 5.17-2. April-May Daily Parsing of Minimum FERC Flow Requirement.**

## 5.17.3 Computation of 1995 FERC Minimum Flow Requirement

This section of the worksheet (Figure 5.17-3) computes the current 1995 FERC flow requirement. Several elements of information provided in this worksheet and from worksheet Control provide the computation of flow requirement based on 1995 FERC Settlement procedures and flow rates. The basis of the year type flow requirements is the SWRCB San Joaquin River Basin 60-20-20 index. The annual flow schedules are assumed to be apply on a

April through March year, with the interpolation water of the schedules applied to April and May pulse flows.

**Current FERC Requirements**

**Tuolumne River Flow Interpolation - Year 2011 Revised Distribution**

| Row | A | B | C | D |
|---|---|---|---|---|
| 1 | | | 1 | |
| 2 | *Unit Title* | | 2 | |
| 3 | *Parameter Title* | | 3 | |
| 5 | *Acre-foot to CFS conversion* | | | |
| 6 | *divide by :* | *1.983471* | | |
| 17 | CYMonth | | | |
| 18 | Index | Date | Day | Days |
| 20 | 1970.10 | 10/1/1970 | T | 31 |
| 21 | 1970.10 | 10/2/1970 | F | 31 |
| 22 | 1970.10 | 10/3/1970 | S | 31 |
| 23 | 1970.10 | 10/4/1970 | S | 31 |
| 24 | 1970.10 | 10/5/1970 | M | 31 |
| 25 | 1970.10 | 10/6/1970 | T | 31 |
| 26 | 1970.10 | 10/7/1970 | W | 31 |
| 27 | 1970.10 | 10/8/1970 | T | 31 |
| 28 | 1970.10 | 10/9/1970 | F | 31 |
| 29 | 1970.10 | 10/10/1970 | S | 31 |
| 30 | 1970.10 | 10/11/1970 | S | 31 |
| 31 | 1970.10 | 10/12/1970 | M | 31 |
| 32 | 1970.10 | 10/13/1970 | T | 31 |
| 33 | 1970.10 | 10/14/1970 | W | 31 |
| 34 | 1970.10 | 10/15/1970 | T | 31 |
| 35 | 1970.10 | 10/16/1970 | F | 31 |

| Row | AN | AO | AP | AQ | AR | AS | AT | AU | AV | AW | AX | AY | AZ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | Flow Year Type | | | SJR Basin Index | | | | Flow Requirement | | | | | |
| 5 | | | | | | | | | | | | | Base |
| 6 | 1 | | < | 1510 | | | | | | | | 94000 | 82,910 |
| 7 | 2 | | | 1510 | -< | 2000 | | 0.0286 | x (Index - | 1510 | ) + | 103000 | 82,910 |
| 8 | 3 | | | 2000 | -< | 2190 | | 0.0552 | x (Index - | 2000 | ) + | 117016 | 84,398 |
| 9 | 4 | | | 2190 | -< | 2440 | | 0.0600 | x (Index - | 2190 | ) + | 127507 | 90,448 |
| 10 | 5 | | | 2440 | -< | 2720 | | 0.0804 | x (Index - | 2440 | ) + | 142502 | 106,583 |
| 11 | 6 | | | 2720 | -< | 3180 | | 0.2955 | x (Index - | 2720 | ) + | 165002 | 104,977 |
| 12 | 7 | | | 3180 | and Greater | | | | | | | 300923 | 211,044 |

| Row | AN | AO | AQ | AR | AS | AT | AU | AV | AW | AX | AY | AZ | BA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | | | | | | | | Option >> | 1 | 2 | 3 | 4 | 5 |
| 14 | 1 | <<Option | | Ave | 219,421 | 149,274 | 70,146 | | Actual | 90% Exc. | 75% Exc. | Med. | 10% Exc. |
| 15 | SJR | | | | Tuolumne | Tuolumne | Pulse | Base | SJR | Apr SJR | Apr SJR | Apr SJR | Apr SJR |
| 16 | Index | Year | Water | | River | River | Flow | Year | Index | Index | Index | Index | Index |
| 17 | 602020 | Class | Year | | Require | Base | Calc | Type | 602020 | Fcast | Fcast | Fcast | Fcast |
| 18 | 4,543,729 | Wet | 1922 | | 300,923 | 211,044 | 89,879 | 7 | 4,543,729 | 2,424,373 | 2,561,322 | 2,674,495 | 2,921,846 |
| 19 | 3,549,358 | Above | 1923 | | 300,923 | 211,044 | 89,879 | 7 | 3,549,358 | 1,765,568 | 1,897,976 | 2,007,411 | 2,246,643 |
| 20 | 1,419,746 | Critical | 1924 | | 94,000 | 82,910 | 11,090 | 1 | 1,419,746 | 799,642 | 853,197 | 957,737 | 1,186,335 |
| 21 | 2,929,617 | Below | 1925 | | 226,944 | 104,977 | 121,967 | 6 | 2,929,617 | 2,042,878 | 2,179,628 | 2,292,637 | 2,539,632 |
| 22 | 2,300,567 | Dry | 1926 | | 134,141 | 90,448 | 43,693 | 4 | 2,300,567 | 1,256,470 | 1,387,014 | 1,494,917 | 1,730,818 |
| 23 | 3,558,955 | Above | 1927 | | 300,923 | 211,044 | 89,879 | 7 | 3,558,955 | 2,147,110 | 2,284,156 | 2,397,408 | 2,644,932 |
| 24 | 2,632,407 | Below | 1928 | | 157,972 | 106,583 | 51,388 | 5 | 2,632,407 | 1,934,163 | 2,068,826 | 2,180,117 | 2,423,380 |
| 25 | 2,004,815 | Critical | 1929 | | 117,282 | 84,398 | 32,884 | 3 | 2,004,815 | 1,140,712 | 1,270,277 | 1,377,372 | 1,611,521 |
| 26 | 2,016,115 | Critical | 1930 | | 117,906 | 84,398 | 33,508 | 3 | 2,016,115 | 1,270,167 | 1,401,445 | 1,509,950 | 1,747,161 |
| 27 | 1,200,755 | Critical | 1931 | | 94,000 | 82,910 | 11,090 | 1 | 1,200,755 | 917,245 | 1,046,199 | 1,152,794 | 1,385,852 |
| 28 | 3,410,299 | Above | 1932 | | 300,923 | 211,044 | 89,879 | 7 | 3,410,299 | 2,675,191 | 2,815,654 | 2,931,719 | 3,185,352 |
| 29 | 2,440,676 | Dry | 1933 | | 142,556 | 106,583 | 35,973 | 5 | 2,440,676 | 1,770,057 | 1,901,889 | 2,010,851 | 2,249,053 |
| 30 | 1,440,719 | Critical | 1934 | | 94,000 | 82,910 | 11,090 | 1 | 1,440,719 | 1,409,613 | 1,541,549 | 1,650,596 | 1,888,983 |
| 31 | 3,557,242 | Above | 1935 | | 300,923 | 211,044 | 89,879 | 7 | 3,557,242 | 2,246,995 | 2,384,346 | 2,497,850 | 2,745,918 |
| 32 | 3,740,020 | Above | 1936 | | 300,923 | 211,044 | 89,879 | 7 | 3,740,020 | 3,075,777 | 3,216,284 | 3,332,384 | 3,586,095 |
| 33 | 3,897,744 | Wet | 1937 | | 300,923 | 211,044 | 89,879 | 7 | 3,897,744 | 3,466,677 | 3,608,402 | 3,725,505 | 3,981,393 |
| 34 | 5,894,485 | Wet | 1938 | | 300,923 | 211,044 | 89,879 | 7 | 5,894,485 | 4,445,912 | 4,594,804 | 4,717,805 | 4,986,506 |
| 35 | 2,198,794 | Dry | 1939 | | 128,035 | 90,448 | 37,587 | 4 | 2,198,794 | 1,767,445 | 1,899,140 | 2,007,989 | 2,245,946 |

**FERC Flow Schedules**

| Year Type | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Oct 1-15 (CFS) | 100 | 100 | 150 | 150 | 180 | 200 | 300 |
| Oct 16-31 (CFS) | 150 | 150 | 150 | 150 | 180 | 175 | 300 |
| Total Base (AF) | 7,736 | 7,736 | 9,223 | 9,223 | 11,068 | 11,504 | 18,447 |
| Attraction (AF) | 0 | 0 | 0 | 0 | 1,676 | 1,736 | 5,950 |
| Total Oct (AF) | 7,736 | 7,736 | 9,223 | 9,223 | 12,744 | 13,240 | 24,397 |
| Nov (CFS) | 150 | 150 | 150 | 150 | 180 | 175 | 300 |
| AF | 8,926 | 8,926 | 8,926 | 8,926 | 10,711 | 10,413 | 17,852 |
| Dec (CFS) | 150 | 150 | 150 | 150 | 180 | 175 | 300 |
| AF | 9,223 | 9,223 | 9,223 | 9,223 | 11,068 | 10,760 | 18,447 |
| Jan (CFS) | 150 | 150 | 150 | 150 | 180 | 175 | 300 |
| AF | 9,223 | 9,223 | 9,223 | 9,223 | 11,068 | 10,760 | 18,447 |
| Feb (CFS) | 150 | 150 | 150 | 150 | 180 | 175 | 300 |
| AF | 8,331 | 8,331 | 8,331 | 8,331 | 9,997 | 9,719 | 16,661 |
| Mar (CFS) | 150 | 150 | 150 | 150 | 180 | 175 | 300 |
| AF | 9,223 | 9,223 | 9,223 | 9,223 | 11,068 | 10,760 | 18,447 |
| Apr (CFS) | 150 | 150 | 150 | 150 | 180 | 175 | 300 |
| :AF | 8,926 | 8,926 | 8,926 | 8,926 | 10,711 | 10,413 | 17,852 |
| May (CFS) | 150 | 150 | 150 | 150 | 180 | 175 | 300 |
| AF | 9,223 | 9,223 | 9,223 | 9,223 | 11,068 | 10,760 | 18,447 |
| Migration Flow | | | | | | | |
| AF | 11,091 | 20,091 | 32,619 | 37,060 | 35,920 | 60,027 | 89,882 |
| Jun (CFS) | 50 | 50 | 50 | 75 | 75 | 75 | 250 |
| AF | 2,975 | 2,975 | 2,975 | 4,463 | 4,463 | 4,463 | 14,876 |
| Jul (CFS) | 50 | 50 | 50 | 75 | 75 | 75 | 250 |
| AF | 3,074 | 3,074 | 3,074 | 4,612 | 4,612 | 4,612 | 15,372 |
| Aug (CFS) | 50 | 50 | 50 | 75 | 75 | 75 | 250 |
| AF | 3,074 | 3,074 | 3,074 | 4,612 | 4,612 | 4,612 | 15,372 |
| Sep (CFS) | 50 | 50 | 50 | 75 | 75 | 75 | 250 |
| AF | 2,975 | 2,975 | 2,975 | 4,463 | 4,463 | 4,463 | 14,876 |
| Total Annual | 94,001 | 103,001 | 117,017 | 127,508 | 142,503 | 165,004 | 300,926 |

**Figure 5.17-3. 1995 FERC Minimum Flow Requirement.**

### 5.17.4 CCSF La Grange Release Responsibility

Also performed in this worksheet is the computation of the hypothetical responsibility of CCSF for Tuolumne River incremental flow requirements.[4] Figure 5.17-4 is a snapshot of the computation.

SF La Grange Responsibility Computation

*Approach - SF 52% Responsibility Scenario*

*Compute difference between existing FERC minimum flow requirement and test scenario*

*Test scenario: SWRCB 30% UF February-June w/ 200/3,500 cfs bounds on SWRCB component, or existing FERC whichever is greater*

| Row | A | B | C | D | BW | BX | BY | BZ | CA | CB | CC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 1 | | | | | | | | |
| 2 | *Unit Title* | | 2 | | | | | | | | |
| 3 | *Parameter Title* | | 3 | | | | | | | | |
| 5 | *Acre-foot to CFS conversion* | | | | | | | | | | |
| 6 | *divide by :* | *1.983471* | | | | | | | | | |
| 14 | | | | | | 213,897 | | 213,897 | | 0 | 0 |
| 15 | | | | | | | | | | Total Diff | |
| 16 | | | | | | | Scenario | Scenario | | Alt | |
| 17 | CYMonth | | | | Exsiting | Exsiting | SWRCB | SWRCB | | minus | 51.7121 |
| 18 | Index | Date | Day | Days | FERC | FERC | 30% | 30% | | FERC | SF Debit |
| 19 | | | | | CFS | AF | CFS | AF | | AF | AF |
| 20 | 1970.10 | 10/1/1970 | T | 31 | 397 | 787 | 397 | 787 | | 0 | 0 |
| 21 | 1970.10 | 10/2/1970 | F | 31 | 397 | 787 | 397 | 787 | | 0 | 0 |
| 22 | 1970.10 | 10/3/1970 | S | 31 | 397 | 787 | 397 | 787 | | 0 | 0 |
| 23 | 1970.10 | 10/4/1970 | S | 31 | 397 | 787 | 397 | 787 | | 0 | 0 |
| 24 | 1970.10 | 10/5/1970 | M | 31 | 397 | 787 | 397 | 787 | | 0 | 0 |
| 25 | 1970.10 | 10/6/1970 | T | 31 | 397 | 787 | 397 | 787 | | 0 | 0 |

**Figure 5.17-4. CCSF La Grange Release Responsibility.**

[4] The "shared responsibility" assumption is presented for the purpose of evaluating alternative operations. The assumption shall not be used as evidence in any proceeding relating to and shall not act as precedence for any allocation of Tuolumne River water between CCSF and the Districts for any purpose under the Fourth Agreement.

The 1995 FERC flow requirement and the scenario flow requirement are compared on a daily basis to identify the difference between the two schedules. The CCSF 52% responsibility factor is applied to the total difference, which values are then provided to the WaterBankRel and SFWaterBank worksheets for use if selected.

## 5.18 DailyCanalsCompute Worksheet

This worksheet (DailyCanalsCompute) performs the computation of the daily canal demands of the MID and TID. The computation of canal demands incorporate the PDAW and canal operations practices of the districts. This worksheet also incorporates the application of a Water Supply Factor (from worksheet DPWSF) that reduces canal diversions during limited water supply conditions. The results from this worksheet have been provided to the Model for the Test Case scenario.

### 5.18.1 Projected Demand for Applied Water and Don Pedro Water Supply Factor

This section of logic (Figure 5.18-1) incorporates two components of information into the computation of canal demands. The PDAW for each District is a pre-processed Model entry based on an estimate developed by the CDWR consumptive use model. The monthly time series for PDAW for the simulation period is modified prior to use in the computation to refine the demand to recognize the local districts' delivery records. The second component of information is the Don Pedro Water Supply Factor (WSF). This fraction is computed in worksheet DPWSF and reflects limited water supplies during periods of drought. The factor is used to reduce canal diversions, based on antecedent reservoir storage and forecasted inflow to Don Pedro Reservoir. There are several versions of the WSF available for use in the Model if user access is allowed. The "full demand" WSF will produce a canal demand/diversion equal to full needs, as if the available water supply is sufficient to meet the full canal demands. The WSF table included in the Model represents canal demands including reductions from full diversions, and manages water supplies to produce a reservoir operation similar to that occurred during the 1987-1992 drought.

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 1 | | District Canal Diversion Computed by Canal Assumptions and Don Pedro Water Supply Factor | | | | | | | | | |
| 2 | *Unit Title* | | 2 | | Factor | | Factor | Factor | | | AF | AF | AF | AF |
| 3 | *Parameter Title* | | 3 | | DP WSF Full | | DP WSF | Dynamic WSF | | | MID Daily | TID Daily / | MID Daily | TID Daily N |
| 4 | | | | | | | | | | | | | | |
| 5 | *Acre-foot to CFS conversion* | | | | | | | | | | | | | |
| 6 | *divide by :* | *1.983471* | | | *Pre-Proc* | *Pre-Proc* | *Active* | *Read* | *Read* | *Read* | | | | |
| 7 | | | | | *Full* | *Base* | *Factor* | *from* | *from* | *from* | | | | |
| 8 | | | | | *Factor* | *Factor* | *Used in* | *DPWSF* | *BU20:487* | *BV20:487* | | | | |
| 9 | | | | | *1* | | *Scenario* | | | | | | | |
| 10 | | | | *39-yr Ave* | | | | | | | *170,364* | *406,025* | *34,500* | *0* |
| 11 | | | | *Max* | *1.0000* | *1.0000* | *1.0000* | *1.0000* | *36,100* | | *1,822* | *4,116* | *110* | *0* |
| 12 | | | | *Min* | *1.0000* | *0.6000* | *0.6000* | *0.6000* | *0* | | *0* | *0* | *74* | *0* |
| 13 | | | | | DP Water Supply Factor | | | | District Projected Demand of Applied Water | | | | | |
| 14 | | | | | | *10-4-2012* | | | | | | | | |
| 15 | | | | | DP | DP | | | | | | | | |
| 16 | | | | | WS Factor | WS Factor | Model | DP | MID | TID | MID | TID | MID | TID |
| 17 | Month | | | | Full | Base | DP | WS Factor | PDAW | PDAW | Daily | Daily | Daily | Daily |
| 18 | Index | Date | Day | Days | Demand | Case | WS Factor | Dynamic | Monthly | Monthly | PDAW | PDAW | M&I | M&I |
| 19 | | | | | | | | | AF | AF | AF | AF | AF | AF |
| 20 | 1970.10 | 10/1/1970 | T | 31 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 6,000 | 16,000 | 347 | 1,217 | 103 | 0 |
| 21 | 1970.10 | 10/2/1970 | F | 31 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 6,000 | 16,000 | 270 | 626 | 103 | 0 |
| 22 | 1970.10 | 10/3/1970 | S | 31 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 6,000 | 16,000 | 262 | 564 | 103 | 0 |
| 23 | 1970.10 | 10/4/1970 | S | 31 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 6,000 | 16,000 | 293 | 990 | 103 | 0 |
| 24 | 1970.10 | 10/5/1970 | M | 31 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 6,000 | 16,000 | 292 | 683 | 103 | 0 |
| 25 | 1970.10 | 10/6/1970 | T | 31 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 6,000 | 16,000 | 315 | 769 | 103 | 0 |

**Figure 5.18-1. Projected Demand for Applied Water and Don Pedro Water Supply Factor.**

## 5.18.2 District Canal Demand Calculation

The sections of logic (Figure 5.18-2 and Figure 5.18-3) compute the components of District canal operations that factor into the daily canal demands/diversions of the Districts. These components build on top of the PDAW to develop a daily canal demand from Don Pedro Reservoir. The PDAW is represented as a daily varying demand based on recent historical daily diversion shapes while the canal operation parameters are generally represented by an even distribution pattern within each month.

| | A | B | C | D | O | P | Q | R | S | T | U | V | W | X | Y | Z | AA | AB | AC | AD | AE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 1 | | | | | | | | | | | | | | | | | | |
| 2 | *Unit Title* | | 2 | | | AF | AF | AF | AF | AF | AF | AF | AF | AF | AF | AF | | AF | | CFS | |
| 3 | *Parameter Title* | | 3 | | M&I | MID Turnc | MID Nom | MID Turnc | MID Canal | MID Canal | MID Canal | MID Lwr C | MID Nom | MID Lwr C | MID M&I [ | MID Upper Sys Losse | | MID La Grange Diver | | MID La Grange Divers | |
| 4 | | | | | | | | | | | | | | | | | | | | | |
| 5 | *Acre-foot to CFS conversion* | | | | *Override for DailyCanals* | | | *(UI 2.10)* | 0 | *(1) on, use user-defined table, (0) off, use Base Case canal diversion* | | | | | | | | | *Capacity Check* | *2,000* | *cfs* |
| 6 | *divide by :* | *1.983471* | | | | 0 | | | 0 | *(0) off, use UserInput option (UI 2.10), or (2) use calculated canal diversion* | | | | | | | | | *Max* | *1,257* | |
| 7 | | | | | *If <> 2, use UserInput or Base* | | | | 1 | *If using calculated canal diversion, (1) Base, (2) Full Demand, or (3) Dynamic* | | | | | | | | | | | |
| 8 | | | | | *If = 2, use calculated* | | | | | | | | | | | | | | | | *Pre-Proc* |
| 9 | | | | | | | | | | | | | | | | | | | | | *Factor* |
| 10 | | | | *39-yr Ave* | | *215,775* | *20,995* | *194,780* | *44,510* | *5,059* | *8,492* | *235,857* | *17,280* | *218,577* | *34,500* | *31,100* | *0* | *284,177* | | | |
| 11 | | | | *Max* | | *2,323* | *133* | *2,291* | *233* | *21* | *45* | *2,314* | *84* | *2,282* | *110* | *158* | *65* | *2,492* | | | |
| 12 | | | | *Min* | | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *74* | *0* | *-97* | *81* | | | |
| 13 | | | | | MID Canal Demand Calculation | | | | | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | | | | MID | | MID | | | | MID |
| 15 | | | | | | MID | | | | | MID | MID | | | M&I Div | MID | Modesto | | MID | | 7-day |
| 16 | | | | | | Turnout | MID | MID | MID | MID | Canal | Lwr Canal | | MID | frm | Upper | Lake | MID | Monthly | MID | 3-yr Ave |
| 17 | Month | | | | MID | w/o | Nom Prvt | Turnout | Canal | Canal | Intercpt | bfr MID | MID | Lwr Canal | Modesto | System | Daily | La Grange | Sum | La Grange | Day |
| 18 | Index | Date | Day | Days | Factor | Prvt Pmp | Pmp | Delivery | Op Spills | Losses | Flow | Nom Pmp | Nom Pmp | Diversion | Lake | Losses | Change | Diversion | Diversion | Diversion | Percent |
| 19 | | | | | % | AF | AF | AF | AF | AF | AF | AF | AF | AF | AF | AF | AF | AF | AF | CFS | % of Mo |
| 20 | 1970.10 | 10/1/1970 | T | 31 | 40 | 869 | 32 | 836 | 223 | 20 | 29 | 1,050 | 68 | 982 | 103 | 65 | -97 | 1,053 | 20,952 | 531 | 0.06 |
| 21 | 1970.10 | 10/2/1970 | F | 31 | 40 | 676 | 32 | 643 | 223 | 20 | 29 | 857 | 68 | 789 | 103 | 65 | -97 | 860 | 20,952 | 434 | 0.05 |
| 22 | 1970.10 | 10/3/1970 | S | 31 | 40 | 656 | 32 | 623 | 223 | 20 | 29 | 837 | 68 | 769 | 103 | 65 | -97 | 840 | 20,952 | 424 | 0.04 |
| 23 | 1970.10 | 10/4/1970 | S | 31 | 40 | 734 | 32 | 701 | 223 | 20 | 29 | 915 | 68 | 847 | 103 | 65 | -97 | 918 | 20,952 | 463 | 0.05 |
| 24 | 1970.10 | 10/5/1970 | M | 31 | 40 | 730 | 32 | 698 | 223 | 20 | 29 | 911 | 68 | 844 | 103 | 65 | -97 | 915 | 20,952 | 461 | 0.05 |
| 25 | 1970.10 | 10/6/1970 | T | 31 | 40 | 789 | 32 | 756 | 223 | 20 | 29 | 970 | 68 | 902 | 103 | 65 | -97 | 973 | 20,952 | 491 | 0.05 |

**Figure 5.18-2. District Canal Demand Components - MID.**

| | A | B | C | D | AF | AG | AH | AI | AJ | AK | AL | AM | AN | AO | AP | AQ | AR | AS | AT | AU | AV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 1 | | | | | | | | | | | | | | | | | | |
| 2 | *Unit Title* | | 2 | | | AF | AF | AF | AF | AF | AF | AF | AF | AF | AF | AF | | AF | | CFS | |
| 3 | *Parameter Title* | | 3 | | sion | TID Turno | TID Nom F | TID Turno | TID Canal | MID Canal | TID Canal | TID Lwr Ca | TID Nom F | TID Lwr Ca | TID M&I D | TID Upper Sys Losses | | TID La Grange Divers | | TID La Grange Diversi | |
| 4 | | | | | | | | | | | | | | | | | | | | | |
| 5 | *Acre-foot to CFS conversion* | | | | | | | | | | | | | | | | | | *Capacity Check* | *3,400* | *cfs* |
| 6 | *divide by :* | *1.983471* | | | | | | | | | | | | | | | | | *Max* | *2,404* | |
| 7 | | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | | *Pre-Proc* |
| 9 | | | | | | | | | | | | | | | | | | | | | *Factor* |
| 10 | | | | *39-yr Ave* | | *532,337* | *31,298* | *501,039* | *46,871* | *36,555* | *0* | *584,465* | *77,066* | *507,399* | *0* | *52,200* | *0* | *559,697* | | | |
| 11 | | | | *Max* | | *4,535* | *206* | *4,455* | *243* | *150* | *0* | *4,815* | *471* | *4,548* | *0* | *290* | *250* | *4,768* | | | |
| 12 | | | | *Min* | | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *32* | *-452* | *1* | | | |
| 13 | | | | | TID Canal Demand Calculation | | | | | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | | | | TID | | | | | | TID |
| 15 | | | | | | TID | | | | | TID | TID | | | M&I Div | TID | Turlock | | TID | | 7-day |
| 16 | | | | | | Turnout | TID | TID | TID | TID | Canal | Lwr Canal | | TID | frm | Upper | Lake | TID | Monthly | TID | 3-yr Ave |
| 17 | Month | | | | TID | w/o | Nom Prvt | Turnout | Canal | Canal | Intercpt | bfr TID | TID | Lwr Canal | Turlock | System | Daily | La Grange | Sum | La Grange | Day |
| 18 | Index | Date | Day | Days | Factor | Prvt Pmp | Pmp | Delivery | Op Spills | Losses | Flow | Nom Pmp | Nom Pmp | Diversion | Lake | Losses | Change | Diversion | Diversion | Diversion | Percent |
| 19 | | | | | % | AF | AF | AF | AF | AF | AF | AF | AF | AF | AF | AF | AF | AF | AF | CFS | % of Mo |
| 20 | 1970.10 | 10/1/1970 | T | 31 | 40 | 3,044 | 77 | 2,966 | 235 | 145 | 0 | 3,347 | 171 | 3,176 | 0 | 65 | -452 | 2,789 | 31,487 | 1,406 | 0.08 |
| 21 | 1970.10 | 10/2/1970 | F | 31 | 40 | 1,565 | 77 | 1,488 | 235 | 145 | 0 | 1,869 | 171 | 1,698 | 0 | 65 | -452 | 1,311 | 31,487 | 661 | 0.04 |
| 22 | 1970.10 | 10/3/1970 | S | 31 | 40 | 1,409 | 77 | 1,332 | 235 | 145 | 0 | 1,712 | 171 | 1,541 | 0 | 65 | -452 | 1,154 | 31,487 | 582 | 0.04 |
| 23 | 1970.10 | 10/4/1970 | S | 31 | 40 | 2,475 | 77 | 2,398 | 235 | 145 | 0 | 2,779 | 171 | 2,608 | 0 | 65 | -452 | 2,220 | 31,487 | 1,119 | 0.06 |
| 24 | 1970.10 | 10/5/1970 | M | 31 | 40 | 1,708 | 77 | 1,631 | 235 | 145 | 0 | 2,011 | 171 | 1,841 | 0 | 65 | -452 | 1,453 | 31,487 | 733 | 0.04 |
| 25 | 1970.10 | 10/6/1970 | T | 31 | 40 | 1,923 | 77 | 1,845 | 235 | 145 | 0 | 2,226 | 171 | 2,055 | 0 | 65 | -452 | 1,668 | 31,487 | 841 | 0.05 |

**Figure 5.18-3. District Canal Demand Components - TID.**

## 5.18.3 District Canal Operation Assumptions

The canal operation assumptions, e.g., regulating reservoir operation, seepage and losses and canal operation spills, are identified in this worksheet (entered into worksheet Control). These parameters are provided to the computations shown above. The canal operation assumptions for each District are shown Figure 5.18-4 and Figure 5.18-5.

| Modesto Irrigation District | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Turnout Delivery Factor | Nominal Private GW Pumping | Canal Operational Spills Critical | Canal Operational Spills Non-crit | System Losses below Modesto Res | Intercepted Flows | Nominal MID GW Pumping | Modesto Res and Upper Canal Losses/Div | Municipal Delivery from Modesto Res | Modesto Res Target Storage | Modesto Res Target Storage Change |
| Month | % | TAF | TAF | TAF | TAF | TAF | TAF | TAF | TAF | TAF | TAF |
| January | 35.0 | 0.0 | 2.0 | 2.0 | 0.1 | 0.0 | 0.0 | 0.0 | 2.3 | 17.0 | 2.0 |
| February | 35.0 | 0.0 | 2.0 | 2.0 | 0.1 | 0.0 | 0.0 | 0.0 | 2.3 | 18.0 | 1.0 |
| March | 65.0 | 1.0 | 1.0 | 3.0 | 0.6 | 0.9 | 1.0 | 2.0 | 2.7 | 18.0 | 0.0 |
| April | 70.0 | 2.0 | 3.0 | 6.0 | 0.6 | 0.9 | 2.3 | 2.9 | 2.7 | 19.0 | 1.0 |
| May | 85.0 | 3.0 | 4.0 | 6.5 | 0.6 | 1.2 | 2.3 | 3.9 | 3.0 | 20.0 | 1.0 |
| June | 85.0 | 4.0 | 3.5 | 6.5 | 0.6 | 1.0 | 2.3 | 4.3 | 3.2 | 20.0 | 0.0 |
| July | 77.5 | 4.0 | 3.5 | 6.5 | 0.6 | 1.0 | 2.6 | 4.9 | 3.3 | 21.0 | 1.0 |
| August | 70.0 | 4.0 | 4.9 | 7.0 | 0.6 | 1.4 | 2.4 | 4.9 | 3.3 | 22.0 | 1.0 |
| September | 65.0 | 2.0 | 5.0 | 7.0 | 0.6 | 1.2 | 2.3 | 4.2 | 3.3 | 20.0 | -2.0 |
| October | 40.0 | 1.0 | 2.8 | 6.9 | 0.6 | 0.9 | 2.1 | 2.0 | 3.2 | 17.0 | -3.0 |
| November | 30.0 | 0.0 | 2.0 | 2.0 | 0.1 | 0.0 | 0.0 | 2.0 | 2.7 | 15.0 | -2.0 |
| December | 35.0 | 0.0 | 2.0 | 2.0 | 0.1 | 0.0 | 0.0 | 0.0 | 2.5 | 15.0 | 0.0 |
| Total | | 21.0 | 35.7 | 57.4 | 5.4 | 8.5 | 17.3 | 31.1 | 34.5 | | |

**Figure 5.18-4. Canal Demand and Operation Components for MID.**

| Turlock Irrigation District | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Turnout Delivery Factor | Nominal Private GW Pumping | Canal Operational Spills Critical | Canal Operational Spills Non-crit | System Losses below Turlock Lk | Intercepted Flows | Nominal TID GW Pumping | Turlock Lk and Upper Canal Losses | Other Delivery from Turlock Lk | Turlock Lk Target Storage | Turlock Lk Target Storage Change |
| Month | % | TAF | TAF | TAF | TAF | TAF | TAF | TAF | TAF | TAF | TAF |
| January | 30.0 | 0.0 | 2.0 | 2.0 | 0.8 | 0.0 | 0.0 | 1.0 | 0.0 | 18.0 | 5.0 |
| February | 30.0 | 0.0 | 2.0 | 2.0 | 0.8 | 0.0 | 0.0 | 1.0 | 0.0 | 25.0 | 7.0 |
| March | 65.0 | 1.2 | 3.0 | 3.0 | 4.5 | 0.0 | 4.1 | 1.0 | 0.0 | 30.0 | 5.0 |
| April | 57.5 | 2.4 | 5.1 | 6.3 | 4.5 | 0.0 | 8.0 | 6.6 | 0.0 | 30.0 | 0.0 |
| May | 85.0 | 3.6 | 4.6 | 6.7 | 4.5 | 0.0 | 10.3 | 7.7 | 0.0 | 32.0 | 2.0 |
| June | 92.5 | 5.2 | 4.2 | 6.7 | 4.5 | 0.0 | 12.4 | 8.2 | 0.0 | 32.0 | 0.0 |
| July | 72.5 | 6.4 | 4.2 | 6.7 | 4.5 | 0.0 | 14.6 | 8.7 | 0.0 | 32.0 | 0.0 |
| August | 62.5 | 6.2 | 4.0 | 7.3 | 4.5 | 0.0 | 13.3 | 9.0 | 0.0 | 30.0 | -2.0 |
| September | 67.5 | 3.9 | 3.2 | 7.3 | 4.5 | 0.0 | 9.1 | 5.0 | 0.0 | 27.0 | -3.0 |
| October | 40.0 | 2.4 | 2.3 | 7.3 | 4.5 | 0.0 | 5.3 | 2.0 | 0.0 | 13.0 | -14.0 |
| November | 30.0 | 0.0 | 2.0 | 2.0 | 0.8 | 0.0 | 0.0 | 1.0 | 0.0 | 13.0 | 0.0 |
| December | 30.0 | 0.0 | 2.0 | 2.0 | 0.8 | 0.0 | 0.0 | 1.0 | 0.0 | 13.0 | 0.0 |
| Total | | 31.3 | 38.6 | 59.3 | 39.2 | 0.0 | 77.1 | 52.2 | 0.0 | | |

**Figure 5.18-5. Canal Demand and Operation Components for TID.**

## 5.19 DailyCanals Worksheet

This worksheet (DailyCanals) assembles the appropriate canal demands for the scenario. While worksheet DailyCanalsCompute is capable of providing several versions of canal demands, worksheet DailyCanals readies either those selected demands or alternatively defined demands for the Model.

### 5.19.1 Model (scenario) Canal Demands

The section of logic (Figure 5.19-1) shows two columns of data used by the Model (worksheet DonPedro) for canal diversions by MID and TID. The version of demand used is user specified. If using the worksheet UserInput interface, UI 2.10 selects whether pre-processed Test Case diversions are used or a user specified table of diversions are used. If access to worksheet DailyCanalsCompute is granted, a time series of canal diversions from worksheet DailyCanalsCompute is used.

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 1 | | District Canal Diversion Read by Model | | | | | |
| 2 | *Unit Title* | | 2 | | | | | | | |
| 3 | *Parameter Title* | | 3 | | | | | | | |
| 4 | | | | | | | | | | |
| 5 | *Acre-foot to CFS conversion* | | | | | | | | | |
| 6 | *divide by :* | *1.983471* | | | MID and TID Canal Diversion Assumption | | | | | |
| 7 | | | | | *Read* | | *Read* | | | |
| 8 | | | | | *by* | | *by* | | | |
| 9 | | | | | *DP Model* | | *DP Model* | | *Sum* | |
| 10 | | | | *39-yr Ave* | *284,177* | | *559,697* | | *843,874* | |
| 11 | | | | | *Option (0) is using Base Case Canal Diversion* | | | | | |
| 12 | | | | | *Option (1) is using Alt from UserInput Canal Diversion* | | | | | |
| 13 | | | | | Option>> | 0 | Switch 2.10 or Override | | | |
| 14 | | | | | *Option (2) is using Calculated Canal Diversion* | | | | | |
| 15 | | | | | Model | Model | Model | Model | Model | Model |
| 16 | | | | | MID | MID | TID | TID | Total | Total |
| 17 | Month | | | | Canal | Canal | Canal | Canal | Canal | Canal |
| 18 | Index | Date | Day | Days | Diversion | Diversion | Diversion | Diversion | Diversion | Diversion |
| 19 | | | | | AF | CFS | AF | CFS | AF | CFS |
| 20 | 1970.10 | 10/1/1970 | T | 31 | 1,053 | 531 | 2,789 | 1,406 | 3,842 | 1,937 |
| 21 | 1970.10 | 10/2/1970 | F | 31 | 860 | 434 | 1,311 | 661 | 2,171 | 1,094 |
| 22 | 1970.10 | 10/3/1970 | S | 31 | 840 | 424 | 1,154 | 582 | 1,994 | 1,006 |
| 23 | 1970.10 | 10/4/1970 | S | 31 | 918 | 463 | 2,220 | 1,119 | 3,139 | 1,582 |
| 24 | 1970.10 | 10/5/1970 | M | 31 | 915 | 461 | 1,453 | 733 | 2,368 | 1,194 |
| 25 | 1970.10 | 10/6/1970 | T | 31 | 973 | 491 | 1,668 | 841 | 2,641 | 1,332 |

**Figure 5.19-1. District Canal Demands.**

### 5.19.2 Test Case and Alternative Canal Diversions

This section of logic (Figure 5.19-2) provides the Model either a pre-processed time series of canal diversions (Test Case) or a time series of canal diversions that has been specified by the user in worksheet UserInput (UI 2.20 and UI 2.30) as monthly canal demands for the simulation period. A snapshot of the worksheet is shown below. This section of logic also parses the user specified monthly table of canal diversions into a daily diversion pattern based on the Test Case scenario's daily pattern of diversions.

| | A | B | C | D | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z | AA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 1 | | | | | | | | | | | | | | | | | |
| 2 | *Unit Title* | | 2 | | | | | | | | | | | | | | | | | |
| 3 | *Parameter Title* | | 3 | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | |
| 5 | *Acre-foot to CFS conversion* | | | | | | | | | | | | | | | | | | | |
| 6 | *divide by :* | *1.983471* | | | *Enter* | | *Enter* | | *Pre-Processed* | | Alternative Canal Diversion | | | | *Enter* | | *Enter* | | *Derived from* | |
| 7 | | | | | *Time* | | *Time* | | *as base scenario* | | | | | | *Data in* | | *Data in* | | *UserInput* | |
| 8 | | | | | *Series* | | *Series* | | | | Daily Distribution of User Supplied | | | | *Matrix* | | *Matrix* | | | |
| 9 | | | | | *Here* | | *Here* | | *Sum* | | Monthly Alternative District Canal | | | | *AI66:AU103* | | *AX66:BJ103* | | *Sum* | |
| 10 | | | | *39-yr Ave* | *284,177* | | *559,697* | | *843,874* | | Diversion | | | | *284,177* | | *559,697* | | *843,874* | |
| 11 | | | | | | *1,257* | | *2,404* | | | Distributed as Daily Percentage of | | | | | *1,257* | | *2,404* | | |
| 12 | | | | | | *41* | | *1* | | | Monthly Total District Base Diversion | | | | | *41* | | *1* | | |
| 13 | | | | | 0 | 0 | 0 | 0 | 0 | 0 | | | | *Option>>* | 1 | 1 | 1 | 1 | 1 | 1 |
| 14 | | | | | *Values of Base Case - October 4, 2012* | | | | | | | | | | | | | | | |
| 15 | | | | | Base | Base | Base | Base | Base | Base | Base | MID % | Base | TID % | Alt | Alt | Alt | Alt | Alt | Alt |
| 16 | | | | | MID | MID | TID | TID | Total | Total | MID Mon | Day of | TID Mon | Day of | MID | MID | TID | TID | Total | Total |
| 17 | Month | | | | Canal | Canal | Canal | Canal | Canal | Canal | Canal | Month | Canal | Month | Canal | Canal | Canal | Canal | Canal | Canal |
| 18 | Index | Date | Day | Days | Diversion | Diversion | Diversion | Diversion | Diversion | Diversion | Diversion | Diversion | Diversion | Diversion | Diversion | Diversion | Diversion | Diversion | Diversion | Diversion |
| 19 | | | | | AF | CFS | AF | CFS | AF | CFS | AF | | AF | | AF | CFS | AF | CFS | AF | CFS |
| 20 | 1970.10 | 10/1/1970 | T | 31 | 1,053 | 531 | 2,789 | 1,406 | 3,842 | 1,937 | 20,952 | 0.05 | 31,487 | 0.09 | 1,053 | 531 | 2,789 | 1,406 | 3,842 | 1,937 |
| 21 | 1970.10 | 10/2/1970 | F | 31 | 860 | 434 | 1,311 | 661 | 2,171 | 1,094 | 20,952 | 0.04 | 31,487 | 0.04 | 860 | 434 | 1,311 | 661 | 2,171 | 1,094 |
| 22 | 1970.10 | 10/3/1970 | S | 31 | 840 | 424 | 1,154 | 582 | 1,994 | 1,006 | 20,952 | 0.04 | 31,487 | 0.04 | 840 | 424 | 1,154 | 582 | 1,994 | 1,006 |
| 23 | 1970.10 | 10/4/1970 | S | 31 | 918 | 463 | 2,220 | 1,119 | 3,139 | 1,582 | 20,952 | 0.04 | 31,487 | 0.07 | 918 | 463 | 2,220 | 1,119 | 3,139 | 1,582 |
| 24 | 1970.10 | 10/5/1970 | M | 31 | 915 | 461 | 1,453 | 733 | 2,368 | 1,194 | 20,952 | 0.04 | 31,487 | 0.05 | 915 | 461 | 1,453 | 733 | 2,368 | 1,194 |
| 25 | 1970.10 | 10/6/1970 | T | 31 | 973 | 491 | 1,668 | 841 | 2,641 | 1,332 | 20,952 | 0.05 | 31,487 | 0.05 | 973 | 491 | 1,668 | 841 | 2,641 | 1,332 |

**Figure 5.19-2. Test Case and Alternative Canal Diversions.**

Adjacent to the above illustrated area of computations are several components of data assemblage (Figure 5.19-3). The monthly time series columns serve to summarize daily Test

Case diversions assumptions and provide user specified monthly diversions for daily parsing. The chronological matrices provide an alternative listing of the monthly data.

| | A | B | C | D | AC | AD | AE | AF | AG |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 1 | | | | | | |
| 2 | *Unit Title* | | 2 | | | | | | |
| 3 | *Parameter Title* | | 3 | | | | | | |
| 4 | | | | | | | | | |
| 5 | *Acre-foot to CFS conversion* | | | | Monthly Time Series Data | | | | |
| 6 | *divide by :* | *1.983471* | | | | *Monthly* | *Enter* | *Monthly* | *Enter* |
| 7 | | | | | | *from* | *Data in* | *from* | *Data in* |
| 8 | | | | | | *Daily* | *Matrix* | *Daily* | *Matrix* |
| 9 | | | | | | *Input* | *AI66:AU103* | *Input* | *AX66:BJ103* |
| 10 | | | *39-yr Ave* | | | *Pre-Proc* | *UserInput* | *Pre-Proc* | *UserInput* |
| 11 | | | | | | | | | |
| 12 | | | | | *39-yr Ave* | *284,177* | *284,177* | *559,697* | *559,697* |
| 13 | | | | | | 1 | 2 | 1 | 2 |
| 14 | | | | | | MID | MID | TID | TID |
| 15 | | | | | | Base | Alt | Base | Alt |
| 16 | | | | | | Assumpt | Assumpt | Assumpt | Assumpt |
| 17 | Month | | | | | Monthly | Monthly | Monthly | Monthly |
| 18 | Index | Date | Day | Days | | Volume | Volume | Volume | Volume |
| 19 | | | | | Yr-Month | AF | AF | AF | AF |
| 20 | 1970.10 | 10/1/1970 | T | 31 | 1970.10 | 20,952 | 20,952 | 31,487 | 31,487 |
| 21 | 1970.10 | 10/2/1970 | F | 31 | 1970.11 | 2,700 | 2,700 | 1,000 | 1,000 |
| 22 | 1970.10 | 10/3/1970 | S | 31 | 1970.12 | 2,500 | 2,500 | 1,000 | 1,000 |
| 23 | 1970.10 | 10/4/1970 | S | 31 | 1971.01 | 4,300 | 4,300 | 6,000 | 6,000 |
| 24 | 1970.10 | 10/5/1970 | M | 31 | 1971.02 | 3,300 | 3,300 | 8,000 | 8,000 |
| 25 | 1970.10 | 10/6/1970 | T | 31 | 1971.03 | 14,746 | 14,746 | 42,220 | 42,220 |

***Monthly Matrix Time Series Data***

User-defined District Canal Diversions at AI66:AU103 and AX66:BJ103

Test_Base MID Canal Assumption - Read from Time Series in Column AD
Acre-feet

| WY | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Total WY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1971 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 30,656 | 42,917 | 47,253 | 54,987 | 49,086 | 32,192 | 305,589 |
| 1972 | 20,952 | 5,130 | 2,500 | 4,300 | 5,679 | 24,844 | 46,800 | 46,544 | 46,542 | 54,987 | 49,086 | 30,637 | 338,001 |
| 1973 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 23,737 | 45,374 | 47,016 | 54,987 | 49,086 | 32,658 | 301,356 |
| 1974 | 20,952 | 2,700 | 2,500 | 4,300 | 3,300 | 14,746 | 18,115 | 42,917 | 45,239 | 49,733 | 49,086 | 32,658 | 286,246 |
| 1975 | 20,952 | 5,460 | 2,500 | 4,300 | 3,300 | 14,746 | 28,782 | 44,672 | 47,253 | 54,859 | 43,423 | 32,658 | 302,906 |
| 1976 | 20,952 | 6,451 | 2,500 | 4,300 | 6,350 | 30,232 | 34,676 | 38,540 | 38,163 | 44,939 | 35,682 | 24,524 | 287,308 |

**Figure 5.19-3. Assemblage of Canal Diversions.**

## 5.20 DPWSF Worksheet

This worksheet (DPSWF) computes the Don Pedro Water Supply Factor (WSF). The premise of the WSF factor is to reduce the amount of water diverted to the canals during years when lack of carryover storage at Don Pedro Reservoir becomes a concern. The modeling mechanism used to reduce canal diversions is a factor applied to the PDAW of the canal demand. This mechanism results in a reduction to the amount of water "turned out" to the customers while still recognizing the relatively constant efficiencies of canal operations.

The WSF is established by forecasting upcoming water supply, based on antecedent storage and anticipated inflow to Don Pedro Reservoir. The forecasting procedure begins in February and ends in April. The Factor Table is based on April forecast results. The February and March Forecasts act as adjustments to get to the April 1 state. The forecasts have the following protocol:

*February Forecast (forecasting April 1 state):*
*End of January storage + Feb-Jul UF - Feb-Jul US adjustment - Feb-Mar minimum river*
*March Forecast (forecasting April 1 state):*
*End of February storage + Mar-Jul UF - Mar-Jul US adjustment - Mar minimum river*
*April Forecast: (final)*
*End of March storage + Apr-Jul UF - Apr-July US adjustment*

Pre-knowledge of unimpaired runoff for each forecast period is assumed, as well as knowledge of upcoming upstream impairment of the runoff. *The WSF factor / Don Pedro Storage + Inflow* relationship is developed through iterations of multi-year system operation simulations. The WSF depicts actions that may be implemented during times of drought, and the projected canal diversions and reservoir storage operation during drought periods. The factors and index triggers were developed reviewing reservoir storage levels that occurred during the 1987-1992 drought.

Figure 5.20-1 is a snapshot of the worksheet computation area.

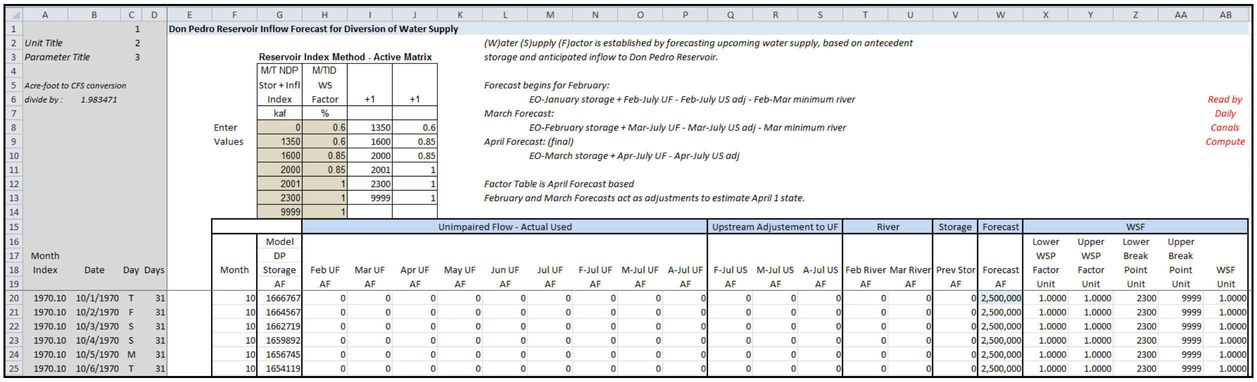



**Figure 5.20-1. Don Pedro Water Supply Factor Computation.**

## 5.21 CCSF Worksheet

This worksheet (CCSF) identifies, assembles and directs several elements of CCSF System operations, and provides input to other Model component worksheets.

### 5.21.1 San Joaquin Pipeline Diversions

The first section of logic concerns the identification of SJPL diversions. Figure 5.21-1 is a snapshot of this section. By user selection (UI 4.10) either pre-processed Test Case SJPL diversions are used, or a user specified table of monthly diversions for the simulation period are used. This section assembles the user selected version of diversions for use by the Model. These two versions of SJPL diversions are available for selection through worksheet UserInput. If access is granted, a third version of SJPL diversions is provided which revises Test Case diversions based on circumstances of the scenario that changes CCSF's operation. Procedures are described below the monthly diversion matrix describing how to employ this third version of SJPL diversions.

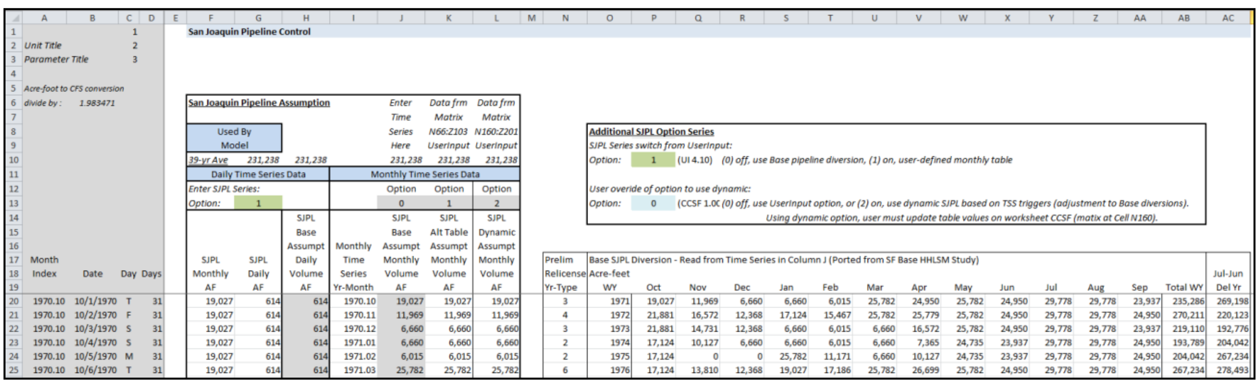
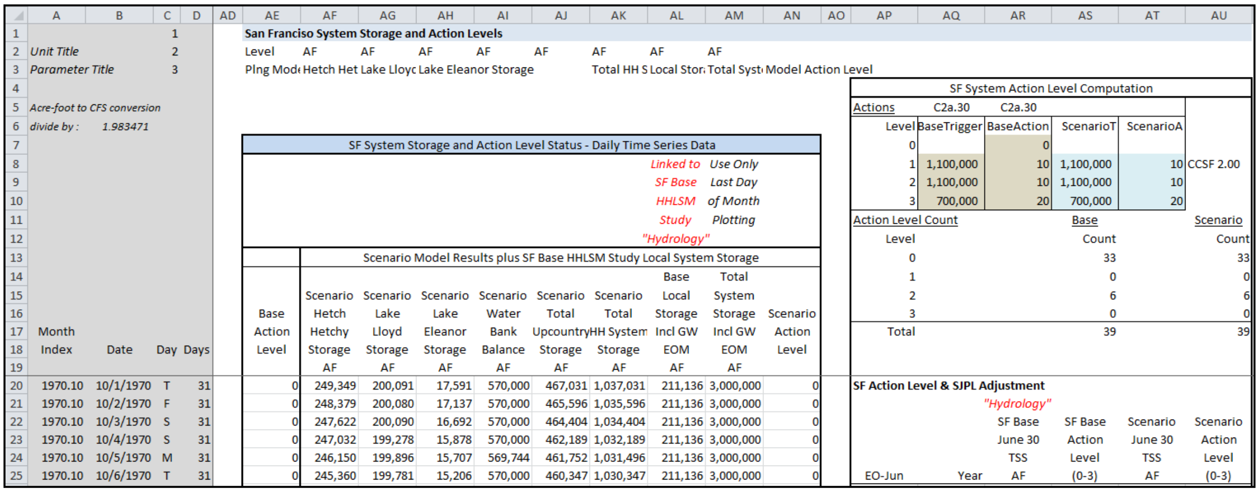



**Figure 5.21-1. CCSF San Joaquin Pipeline Diversions and Assemblage of Data.**

### 5.21.2 CCSF System Storage and Action Levels

This section of logic (Figure 5.21-2) provides reporting and computational functions. The CCSF System action level computation analyzes scenario results concerning CCSF's reservoir storage and extrapolates that information into advised action levels within the CCSF System. Germane to the FERC investigation is the potential effect that flow responsibility placed upon CCSF may have upon its water system and deliveries. The relationship between CCSF System reservoir storage and action levels (translated to increased delivery rationing) is incorporated into this worksheet. Upon changed conditions within a scenario (as compared to Test Case conditions), the change in action levels is identified. This change is also provided the SJPL diversion logic described above, and if allowed to be selected this worksheet will perform an adjustment to SJPL diversions.



San Francisco System Storage and Action Levels

| | A | B | C | D | AE | AF | AG | AH | AI | AJ | AK | AL | AM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 1 | | San Francisco System Storage and Action Levels | | | | | | | | |
| 2 | Unit Title | | 2 | | Level | AF | AF | AF | AF | AF | AF | AF | AF |
| 3 | Parameter Title | | 3 | | Plng Mod | Hetch Het | Lake Lloyc | Lake Eleanor Storage | | | Total HH S | Local Stor | Total Syst Model Action Level |
| 5 | Acre-foot to CFS conversion | | | | | | | | | | | | |
| 6 | divide by : 1.983471 | | | | | | | | | | | | |

SF System Storage and Action Level Status - Daily Time Series Data

Linked to SF Base HHLSM Study "Hydrology" — Use Only Last Day of Month Plotting

Scenario Model Results plus SF Base HHLSM Study Local System Storage

| Month Index | Date | Day | Days | Base Action Level | Scenario Hetch Hetchy Storage AF | Scenario Lake Lloyd Storage AF | Scenario Lake Eleanor Storage AF | Scenario Water Bank Balance AF | Scenario Total Upcountry Storage AF | Scenario Total HH System Storage AF | Base Local Storage Incl GW EOM AF | Total System Storage Incl GW EOM AF | Scenario Action Level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1970.10 | 10/1/1970 | T | 31 | 0 | 249,349 | 200,091 | 17,591 | 570,000 | 467,031 | 1,037,031 | 211,136 | 3,000,000 | 0 |
| 1970.10 | 10/2/1970 | F | 31 | 0 | 248,379 | 200,080 | 17,137 | 570,000 | 465,596 | 1,035,596 | 211,136 | 3,000,000 | 0 |
| 1970.10 | 10/3/1970 | S | 31 | 0 | 247,622 | 200,090 | 16,692 | 570,000 | 464,404 | 1,034,404 | 211,136 | 3,000,000 | 0 |
| 1970.10 | 10/4/1970 | S | 31 | 0 | 247,032 | 199,278 | 15,878 | 570,000 | 462,189 | 1,032,189 | 211,136 | 3,000,000 | 0 |
| 1970.10 | 10/5/1970 | M | 31 | 0 | 246,150 | 199,896 | 15,707 | 569,744 | 461,752 | 1,031,496 | 211,136 | 3,000,000 | 0 |
| 1970.10 | 10/6/1970 | T | 31 | 0 | 245,360 | 199,781 | 15,206 | 570,000 | 460,347 | 1,030,347 | 211,136 | 3,000,000 | 0 |

SF System Action Level Computation

| Actions Level | C2a.30 BaseTrigger | C2a.30 BaseAction | ScenarioT | ScenarioA | |
|---|---|---|---|---|---|
| 0 | | 0 | | | |
| 1 | 1,100,000 | 10 | 1,100,000 | 10 | CCSF 2.00 |
| 2 | 1,100,000 | 10 | 1,100,000 | 10 | |
| 3 | 700,000 | 20 | 700,000 | 20 | |

Action Level Count

| Level | Base Count | Scenario Count |
|---|---|---|
| 0 | 33 | 33 |
| 1 | 0 | 0 |
| 2 | 6 | 6 |
| 3 | 0 | 0 |
| Total | 39 | 39 |

SF Action Level & SJPL Adjustment

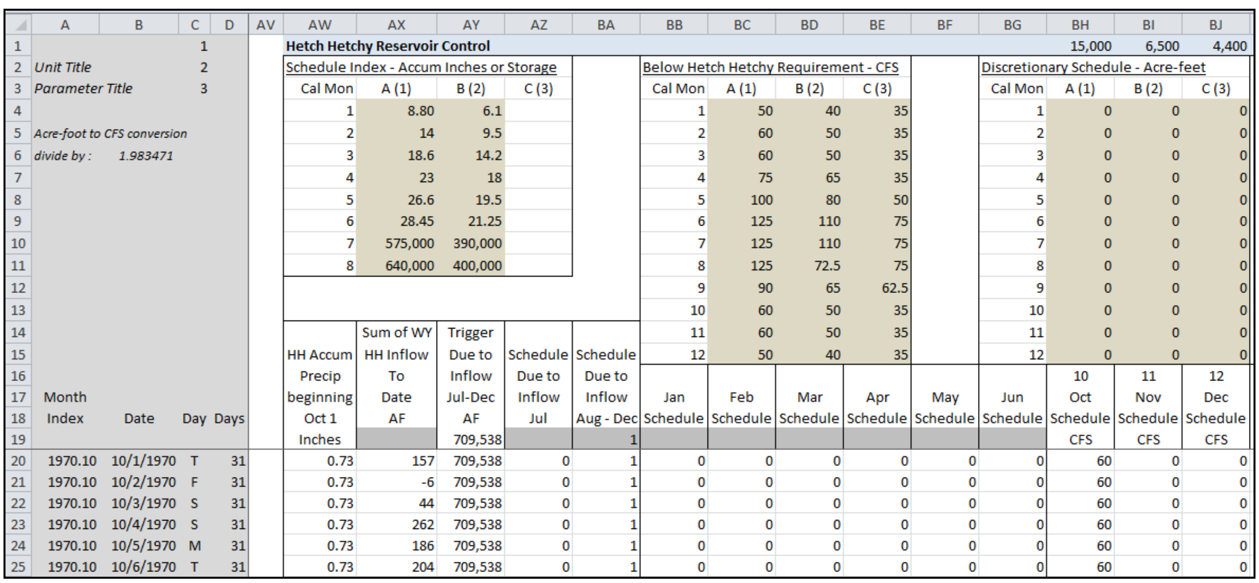
"Hydrology"

| EO-Jun | Year | SF Base June 30 TSS AF | SF Base Action Level (0-3) | Scenario June 30 TSS AF | Scenario Action Level (0-3) |
|---|---|---|---|---|---|

**Figure 5.21-2. CCSF System Storage and Action Levels.**

### 5.21.3 Hetch Hetchy Reservoir Control

This section of logic (Figure 5.21-3) identifies several underlying operation constraints for Hetch Hetchy Reservoir. The minimum stream release below Hetch Hetchy Reservoir is computed in this section. Also identified in this section are reservoir storage targets and limits. This information is used in worksheet SFHetchHetchy for several operational constraints and objectives.



Hetch Hetchy Reservoir Control — 15,000 | 6,500 | 4,400

Unit Title 2; Parameter Title 3; Acre-foot to CFS conversion divide by : 1.983471

Schedule Index - Accum Inches or Storage

| Cal Mon | A (1) | B (2) | C (3) |
|---|---|---|---|
| 1 | 8.80 | 6.1 | |
| 2 | 14 | 9.5 | |
| 3 | 18.6 | 14.2 | |
| 4 | 23 | 18 | |
| 5 | 26.6 | 19.5 | |
| 6 | 28.45 | 21.25 | |
| 7 | 575,000 | 390,000 | |
| 8 | 640,000 | 400,000 | |

Below Hetch Hetchy Requirement - CFS

| Cal Mon | A (1) | B (2) | C (3) |
|---|---|---|---|
| 1 | 50 | 40 | 35 |
| 2 | 60 | 50 | 35 |
| 3 | 60 | 50 | 35 |
| 4 | 75 | 65 | 35 |
| 5 | 100 | 80 | 50 |
| 6 | 125 | 110 | 75 |
| 7 | 125 | 110 | 75 |
| 8 | 125 | 72.5 | 75 |
| 9 | 90 | 65 | 62.5 |
| 10 | 60 | 50 | 35 |
| 11 | 60 | 50 | 35 |
| 12 | 50 | 40 | 35 |

Discretionary Schedule - Acre-feet

| Cal Mon | A (1) | B (2) | C (3) |
|---|---|---|---|
| 1 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 |
| 3 | 0 | 0 | 0 |
| 4 | 0 | 0 | 0 |
| 5 | 0 | 0 | 0 |
| 6 | 0 | 0 | 0 |
| 7 | 0 | 0 | 0 |
| 8 | 0 | 0 | 0 |
| 9 | 0 | 0 | 0 |
| 10 | 0 | 0 | 0 |
| 11 | 0 | 0 | 0 |
| 12 | 0 | 0 | 0 |

| Month Index | Date | Day | Days | HH Accum Precip beginning Oct 1 Inches | Sum of WY HH Inflow To Date AF | Trigger Due to Inflow Jul-Dec AF | Schedule Due to Inflow Jul | Schedule Due to Inflow Aug - Dec | Jan Schedule | Feb Schedule | Mar Schedule | Apr Schedule | May Schedule | Jun Schedule | 10 Oct Schedule CFS | 11 Nov Schedule CFS | 12 Dec Schedule CFS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 709,538 | | 1 | | | | | | | | | |
| 1970.10 | 10/1/1970 | T | 31 | 0.73 | 157 | 709,538 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 60 | 0 | 0 |
| 1970.10 | 10/2/1970 | F | 31 | 0.73 | -6 | 709,538 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 60 | 0 | 0 |
| 1970.10 | 10/3/1970 | S | 31 | 0.73 | 44 | 709,538 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 60 | 0 | 0 |
| 1970.10 | 10/4/1970 | S | 31 | 0.73 | 262 | 709,538 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 60 | 0 | 0 |
| 1970.10 | 10/5/1970 | M | 31 | 0.73 | 186 | 709,538 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 60 | 0 | 0 |
| 1970.10 | 10/6/1970 | T | 31 | 0.73 | 204 | 709,538 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 60 | 0 | 0 |

| | A | B | C | D | BK | BL | BM | BN | BO | BP | BQ | BR | BS | BT | BU | BV | BW | BX | BY | BZ | CA | CB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 1 | | | | | | | | | | | | | | | | | | | |
| 2 | *Unit Title* | | 2 | | | | | | | | | | | | | | | AF | CFS | Target Storage - Acre-feet | | |
| 3 | *Parameter Title* | | 3 | | | | | | | | | | | | | | | Total Mini | Total Mini | | Target | Limit |
| 4 | | | | | | | | | | | | | | | | | | | | Cal Mon | EOM | EOM |
| 5 | *Acre-foot to CFS conversion* | | | | | | | | | | | | | | | | | | | 0 | 320000 | |
| 6 | *divide by :* | *1.983471* | | | | | | | | | | | | | Month | | | | | 1 | 320,000 | 360,360 |
| 7 | | | | | | | | | | | | | | | on | | | | | 2 | 320,000 | 360,360 |
| 8 | | | | | | | | | | | | | | | 5 | | | | | 3 | 320,000 | 360,360 |
| 9 | | | | | | | | | | | | | | | *Does not* | *Does not* | *Lagged* | | | 4 | 320,000 | 360,360 |
| 10 | | | | | | | | | | | | | | | *include* | *include* | *by 1 day* | | | 5 | 360,360 | 360,360 |
| 11 | | | | | | | | | | | | | | | *offramp* | *Canyon* | *to avoid* | | | 6 | 360,360 | 360,360 |
| 12 | | | | | | | | | | | | | | | *of Discret* | *64 cfs* | *circular* | | | 7 | 360,360 | 360,360 |
| 13 | | | | | | | | | | | | | | | *"C" Sch* | | *reference* | | | 8 | 360,360 | 360,360 |
| 14 | | | | | | | | | | | | | | | *due to* | | | | | 9 | 360,360 | 360,360 |
| 15 | | | | | | | | | | | | | | | *HH Stor* | Min HH | | w/ 64 cfs | w/ 64 cfs | 10 | 330,000 | 360,360 |
| 16 | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | | Basic + | Canyon | Total | Total | 11 | 320,000 | 360,360 |
| 17 | Month | | | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Basic | Discret | Discret | 64 cfs | Min HH | Min HH | 12 | 320,000 | 360,360 |
| 18 | Index | Date | Day | Days | Schedule | Schedule | Schedule | Schedule | Schedule | Schedule | Schedule | Schedule | Schedule | Schedule | Schedule | Schedule | Schedule | Schedule | Schedule | | Day Chg | Target |
| 19 | | | | | CFS | CFS | CFS | CFS | CFS | CFS | CFS | CFS | CFS | AF | AF | AF | AF | AF | CFS | | Target | 360,360 |
| 20 | 1970.10 | 10/1/1970 | T | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 119 | 0 | 119 | | 119 | 60 | | -979 | 359,381 |
| 21 | 1970.10 | 10/2/1970 | F | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 119 | 0 | 119 | 0 | 119 | 60 | | -979 | 358,401 |
| 22 | 1970.10 | 10/3/1970 | S | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 119 | 0 | 119 | 0 | 119 | 60 | | -979 | 357,422 |
| 23 | 1970.10 | 10/4/1970 | S | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 119 | 0 | 119 | 0 | 119 | 60 | | -979 | 356,443 |
| 24 | 1970.10 | 10/5/1970 | M | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 119 | 0 | 119 | 0 | 119 | 60 | | -979 | 355,463 |
| 25 | 1970.10 | 10/6/1970 | T | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 119 | 0 | 119 | 0 | 119 | 60 | | -979 | 354,484 |

**Figure 5.21-3. Hetch Hetchy Reservoir Controls.**

## 5.21.4 Lake Lloyd Control

This section of logic identifies several underlying operation constraints for Lake Lloyd. Figure 5.21-4 is a snapshot of this section. The minimum stream release below Lake Lloyd is computed in this section. Also identified in this section are reservoir storage targets and limits, and the target release objective for Holm Powerhouse. The maximum drawdown of Lake Lloyd due to supplemental releases is identified. This information is used in worksheet SFLloyd for several operational constraints and objectives.

| | A | B | C | D | CE | CF | CG | CH | CI | CJ | CK | CL | CM | CN | CO | CP | CQ | CR | CS | CT | CU | CV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 1 | | | **Lake Lloyd and Lake Eleanor Control** | | | | | | | | | | | | | | | | |
| 2 | *Unit Title* | | 2 | | | Lloyd Target Storage - Acre-feet | | | | Lake Lloyd/Lake Eleanor Split of Combined Inflow | | | | | | Blw Lake Lloyd - CFS | | | Holm Target Releases | | | |
| 3 | *Parameter Title* | | 3 | | | | Soft Trgt | Hard Limit | | | Lloyd | Eleanor | | | | Cal Mon | Req | | | | | |
| 4 | | | | | | Cal Mon | EOM | EOM | | Cal Mon | % | % | *Note:* | | | 1 | 5 | | May (Memorial Day) thru | | | |
| 5 | *Acre-foot to CFS conversion* | | | | | 0 | 238,000 | | | 1 | 53 | 47 | *Watershed* | | | 2 | 5 | | August (Labor Day) | | | |
| 6 | *divide by :* | *1.983471* | | | | 1 | 238,000 | 273,300 | | 2 | 52 | 48 | *proportions* | | | 3 | 5 | | Holm Capacity | | 950 | cfs |
| 7 | | | | | | 2 | 238,000 | 273,300 | | 3 | 52 | 48 | *were developed* | | | 4 | 5 | | | Day | 1,884 | acre-feet |
| 8 | | | | | | 3 | 238,000 | 273,300 | | 4 | 57 | 43 | *from the record* | | | 5 | 5 | | 4-hours per day | | 314 | acre-feet |
| 9 | | | | | | 4 | 273,300 | 273,300 | | 5 | 65 | 35 | *of runoff each basin* | | | 6 | 5 | | | | | |
| 10 | | | | | | 5 | 273,300 | 273,300 | | 6 | 72 | 28 | *basin prior to 1960.* | | | 7 | 15.5 | | Minimum Lloyd Storage to Draw | | | |
| 11 | | | | | | 6 | 273,300 | 273,300 | | 7 | 72 | 28 | | | | 8 | 15.5 | | for Water Bank/Supplemental Release | | | |
| 12 | | | | | | 7 | 268,000 | 273,300 | | 8 | 56 | 44 | | | | 9 | 15.5 | | Release: | 45,000 | acre-feet | CCSF 3.00 |
| 13 | | | | | | 8 | 258,000 | 273,300 | | 9 | 52 | 48 | | | | 10 | 5 | | | | | |
| 14 | | | | | | 9 | 248,000 | 273,300 | | 10 | 69 | 31 | | | | 11 | 5 | | | May-Aug | | |
| 15 | | | | | | 10 | 248,000 | 273,300 | | 11 | 58 | 42 | | | | 12 | 5 | | | Min | | |
| 16 | | | | | | 11 | 238,000 | 273,300 | | 12 | 57 | 43 | | | | | | | | Holm | | |
| 17 | Month | | | | | 12 | 238,000 | 273,300 | | Total | Lloyd | Lloyd | Eleanor | Eleanor | | Min Req | Min Req | | | Target | | |
| 18 | Index | Date | Day | Days | | Day Chg | Target | | | Inflow | Inflow | Inflow | Inflow | Inflow | | Release | Release | | | Release | | |
| 19 | | | | | | Target | 248,000 | | | CFS | CFS | AF | CFS | AF | | CFS | AF | | CFS | AF | | |
| 20 | 1970.10 | 10/1/1970 | T | 31 | | 0 | 248,000 | | | 81 | 56 | 111 | 25 | 50 | | 5 | 10 | | 0 | 0 | | |
| 21 | 1970.10 | 10/2/1970 | F | 31 | | 0 | 248,000 | | | 7 | 5 | 10 | 2 | 4 | | 5 | 10 | | 0 | 0 | | |
| 22 | 1970.10 | 10/3/1970 | S | 31 | | 0 | 248,000 | | | 22 | 15 | 30 | 7 | 14 | | 5 | 10 | | 0 | 0 | | |
| 23 | 1970.10 | 10/4/1970 | S | 31 | | 0 | 248,000 | | | -578 | -399 | -791 | -179 | -355 | | 5 | 10 | | 0 | 0 | | |
| 24 | 1970.10 | 10/5/1970 | M | 31 | | 0 | 248,000 | | | 466 | 322 | 638 | 144 | 287 | | 5 | 10 | | 0 | 0 | | |
| 25 | 1970.10 | 10/6/1970 | T | 31 | | 0 | 248,000 | | | -69 | -48 | -94 | -21 | -42 | | 5 | 10 | | 0 | 0 | | |

**Figure 5.21-4. Lake Lloyd Controls.**

## 5.21.5 Lake Eleanor Control

This section of logic identifies several underlying operation constraints for Lake Eleanor. Figure 5.21-5 is a snapshot of this section. The minimum stream release below Lake Lloyd is computed in this section. Also identified in this section are reservoir storage targets and limits. This information is used in worksheet SFEleanor for several operational constraints and objectives.

| | A | B | C | D | CW | CX | CY | CZ | DA | DB | DC | DD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 1 | | | | | | | | | |
| 2 | *Unit Title* | | 2 | | | Blw Lake Eleanor - CFS | | | | Eleanor Target Storage - Acre-fe | | |
| 3 | *Parameter Title* | | 3 | | | | w/Pump | w/o | | | Soft Trgt | Hard Limit |
| 4 | | | | | | Cal Mon | Req | Req | | Cal Mon | EOM | EOM |
| 5 | *Acre-foot to CFS conversion* | | | | | 1 | 5 | 5 | | 0 | 18,250 | |
| 6 | *divide by :* | *1.983471* | | | | 2 | 5 | 5 | | 1 | 21,495 | 27,100 |
| 7 | | | | | | 3 | 10 | 5 | | 2 | 21,495 | 27,100 |
| 8 | | | | | | 4 | 15 | 5 | | 3 | 21,495 | 27,100 |
| 9 | | | | | | 5 | 20 | 5 | | 4 | 27,100 | 27,100 |
| 10 | | | | | | 6 | 20 | 5 | | 5 | 27,100 | 27,100 |
| 11 | | | | | | 7 | 20 | 16 | | 6 | 27,100 | 27,100 |
| 12 | | | | | | 8 | 20 | 16 | | 7 | 27,100 | 27,100 |
| 13 | | | | | | 9 | 15 | 16 | | 8 | 27,100 | 27,100 |
| 14 | | | | | | 10 | 10 | 5 | | 9 | 15,000 | 27,100 |
| 15 | | | | | | 11 | 5 | 5 | | 10 | 15,000 | 27,100 |
| 16 | | | | | | 12 | 5 | 5 | | 11 | 15,000 | 27,100 |
| 17 | Month | | | | | Min Req | Min Req | *Always* | | 12 | 18,250 | 27,100 |
| 18 | Index | Date | Day | Days | | Release | Release | *Assume* | | Day Chg | Target | |
| 19 | | | | | | CFS | AF | *Pump* | | Target | 15,000 | |
| 20 | 1970.10 | 10/1/1970 | T | 31 | | 10 | 20 | | | 0 | 15,000 | |
| 21 | 1970.10 | 10/2/1970 | F | 31 | | 10 | 20 | | | 0 | 15,000 | |
| 22 | 1970.10 | 10/3/1970 | S | 31 | | 10 | 20 | | | 0 | 15,000 | |
| 23 | 1970.10 | 10/4/1970 | S | 31 | | 10 | 20 | | | 0 | 15,000 | |
| 24 | 1970.10 | 10/5/1970 | M | 31 | | 10 | 20 | | | 0 | 15,000 | |
| 25 | 1970.10 | 10/6/1970 | T | 31 | | 10 | 20 | | | 0 | 15,000 | |

**Figure 5.21-5. Lake Eleanor Controls.**

## 5.22 Hydrology Worksheet

This worksheet (Hydrology) identifies and assembles underlying watershed hydrologic data necessary for Model operation. Required elements of historical hydrology include inflows to CCSF System reservoirs and the unregulated inflow to Don Pedro Reservoir. Also necessary are certain Test Case conditions for the CCSF System, namely Test Case SJPL diversions and water delivery (action levels) associated with Test Case conditions. Also needed is the status of local watershed reservoir storage associated with the Test Case condition.

## 5.23 602020 Worksheet

This worksheet (602020) identifies and assembles underlying watershed hydrologic data necessary for Model operation. Included is the computation of the San Joaquin River Index. Also included are published results of CDWR runoff forecasts.

# 6.0 EXAMPLES OF MODEL USE

As part of the Model training during W&AR-02 Workshop #3, October 23, 2012, a set of example scenarios was provided, described and illustrated to attending Representative Participants. The following describes those examples.[5]

## 6.1 Example 1

Modify lower Tuolumne River flow requirements. Assume a 10 percent increase in current FERC requirements. Assume no CCSF responsibility for additional flow.

*Advice: the workbook may be running in an auto-recalculation mode. To avoid a recalculation following an entry of each item the user may want to change the workbook settings to recalculate in the "manual" mode, and then apply a recalculation (F9) after multiple entries have been made. Also, worksheet Review is extremely processor time intensive. It is recommended that the worksheet be set in the "No" recalculation mode at all times except when necessary to review results.*

Enter a study reference name in UserInput (UI 1.00), indicative of the scenario. In this example the study reference will be "Alt_10%".

An alternative flow requirement for the lower Tuolumne River is entered in worksheet UserInput, Section 1. The alternative flow requirement can be entered by two methods: 1) a daily time series (Column BM) reflective of a computation made external to this worksheet, or 2) a modified schedule entered as a year type schedule at UI 1.30.

Choose the table option. The current FERC requirements have been equated to the year type schedule format for UI 1.30, and are listed in the area to the right of the input matrix. One method of providing entry to the matrix is to write an equation for each cell of the matrix to increase the current schedule by 10 percent (e.g., the matrix cell could be represented as [Current FERC * 1.1]).

To employ the table, enter option (1) for UI 1.10 to use an alternative flow schedule. Also, enter option (1) for UI 1.20 to use the year type schedule. The month of "Apr" is selected for UI 1.40 to engage the flow schedule on an April through following year March flow year.

At this point Don Pedro Reservoir will have attempted to provide the additional flow requirement from reservoir storage and reoperation of releases which otherwise were released in excess of minimum releases in other periods. Worksheet Review is viewed to identify changes that have occurred and for warnings. Viewing the worksheet Review summary shows that river requirements have increased, and releases to the river have increased but by not as much. This circumstance indicates that some of the increases in requirements have been met with releases that were previously released in excess of minimum requirements and possibly from reservoir storage. The review summary also shows differences in reservoir minimum storage that occurred

[5] The examples described in this document are examples only and not alternatives endorsed or supported by the Districts and CCSF.

in the simulation. A warning has also been indicated for CCSF Water Bank Account operations. Additional detail of the monthly results for the simulation and a comparison to the Test Base is found in the summary matrices. Differences between the two scenarios are can also be viewed in worksheets DSSAnyGroup and DSSMonthTable.

The scenario should be refined by eliminating the "negative Water Bank Account" warning. To remedy the circumstance the user could employ two methods: 1) the preferred daily adjustment method, or 2) a year type table approach, with or without a combination of daily adjustments. To use the preferred daily adjustment method option (1) is selected for UI 3.10, and the user is directed to worksheet WaterBankRel.

Upon selection of worksheet WaterBankRel, the user will see the same warning and the value of negative balance (Cell M14). Column T is provided to enter daily supplemental releases to remedy negative Water Bank Account Balances. The column will be populated with the time series last entered into the worksheet. By scrolling down the column the user will find previously entered values. In this example, entries began in 1992 which is associated with the Test Case scenario. It is seen that with the alternative flow requirement of this example the Water Bank Account Balance (Column M) is shown as a negative 161 acre-feet, and continues to be negative for numerous subsequent days. Under the Test Case scenario the Water Bank Account Balance remained at or above zero during this period as the result of the Test Case supplemental releases.

*Advice: Set worksheet Review in the "No" recalculation mode prior to entering daily supplemental releases.*

To remedy the new resultant negative Water Bank Account Balance an additional 161 acre-feet of supplemental release is added to the previously entered amount, and the "negatives" go away.

If the user is satisfied that this set of results represents an alternative simulation of future operations, the study is completed. The output worksheet could be saved as a unique result named Alt_10 or some other more explicit title.

## 6.2 Example 2

Same alternative flow requirements as Example 1; however, CCSF is to share in responsibility for the change in flow requirements.

Enter a study reference name in UserInput (UI 1.00), indicative of the scenario. In this instance the study reference will be "Alt_10%_Shared".

The alternative flow schedule entered at UI 1.30 remains the same. To invoke the CCSF responsibility logic the switch at UI 1.31 is set to option (1). The model will recalculate and provide a new set of results. Viewing worksheet Review shows that results for Don Pedro Reservoir operations remain the same as Example 1. However, the results for CCSF Water Bank Account operations have changed, and indicate that a negative balance again occurs (maximum of -43,000 acre-feet). However, review of other CCSF reservoir and diversion results will show no change from Example 1. This circumstance illustrates how invoking the CCSF responsibility logic (UI 1.31) will affect the Water Bank Account Balance, but it alone will not change the Model's CCSF's operation. Review of the detailed monthly summary results for the Water Bank Account Balance (shown in the worksheet Review matrix beginning at Row 423) negative balances begin in the simulation in June 1990 and intermittently occur through December 1993.

The scenario should be refined by eliminating the "negative Water Bank Account" warning. To use the preferred daily adjustment method option (1) is selected for UI 3.10, and the user is directed to worksheet WaterBankRel.

*Advice: Set worksheet Review in the "No" recalculation mode prior to entering daily supplemental releases.*

Upon selection of worksheet WaterBankRel, the user will see the same warning and the value of negative balance (Cell M14). Column T will be used to remedy negative Water Bank Account Balances. The column is currently populated with the time series for Example 1. By scrolling down the column the user will find negative balances will begin to occur in June 1990 (-3,348 acre-feet on June 9). To remedy the new resultant negative Water Bank Account Balance an additional 3,348 acre-feet of supplemental release is entered in Column T. The worksheet will recalculate and show a revised balance for the day as zero. Subsequent balances will also change. The user will continue to make daily entries to eliminate the negative balances. Supplemental releases are needed through the later part of July for 1990. The exercise of entering supplemental releases is required again beginning June 28, 1991, and ends during July. Supplemental releases are also required beginning March 1992. It is recommended that the previously entered supplemental releases entered for 1992 for Example 1 be deleted. Completing the supplemental releases for 1992 should result in the negative balance warning going away.

At this juncture of Model input and adjustment the results are reflective of an increase of 10 percent in minimum Tuolumne River requirements, with the Districts providing the flows from Don Pedro Reservoir. CCSF is responsible for a share of the differences in flow requirements and its Water Bank Account Balance is affected by that computed responsibility. CCSF operates its system as usual, and due to the affect at the Water Bank Account makes additional supplemental releases when needed to maintain a positive Water Bank Account Balance.

If the user accepts this set of results as an acceptable simulation of operations the study is completed. The output worksheet could be saved as a unique result named Alt_10_Shared.

## 6.3 Example 3

Modify lower Tuolumne River flow requirements. Assume a minimum flow regime that is the current FERC requirement, except the minimum flow requirement is 300 cfs. Assume no CCSF responsibility for additional flow.

Choose the table option for flow requirements. The existing FERC requirements have been equated to the year type schedule format for UI 1.30, and are listed in the area to the right of the input matrix. One method of providing entry to the matrix is to write an equation for each cell of the matrix to provide the current FERC release but maintain at least a 300 cfs requirement (e.g., the matrix cell could be represented as [Max(Current FERC,300)].

At this point Don Pedro Reservoir will have attempted to provide the additional flow requirement from reservoir storage and reoperation of releases which otherwise were released in excess of minimum releases in other periods. Worksheet Review is viewed to identify changes that have occurred and for warnings. Viewing the worksheet Review summary shows that river requirements have increased, and releases to the river have increased but by not as much. This circumstance indicates that some of the increases in requirements have been met with releases that were previously released in excess of minimum requirements and possibly from reservoir storage. The review summary also shows differences in reservoir minimum storage that occurred in the simulation. A warning has also been indicated for CCSF Water Bank Account operations, and a warning indicates that Don Pedro Reservoir storage has been simulated below dead storage as a result of both the 1976-1977 and 1987-1992 droughts. Additional detail of the monthly results for the simulation and a comparison to the other scenarios is found in the summary matrices. Differences between two scenarios are also viewed in worksheets DSSAnyGroup and DSSMonthTable.

In the circumstance of this example where there is no shared responsibility with CCSF, prior to developing a remedy for the negative Water Bank Account Balance it is recommended that the dead storage warning be corrected. The user can either reduce the minimum flow requirements or the canal diversions, either resulting in retaining additional storage in Don Pedro Reservoir.

By choosing reduced canal diversions the user will use option (1) at UI 2.10, and enter an alternative monthly diversion for the Districts at UI 2.20 and UI 2.30. The simulated diversions for the Test Base are shown to the right of the matrices of UI 2.20 and UI 2.30.

The volume and pattern of canal reduction is entered at the user's discretion. For merely illustrative purposes this example assumes that WY 1976 diversions of both MID and TID are reduced from the already reduced values of the Test Case by an additional 10 percent. For the WY 1987-1992 period, it is assumed each District's already reduced diversions are additionally reduced by 5 percent.

The Model will recalculate the simulation and the results are viewed in worksheet Review. It is shown that the Don Pedro Reservoir dead pool storage warning has been remedied, with resultant storage after selective diversion reductions are now greater than 308,960 acre-feet. The warning for negative Water Bank Account Balances still occurs. To complete the study the negative balances need to be eliminated, which would require adjustment as described in Example 1 and Example 2.

## 6.4 Additional Example

Example 3 could be amended to include a CCSF responsibility for the incremental flow requirements. The process described in Example 2 would be executed by switching CCSF responsibility "on" and then providing supplemental releases to maintain a positive balance in the Water Bank Account. If CCSF storage in Lake Lloyd and Hetch Hetchy becomes depleted an adjustment (reduction) to CCSF's SJPL would be required which requires a similar process as used to reduce the Districts' canal diversions.